z/OS
Version 2 Release 3

Distributed File Service zFS
Administration

IBM
Note
Before using this information and the product it supports, read the information in “Notices” on page 469.

This edition applies to Version 2 Release 3 of z/OS (5650-ZOS) and to all subsequent releases and modifications until otherwise indicated in new editions.

Last updated: 2019-03-28

US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.
# Contents

List of Figures........................................................................................................ ix  
List of Tables........................................................................................................ xi  

About this document........................................................................................... xiii  
How this document is organized......................................................................... xiii  
Conventions used in this document .................................................................... xiii  
z/OS information.................................................................................................... xiv  
References to DFS information........................................................................... xiv  

How to send your comments to IBM................................................................. xv  
If you have a technical problem........................................................................... xv  

Summary of changes.......................................................................................... xvi  
Summary of changes for zFS for z/OS Version 2 Release 3 (V2R3)................... xvi  
Summary of changes for zFS for z/OS Version 2 Release 2 (V2R2)................... xx  
z/OS Version 2 Release 1 summary of changes.................................................. xxii  

Part 1. zFS administration guide.......................................................................... 1  

Chapter 1. Overview of the zFS File System....................................................... 3  
Features.............................................................................................................. 3  
Terminology and concepts.................................................................................. 4  
What’s new or changed for zFS in z/OS V2R3............................................... 7  
What’s new or changed for zFS in z/OS V2R2............................................... 7  
What’s new or changed for zFS in z/OS V2R1............................................... 8  

Chapter 2. Installing and configuring zFS......................................................... 11  
zFS installation and configuration steps.............................................................. 11  
Applying required APARs for z/OS V2R3......................................................... 14  
Specifying zFS file systems as sysplex-aware............................................... 14  
Using zFS read/write sysplex-aware file systems.......................................... 15  
Changing the sysplex-awareness of a mounted zFS read/write file system.... 16  
zFS running in the z/OS UNIX address space.................................................. 16  

Chapter 3. Managing zFS processes................................................................. 19  
Starting zFS....................................................................................................... 19  
Stopping zFS..................................................................................................... 19  
Determining zFS status..................................................................................... 20  

Chapter 4. Creating and managing zFS file systems using compatibility mode aggregates........................................................................................................... 21  
Creating a compatibility mode aggregate....................................................... 21  
Using version 1.5 aggregates and extended (v5) directories.......................... 23  
Creating a version 1.5 aggregate..................................................................... 23  
Converting an existing aggregate to version 1.5.......................................... 24  
Converting an existing v4 directory to an extended (v5) directory.............. 25  
Guidelines for v4 to v5 conversion................................................................. 25  
Growing a compatibility mode aggregate....................................................... 26  
Dynamically growing a compatibility mode aggregate............................... 26  
Creating a multi-volume compatibility mode aggregate.............................. 27  
Adding volumes to a compatibility mode aggregate..................................... 29  
Increasing the size of a compatibility mode aggregate................................. 29  
Copying each file and directory of the aggregate to a larger data set........... 30  

iii
Part 2. zFS administration reference ................................................................. 105

Chapter 10. z/OS system commands ................................................................. 107
MODIFY ZFS PROCESS.................................................................................... 108
SETOMVS RESET........................................................................................... 115

Chapter 11. zFS commands ........................................................................... 117
ioeagfmt.................................................................................................. 118
ioeagsvl........................................................................................................ 122
ioefsutl........................................................................................................... 127
ioefsutl converttov4................................................................................................. 128
ioefsutl converttov5................................................................................................. 130
ioefsutl format................................................................................................ 132
ioefsutl salvage................................................................................................ 136
MOUNT........................................................................................................... 140
zfsadm........................................................................................................ 143
zfsadm aggrinfo................................................................................................. 147
zfsadm apropos................................................................................................. 150
zfsadm attach................................................................................................. 152
zfsadm chagr................................................................................................ 155
zfsadm compress............................................................................................. 158
zfsadm config............................................................................................... 160
zfsadm configquery............................................................................................. 165
zfsadm convert.............................................................................................. 169
zfsadm decompress......................................................................................... 172
zfsadm decrypt............................................................................................ 174
zfsadm define.......................................................................................... 176
zfsadm delete............................................................................................. 179
zfsadm detach............................................................................................ 181
zfsadm encrypt.......................................................................................... 183
zfsadm fileinfo.......................................................................................... 186
zfsadm format.......................................................................................... 192
zfsadm fsinfo.......................................................................................... 195
zfsadm grow............................................................................................ 205
zfsadm help.......................................................................................... 206
zfsadm lsaggr........................................................................................... 208
zfsadm lsfs.............................................................................................. 210
zfsadm lssys............................................................................................ 212
zfsadm query.......................................................................................... 213
zfsadm quiesce.......................................................................................... 216
zfsadm setauditid......................................................................................... 218
zfsadm salvage.......................................................................................... 220
zfsadm shrink.......................................................................................... 222
zfsadm unquiesce......................................................................................... 225

Chapter 12. The zFS configuration options file (IOEPRMxx or IOEFSPRM) .......... 227
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>z/OS UNIX and zFS file system ownership</td>
</tr>
<tr>
<td>2</td>
<td>Example job to create a compatibility mode file system using IOEFSUTL</td>
</tr>
<tr>
<td>3</td>
<td>Example job to add volumes to a zFS aggregate</td>
</tr>
<tr>
<td>4</td>
<td>Sample job to copy each file and directory of an aggregate to a larger data set</td>
</tr>
<tr>
<td>5</td>
<td>Sample job to copy the physical blocks of an aggregate to a larger data set</td>
</tr>
<tr>
<td>6</td>
<td>Copying blocks from a full zFS data set into a larger data set</td>
</tr>
<tr>
<td>7</td>
<td>Example job to reconcile the file system and aggregate name</td>
</tr>
<tr>
<td>8</td>
<td>Example job to delete a compatibility mode aggregate</td>
</tr>
<tr>
<td>9</td>
<td>Allocating disk space (example 1)</td>
</tr>
<tr>
<td>10</td>
<td>Allocating disk space (example 2)</td>
</tr>
<tr>
<td>11</td>
<td>Example of a secondary zfsadm define command</td>
</tr>
<tr>
<td>12</td>
<td>Sysplex-aware file system (read-only)</td>
</tr>
<tr>
<td>13</td>
<td>zFS read/write file systems sysplex-aware and non-sysplex aware on a file system basis</td>
</tr>
<tr>
<td>14</td>
<td>zFS sysplex-aware file system with new owner</td>
</tr>
<tr>
<td>15</td>
<td>zfsadm lsaggr and df -v output after mount</td>
</tr>
<tr>
<td>16</td>
<td>D OMVS,F output after mount</td>
</tr>
<tr>
<td>17</td>
<td>zfsadm lsaggr and df -v output after movement</td>
</tr>
<tr>
<td>18</td>
<td>D OMVS,F output after movement</td>
</tr>
<tr>
<td>19</td>
<td>File system ownership when mount fails</td>
</tr>
<tr>
<td>20</td>
<td>Steps for quiesce and unquiesce</td>
</tr>
<tr>
<td>21</td>
<td>Job to back up a zFS aggregate</td>
</tr>
<tr>
<td>22</td>
<td>Job to restore a zFS aggregate</td>
</tr>
<tr>
<td>23</td>
<td>Job to restore a zFS aggregate with replace</td>
</tr>
<tr>
<td>24</td>
<td>Sample STOR report (part 1 of 2)</td>
</tr>
<tr>
<td>25</td>
<td>Sample STOR report (part 2 of 2)</td>
</tr>
<tr>
<td>26</td>
<td>Example of how to check whether user tasks are hung</td>
</tr>
<tr>
<td>27</td>
<td>zFS auditid examples</td>
</tr>
<tr>
<td>28</td>
<td>Sample job to create a compatibility mode aggregate and file system</td>
</tr>
<tr>
<td>29</td>
<td>Job to verify a zFS aggregate that uses debug parameters specified in IOEFSPRM</td>
</tr>
<tr>
<td>30</td>
<td>Job to verify a zFS aggregate that uses debug parameters specified in parmlib member IOEPRM03</td>
</tr>
<tr>
<td>31</td>
<td>Job to convert a version 1.5 aggregate to a version 1.4 aggregate</td>
</tr>
<tr>
<td>32</td>
<td>Job to convert a version 1.4 aggregate to a version 1.5 aggregate</td>
</tr>
<tr>
<td>33</td>
<td>Sample job to create and format a version 1.4 aggregate</td>
</tr>
<tr>
<td>34</td>
<td>Job to verify a zFS aggregate using debug parameters specified in IOEZPRM</td>
</tr>
<tr>
<td>35</td>
<td>Example of zfsadm aggrinfo -long command</td>
</tr>
<tr>
<td>36</td>
<td>Job to attach an aggregate</td>
</tr>
</tbody>
</table>
# List of Tables

1. Determining sysplex-awareness for zFS read/write file systems................................................................. 50
2. DATASET report fields..................................................................................................................................... 70
3. FILE report fields........................................................................................................................................ 71
4. IOBYDASD report fields................................................................................................................................. 72
5. LFS report fields........................................................................................................................................ 77
6. COMPRESS report fields.................................................................................................................................. 78
7. STKM report fields........................................................................................................................................ 81
8. STOR report fields........................................................................................................................................ 85
10. Subtypes for SMF record type 92................................................................................................................... 90
11. zFS man command examples......................................................................................................................117
12. Return codes for -verifyonly that are returned by the salvager................................................................. 122
13. Return codes for -recoveronly that are returned by the salvager............................................................... 123
14. Criteria for selecting aggregates.................................................................................................................. 197
15. Definitions of abbreviated values when the -basic or -owner options are specified................................. 198
16. Statistics displayed when the -owner option is specified............................................................................... 199
17. Sorting options when the -sort option is specified......................................................................................... 200
18. Local statistics displayed when the full option is specified......................................................................... 201
19. Summary of APIs for pfscrl ............................................................................................................................ 242
20. Summary of w_pioctl calls for zFS............................................................................................................... 245
About this document

The purpose of this document is to provide complete and detailed guidance and reference information. This information is used by system administrators that work with the z/OS File System (zFS) component of the IBM® z/OS® Distributed File Service base element.

How this document is organized

This document is divided into parts, each part divided into chapters:

- Part 1, “zFS administration guide,” on page 1 provides guidance information for the z/OS File System (zFS).
- Part 2, “zFS administration reference,” on page 105 provides reference information about z/OS File System (zFS), which includes z/OS system commands, zFS commands, and zFS data sets.

Conventions used in this document

This document uses the following typographic conventions:

**Bold**

Bold words or characters represent system elements that you must enter into the system literally, such as commands.

**Italic**

Italicized words or characters represent values for variables that you must supply.

**Example Font**

Examples and information displayed by the system are printed using an example font that is a constant width typeface.

[]

Optional items found in format and syntax descriptions are enclosed in brackets.

{}

A list from which you choose an item found in format and syntax descriptions are enclosed by braces.

| |

A vertical bar separates items in a list of choices.

< >

Angle brackets enclose the name of a key on a keyboard.

...

Horizontal ellipsis points indicated that you can repeat the preceding item one or more times.

\

A backslash is used as a continuation character when entering commands from the shell that exceed one line (255 characters). If the command exceeds one line, use the backslash character \ as the last nonblank character on the line to be continued, and continue the command on the next line.

**Note:** When you enter a command from this document that uses the backslash character (\), make sure that you immediately press the Enter key and then continue with the rest of the command. In most cases, the backslash has been positioned for ease of readability.

#

A pound sign is used to indicate a command is entered from the shell, specifically where root authority is needed (root refers to a user with a UID = 0).
This information explains how z/OS references information in other documents and on the web.

When possible, this information uses cross document links that go directly to the topic in reference using shortened versions of the document title. For complete titles and order numbers of the documents for all products that are part of z/OS, see z/OS Information Roadmap.

To find the complete z/OS library, go to IBM Knowledge Center (www.ibm.com/support/knowledgecenter/SSLTBW/welcome).

References to DFS information

Information about installing Distributed File Service components is found in z/OS Program Directory.

Information about z/OS File System messages and codes is found in z/OS Distributed File Service Messages and Codes.
How to send your comments to IBM

We invite you to submit comments about the z/OS product documentation. Your valuable feedback helps to ensure accurate and high-quality information.

**Important:** If your comment regards a technical question or problem, see instead “If you have a technical problem” on page xv.

Submit your feedback by using the appropriate method for your type of comment or question:

**Feedback on z/OS function**
If your comment or question is about z/OS itself, submit a request through the IBM RFE Community (www.ibm.com/developerworks/rfe/).

**Feedback on IBM Knowledge Center function**
If your comment or question is about the IBM Knowledge Center functionality, for example search capabilities or how to arrange the browser view, send a detailed email to IBM Knowledge Center Support at ibmkc@us.ibm.com.

**Feedback on the z/OS product documentation and content**
If your comment is about the information that is provided in the z/OS product documentation library, send a detailed email to mhvrdfs@us.ibm.com. We welcome any feedback that you have, including comments on the clarity, accuracy, or completeness of the information.

To help us better process your submission, include the following information:
- Your name, company/university/institution name, and email address
- The following deliverable title and order number: z/OS Distributed File Service zFS Administration, SC23-6887-30
- The section title of the specific information to which your comment relates
- The text of your comment.

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute the comments in any way appropriate without incurring any obligation to you.

IBM or any other organizations use the personal information that you supply to contact you only about the issues that you submit.

**If you have a technical problem**

If you have a technical problem or question, do not use the feedback methods that are provided for sending documentation comments. Instead, take one or more of the following actions:

- Go to the IBM Support Portal (support.ibm.com).
- Contact your IBM service representative.
- Call IBM technical support.
Summary of changes

This information includes terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations for the current edition are indicated by a vertical line to the left of the change.

Summary of changes for zFS for z/OS Version 2 Release 3 (V2R3)

The most recent updates are listed at the top of each section.

New

• With APAR OA56145, which added support for backup of zFS file system data on a file basis, these sections were added or updated.
  – A new API, File Snapshot, was added. See “File Snapshot” on page 261.
  – A new field, backup progress, was added to the -localonly option of zfsadm fileinfo. It indicates that the file is being backed up and the percentage of completion. The example was also updated. See “zfsadm fileinfo” on page 186.
  – Updates were made to zfsadm fsinfo.
    - The new BK value shows aggregates that contain files being backed up. See Table 14 on page 197.
    - The BK value was also added to Table 15 on page 198.
    - You can also obtain statistics for files that are being backed up. See Table 16 on page 199.
  – A new usage note was added to these commands to indicate that you cannot perform them with active file backups.
    - “zfsadm compress” on page 158
    - “zfsadm decompress” on page 172
    - “zfsadm decrypt” on page 174
    - “zfsadm encrypt” on page 183
    - “zfsadm shrink” on page 222
  – Examples were updated for these APIs:
    - “List Detailed File System Information” on page 290
    - “List File Information” on page 304
• With APAR OA55235, clarification was added that, beginning with z/OS V2R3, the DEFINE CLUSTER command string contains the ZFS parameter to indicate that the specified VSAM linear set is intended to be used as a ZFS aggregate. See the usage notes section in “zfsadm define” on page 176.
• Health check ZFS_VERIFY_COMPRESSION_HEALTH was added. It checks whether all user cache pages are registered with the zEDC Express service when there are compressed file systems. For more information about the health check, see IBM Health Checker for z/OS User’s Guide.
• “What's new or changed for zFS in z/OS V2R3” on page 7 was added.
• “Applying required APARs for z/OS V2R3” on page 14 was added.
• Subcommands that were missing in previous releases were added in the pfsctl section. See the table on summary of APIs for pfsctl in “pfsctl (BPX1PCT)” on page 240.
• VSAM linear data sets that are created on z/OS V2R3 systems with the zfsadm define command or the Define Aggregate API do not need to be formatted before they are mounted. If IDCAMS is used to define the VSAM linear sets and the ZFS keyword is used, they also do not need to be formatted before they are mounted. When the aggregates are formatted at mount, default values are used for all format...
options. If the IOEFSprm format_aggrversion option is not specified, the defaults will result in the creation and mount of a version 1.5 aggregate.

- The -format_perms option was added to “zfsadm config” on page 160 and “zfsadm configquery” on page 165.
- A new configuration option, format_perms, was added to the IOEFSprm configuration file. See “IOEFSprm” on page 227.
- Two new subcommands were added: Query format_perms (267) and Set format_perms (266). See theZFSCALL_CONFIG section in the table on summary of APIs for pfsctl in “pfsctl (BPX1PCT)” on page 240.

zFS has added support for encrypting file system data using the DFSMS access method encryption. Support has also been added for compressing file system data using the zEDC compression method. New file systems can be defined and formatted so that any data added to them are automatically encrypted, compressed, or both. For more information, see “Encrypting and compressing zFS file system data” on page 32.

- New commands were added:
  - “zfsadm compress” on page 158
  - “zfsadm decompress” on page 172
  - “zfsadm decrypt” on page 174
  - “zfsadm encrypt” on page 183
- These commands have new options:
  - “ioeagfmt” on page 118
  - “ioefsutil format” on page 132
  - “zfsadm config” on page 160
  - “zfsadm configquery” on page 165
  - “zfsadm format” on page 192
- New APIs were added:
  - “Encrypt (Decrypt, Compress, or Decompress) Aggregate” on page 258
  - “Statistics Compression Information” on page 352
- These APIs were updated:
  - “Define Aggregate” on page 252
  - “Format Aggregate” on page 266
  - “List Detailed File System Information” on page 290
  - “List File Information” on page 304
  - “Statistics User Cache Information” on page 439
- The contents of the VM report was updated. For a sample report, see “VM” on page 86.
- New processing options (edc_buffer_pool, format_compression, format_encryption, and long_cmd_threads) were added to the IOEFSprm configuration file. The edc_fixed option was added to user_cache_size. See “IOEFSprm” on page 227.

The size of a zFS aggregate can be reduced by releasing space from the associated VSAM data set.

- A new command, zfsadm shrink, was added. See “zfsadm shrink” on page 222.
- A new API was added. See “Shrink Aggregate” on page 349. This API can be accessed via a new subcommand opcode (266).
- A new section was added. See “Decreasing the size of a compatibility mode aggregate” on page 39.

Certain common mount options such as aggrfull and aggrgrow can be changed dynamically without the overhead of unmounting and remounting the file system.

- A new command, zfsadm chaggr, was added. See “zfsadm chaggr” on page 155.
- A new API was added. See “Change Aggregate Attributes” on page 249. This API is accessed via a new subcommand opcode (160). See the table on summary of APIs for pfsctl in “pfsctl (BPX1PCT)” on page 240.

• With appropriate authority, a system programmer can initiate an online salvage of a zFS aggregate in order to repair a damaged file system while the file system is still mounted.

- A new command, zfsadm salvage, was introduced. See “zfsadm salvage” on page 220.

- A new API was added. See “Salvage Aggregate” on page 341. This API is accessed by means of a new subcommand opcode (155). See the table on summary of APIs for pfsctl in “pfsctl (BPX1PCT)” on page 240.

• The zfsadm commands have a new option, -trace. The privilege section for these commands was updated because READ access is no longer needed to the IOEFSPRM data set.

- zFS can record file system events, performance data, and per-file system statistics in the System Management Facility (SMF). See “Using SMF records to report on activities” on page 89. A new option, -smf_recording, was added to two commands.
  - “zfsadm config” on page 160
  - “zfsadm configquery” on page 165

The smf_recording processing option was added to the IOEFSPRM configuration file. See “IOEFSPRM” on page 227.

• These sections were updated to include information about the new bpxwmigf shell command.
  - Chapter 7, “Migrating data from HFS or zFS to zFS,” on page 63
  - “Using the z/OS HFS to zFS migration tool” on page 63

**Changed**

• With APAR OA55616, the AGGRFULL and FSFULL descriptions were updated in these sections:
  - “MOUNT” on page 140
  - “IOEFSPRM” on page 227

• In “zfsadm fileinfo” on page 186, compressed # saved was changed to compress-eligible # saved.

• Corrected the pax example in “Without using an intermediate archive file” on page 64.

• “The encryption process” on page 33 was updated with the following information:
  - Decryption is supported. However, the decryption process does not remove key labels. File systems that have had key labels assigned cannot be mounted on a release prior to V2R3, even if those file systems have not been encrypted or are currently not encrypted. Therefore, if there is no zFS system in the shared file system environment that is eligible to own a file system with a key label assigned to it, the file system will be inaccessible.
  - If you must back out to a release that is prior to V2R3, any file systems that are encrypted or have key labels assigned to them cannot be owned on a system running the prior release. You may also need to back out the file system by taking one of the following actions:
    - Restore a version of the file system that was backed up prior to encrypting it or assigning a key label to it.
    - Create a new file system that does not have a key label assigned to it and follow the migration procedures in Chapter 7, “Migrating data from HFS or zFS to zFS,” on page 63.

• “Encrypting existing file system data” on page 35 was updated with the following important note: Before an existing file system has a key label assigned to it, or is encrypted for the first time, do a full backup of the file system.

• “The compression process” on page 36 was updated with the following restriction: Compressed file systems cannot be mounted on a release prior to V2R3. Therefore, if there is no zFS system in the
shared file system environment that is eligible to own a compressed file system, the file system will be inaccessible.

- These changes were made for APAR OA54472:
  - “zFS installation and configuration steps” on page 11 was updated.
  - A reminder to take ICSF into consideration when enabling encryption was added. See “Encrypting and compressing zFS file system data” on page 32.
  - The zfsadm chagr command was updated to indicate that The -aggrfull, -aggrgrow, -rwshare, and -norwshare options are mutually exclusive. See “zfsadm chagr” on page 155.
  - For zfsadm fileinfo, the partially encrypted field was updated to include an explanation that the completion percentage is displayed for large files. The partially decrypted field was added. See “zfsadm fileinfo” on page 186.
  - For the List File Information API, fo_CEprogress in the Format section was updated to include only encryption and decryption. See “List File Information” on page 304.
  - Clarification was added to indicate that COMPRESS is part of the LFS report. “LFS” on page 74 contains the updated LFS report.
  - “zFS installation and configuration steps” on page 11 was updated to indicate that the DFS user ID (or the OMVS user ID, if running in the OMVS address space) must have at least READ access to any CSFKEYS and CSFSERV profiles for encrypted aggregates.
  - A new usage note was added to zfsadm encrypt. See “zfsadm encrypt” on page 183.
  - Usage notes were added to zfsadm shrink. See “zfsadm shrink” on page 222.

- This change was made for APAR OA54416:
  - The values for the long_cmd_thread option in the configuration option file were changed. The allowed range for the foreground threads is now 1-3. The default number of foreground threads is now 1. See “IOEFSPRM” on page 227.

- Prior to V2R3, user data was kept in data spaces. In V2R3, the data is now kept in chunks of memory called cache spaces.

- Privileged users can no longer format without at least UPDATE access to the VSAM linear data set. Privileged users are those who are either UID 0 or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class. Various updates have been made to reflect this change.

- Release updates were made to the service levels. See “Determining service levels” on page 94.

- The default for the romount_recovery option for the IOEFSPRM configuration file was changed from OFF to ON. See “IOEFSPRM” on page 227.

- The default of the format_aggrversion option was changed from 4 to 5.

- The default of the change_aggrversion_on_mount option was changed from OFF to ON.

- The zfsadm fsinfo and MODIFY FSINFO commands have new owner status values, new selection criteria, and a progress indicator for long-running administrative options.

- The F ZFS,QUERY,KNPFS output was updated. See “KN” on page 72.

- In V2R2, APAR OA49516 was made available. When applied, zFS ownership movement could be controlled by using the honor_syslist option in IOEFSPRM. The honor_syslist option could be dynamically queried and changed with zfsadm config and zfsadm configquery.

  - “Dynamic movement of the zFS owner” on page 54 was updated to indicate that zFS always uses the AUTOMOVE specification to limit zFS ownership to a subset of sysplex members.

  - “IOEFSPRM” on page 227 was updated to indicate that the honor_syslist is no longer supported. If it is specified, it is accepted but not used.

  - “zfsadm config” on page 160 was updated to indicate that the -honor_syslist option is no longer supported. If it is specified, it is accepted but not used.

  - “zfsadm configquery” on page 165 was updated to indicate that the -honor_syslist option is no longer supported. If it is specified, it is accepted but not used.
- “zfsadm attach” on page 152 was updated to indicate that the command will be removed in a future release

• These APIs were updated to return 8-bit time stamp values:
  - “List Attached Aggregate Names (Version 1)” on page 283
  - “List Aggregate Status (Version 2)” on page 276

• The descriptions of certain field names were changed for the List Aggregate Status (Version 2) API. See “List Aggregate Status (Version 2)” on page 276.

• The authorization level was changed from ALTER to UPDATE.
  - “ioeagfmt” on page 118
  - “ioefsutl format” on page 132
  - “zfsadm format” on page 192
  - “Format Aggregate” on page 266

• LINEAR was replaced by ZFS in the sample job to create and format a version 1.4 aggregate. See the Examples section in “ioefsutl format” on page 132.

Deleted
The zfsspace, largedir.pl, and auditid utilities are no longer available. Information about them has been deleted.

Summary of changes for zFS for z/OS Version 2 Release 2 (V2R2)

New
- “What’s new or changed for zFS in z/OS V2R2” on page 7 was added.

• zFS can be run in the OMVS address space, which is used by z/OS UNIX. See “zFS running in the z/OS UNIX address space” on page 16.

• You can display detailed information about the zFS file system. See “Usage notes for displaying file system information” on page 112 and “Examples of displaying file system information” on page 114.

• MODIFY ZFS PROCESS has a new parameter, fsinfo, which displays detailed information about zFS file systems. Usage notes and examples for displaying file system information were also added. See “MODIFY ZFS PROCESS” on page 108.

• The zfsadm config and zfsadm configquery commands have a new option, -modify_cmd_threads. It specifies the current number of threads that are defined to handle zFS modify commands. See “zfsadm config” on page 160 and “zfsadm configquery” on page 165.

• The zfsadm fsinfo command displays detailed information about zFS file systems. See “zfsadm fsinfo” on page 195.

• New reports are available that can be printed with the zfsadm query command using the keywords -stkm, -ctkc, and -svi. This information is also available in new application programming interfaces for Client Token Caching Component, Server Token Manager, and Statistics from the Server Vnode Interface. For more information about the keywords, see “zfsadm query” on page 213.

• The IOEFSPPRM configuration options file has new options.
  - The modify_cmd_threads option controls the number of modify commands that are running simultaneously.
  - The user_running_hangdump option specifies whether a hang dump should be taken for a user task that has been hanging for approximately 5 minutes.
  - The quiesceinfo_message_delay option specifies the minimum number of seconds to delay issuing the IOEZ00830E message. See “Processing options for IOEFSPPRM and IOEPRMxx” on page 229.
• The pfsctl (BPX1PCT) application programming interface was updated to include a new command, ZFSCALL_FSINFO. Two subcommands (query modify cmd_threads and set modify_cmd_threads) were added to ZFSCALL_CONFIG. See Table 19 on page 242.

• These application programming interfaces (APIs) were added:
  – “List Detailed File System Information” on page 290. It lists detailed file or directory information.
  – “Statistics Sysplex Client Operations Information” on page 423. It returns information about the number of local operations that required the sending of a message to another system.
  – “Statistics Sysplex Owner Operations Information” on page 429. It returns information about the number of calls that are processed on the local system as a result of a message that was sent from another system.

**Changed**

• Information about updating required APARs was updated for V2R2. See “Applying required APARs for z/OS V2R3” on page 14.

• zFS caches can now be obtained in virtual storage above the 2 GB bar (64-bit storage). As a result, much larger caches can be used to increase zFS performance. zFS performance can further be increased because it can be run in the OMVS address space, which is used by z/OS UNIX. See “zFS running in the z/OS UNIX address space” on page 16.

• Clarification was added about the statistics that zFS supplies for SMF type 30 records. See “Support for type 30 SMF record” on page 46.

• "Performing a backup of zFS " was renamed to "Copying or performing a backup of a zFS" and a warning was added. See Chapter 6, “Copying or performing a backup of a zFS,” on page 59.

• To handle the case of the source file system having symbolic links (or names) longer than 100 characters, the pax examples in “Using an intermediate archive file” on page 64 and “Without using an intermediate archive file” on page 64 were updated to include the -o saveext option.

• Chapter 8, “Performance and debugging,” on page 65 was updated.

• The QUERY,KN report was updated because the statistics report now allows for larger counter values to be displayed. These displays will use a suffix indicating the multiplier that is to be used for the displayed counter value. See “KN” on page 72.

• The LFS report was updated because large fast lookup statistics is no longer supported. See “LFS” on page 74.

• Information about thrashing was added to the STKM report. See “STKM” on page 80.

• The STOR report was updated. See “STOR” on page 81.

• The VM report was updated because client caching is no longer supported. See “VM” on page 86.

• Release updates were made to “Determining service levels” on page 94.

• Starting in V2R2, zFS uses the enhanced log and enhanced status APIs XCF communication protocol. Previously, it used the extended directory XCF communications protocol. For more information, see “Determining the XCF protocol interface level” on page 94.

• The -client_cache_size and -tran_cache_size keywords for the zfsadm config and zfsadm configquery commands are no longer supported. If they are specified, they are accepted but not used.

• Various updates were made to the IOEFSPRM configuration options file.
  – The client_cache_size option is now ignored because V1R12 can no longer exist in the sysplex.
  – The tran_cache_size option is now ignored because there is no longer a separate transaction cache.
  – The expected default value for the meta_cache_size and metaback_cache_size options were changed because the entire calculated default for the size of the metadata cache is now assigned to meta_cache_size.
The upper end of the expected value for token_cache_size was changed from 2621440 to 20 million.
The upper end of the expected value for meta_cache_size was changed from 1024 M to 64 G.
The upper end of the expected value for trace_table_size and xcf_trace_table_size were changed from 2048 M to 65535 M.
The upper end of the expected value for vnode_cache_size was changed from 500000 to 10 million.
See “IOEFSPRM” on page 227.

- The APIs in Chapter 13, “zFS application programming interface information,” on page 239 were reformatted. One of the changes was that long was changed to int because the length of a long can be 4 bytes or 8 bytes, depending on compiler options.
- The pfsctl (BPX1PCT) application programming interface was updated to include a new command, ZFSCALL_FSINFO. See “pfsctl (BPX1PCT)” on page 240.
- The Statistics Log Cache Information format was changed because a new log cache facility is used in V2R2. New statistics are returned pertaining to this new logging method. See “Statistics Log Cache Information” on page 393.
- Statistics Storage Information returns information for storage above the 2 G addressing bar. See “Statistics Storage Information” on page 413.
- The Statistics Transaction Cache Information is no longer used, but documentation about it was kept. See “Statistics Transaction Cache Information” on page 435.

Deleted
- The section “Transaction cache” in Chapter 8, “Performance and debugging,” on page 65 was deleted because a separate transaction cache no longer exists.
- The flc IOEPRMxx configuration option was deleted because it is no longer supported.
- The Delete File System API was deleted because it is no longer supported.
- The sections "zFS support for read/write non-sysplex aware mounted file system" and "zFS support for read/write sysplex aware mounted file system" were deleted because they described how zFS in V1R11 or V1R12 systems handled read/write file systems. These systems can no longer exist in the sysplex with V2R2.
- The section "Disabled aggregates when there are no z/OS V1R13 or later systems" was deleted because all systems must now be at z/OS V1R13 or later.
- The description of the IOEFSPRM configuration file option client_cache_size was deleted because V1R12 can no longer exist in the sysplex.
- The description of the IOEFSPRM configuration file option tran_cache_size was deleted because the new zFS aggregate metadata logging method does not require a transaction cache.
- Information about large fast lookup statistics was deleted because it is no longer supported.
- Information about large FLC processing was deleted because it is no longer supported.

z/OS Version 2 Release 1 summary of changes

See the Version 2 Release 1 (V2R1) versions of the following publications for all enhancements related to z/OS V2R1:
- z/OS Migration
- z/OS Planning for Installation
- z/OS Summary of Message and Interface Changes
- z/OS Introduction and Release Guide
Part 1. zFS administration guide

This part of the document discusses guidance information for the z/OS File System (zFS).

- Chapter 1, “Overview of the zFS File System,” on page 3
- Chapter 2, “Installing and configuring zFS,” on page 11
- Chapter 3, “Managing zFS processes,” on page 19
- Chapter 4, “Creating and managing zFS file systems using compatibility mode aggregates,” on page 21
- Chapter 5, “Using zFS in a shared file system environment,” on page 49
- Chapter 6, “Copying or performing a backup of a zFS,” on page 59
- Chapter 7, “Migrating data from HFS or zFS to zFS,” on page 63
- Chapter 8, “Performance and debugging,” on page 65
- Chapter 9, “Overview of the zFS audit identifier,” on page 103
Chapter 1. Overview of the zFS File System

z/OS Distributed File Service z/OS File System (zFS) is a z/OS UNIX System Services (z/OS UNIX) file system that can be used in addition to the hierarchical file system (HFS). zFS file systems contain files and directories that can be accessed with z/OS UNIX application programming interfaces (APIs). These file systems can support access control lists (ACLs). zFS file systems can be mounted into the z/OS UNIX hierarchy along with other local (or remote) file system types (for example, HFS, TFS, AUTOMNT, and NFS).

zFS can be used for all levels of the z/OS UNIX System Services hierarchy (including the root file system). Because zFS has higher performance characteristics than HFS and is the strategic file system, HFS might not be supported in any future releases, which will cause you to migrate the remaining HFS file systems to zFS.

zFS can run sysplex-aware for read/write mounted file systems and for read-only mounted file systems. For more information, see “Terminology and concepts” on page 4, “Specifying zFS file systems as sysplex-aware” on page 14, and Chapter 5, “Using zFS in a shared file system environment,” on page 49.

Beginning with z/OS V1R13, zFS has enhanced its sysplex-aware support. For many file operations, zFS can now directly access zFS read/write mounted file systems in a shared file system environment from zFS client systems. In z/OS V1R13 and later releases, when zFS runs in a shared file system environment, zFS always runs sysplex-aware on a file system basis (sysplex=filesys). See “zFS-enhanced sysplex-aware support” on page 51 for more information.

zFS and HFS can both participate in a shared sysplex. However, only zFS supports security labels. Therefore, in a multilevel-secure environment, you must use zFS file systems instead of HFS file systems. See z/OS Planning for Multilevel Security and the Common Criteria for more information about multilevel security and migrating your HFS version root to a zFS version root with security labels.

Notes:
1. Beginning with z/OS V2R1, zFS no longer supports multi-file system aggregates. If you have data that is stored in zFS multi-file system aggregates, copy that data from the zFS multi-file system aggregate file systems into zFS compatibility mode aggregates. Because zFS multi-file system aggregates cannot be mounted in z/OS V2R1, you must copy the data from any file systems that are contained in multi-file system aggregates into zFS compatibility mode file systems using a non-shared file system environment on a system that is running a release prior to z/OS V2R1.
2. Beginning with z/OS V2R1, zFS no longer supports clones. If you have read-only clone (.bak) file systems, you should delete them using the zfsadm delete command on a system that is running a release prior to z/OS V2R2.
3. Beginning with z/OS V2R2, zFS will only allow aggregates that contain exactly one file system in it to be attached.

Features

zFS provides many features and benefits, which are described in the following sections:

Performance
zFS provides significant performance gains in many customer environments. zFS provides additional performance improvements when running sysplex-aware in a shared file system environment.

Restart
zFS reduces the exposure to loss of updates. zFS writes data blocks asynchronously and does not wait for a sync interval. zFS is a logging file system. It logs metadata updates. If a system failure occurs, zFS replays the log when it comes back up to ensure that the file system is consistent.
Aggregate movement
As a part of supporting read/write mounted file systems that are accessed as sysplex-aware, zFS automatically moves zFS ownership of a zFS file system to the system that has the most read/write activity. This system must also satisfy the restrictions that are imposed by the automove mount options for the file system. “Terminology and concepts” on page 4 has an explanation of z/OS UNIX file system ownership and zFS file system ownership. Chapter 5, “Using zFS in a shared file system environment,” on page 49 contains details.

Terminology and concepts
To present all the benefits and details of zFS administration, the following concepts and terminology are introduced:

Attach
When a zFS file system is mounted, the data set is also attached. Attach means that zFS allocates and opens the data set. This attach occurs the first time a file system contained in the data set is mounted.

A zFS data set can also be attached (by issuing the zfsadm attach command) without mounting it. Beginning in z/OS V2R2, only zFS data sets that contain exactly one file system are allowed to be attached. However, there are many restrictions in this case. For example, the zFS data set would not be available to z/OS UNIX applications because it was not mounted. In a shared file system environment, the zFS data set would be detached, not moved, if the system went down or zFS internally restarted. You might attach a zFS data set to explicitly grow it (zfsadm grow) or to determine the free space available (zfsadm aggrinfo). You must detach the zFS data set (zfsadm detach) before mounting it.

Catch-up mount
When a file system mount is successful on a system in a shared file system environment, z/OS UNIX automatically issues a corresponding local mount, which is called a catch-up mount, to every other system's PFS for a zFS read/write mounted file system that is mounted RWSHARE or for a read-only mounted file system.

If the corresponding local mount is successful, z/OS UNIX does not function ship from that system to the z/OS UNIX owning system when that file system is accessed. Rather, the file request is sent directly to the local PFS. This is sometimes referred to as Client=N, as indicated by the output of the D OMVS,F operator command, or df -v shell command. If the corresponding local mount is unsuccessful (for instance, DASD is not accessible from that system), z/OS UNIX function ships requests to the z/OS UNIX owning system when that file system is accessed (message BPXF221I might be issued). This is sometimes referred to as Client=Y, as indicated by the output of the D OMVS,F or df -v commands. For examples of the command output, see “Determining the file system owner” on page 52.

File system ownership
IBM defines a file system owner as the system that coordinates sysplex activity for a particular file system. In a shared file system environment, there is also the concept of file system ownership. The owner of a file system is the first system that processes the mount. This system always accesses the file system locally; that is, the system does not access the file system through a remote system. Other non-owning systems in the sysplex access the file system either locally or through the remote owning system, depending on the PFS and the mount mode.

The file system owner is the system to which file requests are forwarded when the file system is mounted non-sysplex aware. Having the appropriate owner is important for performance when the file system is mounted read/write and non-sysplex aware. The term z/OS UNIX file system owner refers to the owner of the zFS file system as z/OS UNIX recognizes it. This is typically the system where the file system is first mounted, but it can differ from the zFS file system owner (see zFS file system owner).

zFS file system owner
zFS has its own concept of file system ownership, called the zFS file system owner. This is also typically the system where the file system is first mounted in a sysplex-aware environment. File requests to sysplex-aware file systems are sent directly to the local zFS PFS, rather than being
forwarded to the z/OS UNIX file system owner. This concept is shown in Figure 1 on page 5. The local zFS PFS forwards the request to the zFS file system owner, if necessary. The z/OS UNIX file system owner can be different from the zFS file system owner. (In reality, zFS owns aggregates. Generally, we simplify this to say zFS file system owner because zFS compatibility mode aggregates only have a single file system.)

z/OS UNIX file system owner
The term z/OS UNIX file system owner refers to the owner of the zFS file system as z/OS UNIX knows it. This is typically the system where the file system is first mounted.

For details about sysplex considerations and the shared file system environment, see “Determining the file system owner” on page 52 and Chapter 5, “Using zFS in a shared file system environment,” on page 49.

zFS read/write file system mounted with NORSHARE

zFS read/write file system mounted with RWSHARE

Figure 1: z/OS UNIX and zFS file system ownership

When a file system is not sysplex-aware (that is, mounted as NORSHARE), file requests are function-shipped by z/OS UNIX to the z/OS UNIX file system owner, and then to the PFS. When a file system is sysplex-aware (that is, mounted as RWSHARE), file requests are sent directly to the local zFS PFS and then function-shipped by zFS to the zFS file system owner, if necessary.

Function shipping
Function shipping means that a request is forwarded to the owning system and the response is returned to the requestor through XCF communications.

Local mount
A local mount means that z/OS UNIX issues a successful mount to the local PFS, which in this case is zFS. z/OS UNIX does this when either the file system is mounted sysplex-aware for that mode (read/write or read-only) or the system is the z/OS UNIX owner. When a file system is locally mounted on the system, z/OS UNIX does not function ship requests to the z/OS UNIX owning system. To determine if a system has a local mount, see “Determining the file system owner” on page 52.

Non-sysplex aware (sysplex-unaware)
A file system is non-sysplex aware (or sysplex-unaware) if the PFS (Physical File System) supporting that file system requires it to be accessed through the remote owning system from all other systems in a sysplex (allowing only one connection for update at a time) for a particular mode (read-only or read/write). The system that connects to the file system is called the file system owner. Other system’s access is provided through XCF communication with the file system owner. For a non-sysplex aware zFS file system, file requests for read/write mounted file systems are function-shipped to the owning system by z/OS UNIX. The owning system is the only system where the file system is locally mounted and the only system that does I/O to the file system. See zFS file system owner and z/OS UNIX file system owner.
OMVS address space
The address space used by z/OS UNIX, it runs a program that initializes the kernel. Starting in V2R2, zFS can be run in the OMVS address space.

Read-only file system
A file system that is mounted for read-only access is a read-only file system.

Read/write file system
A file system that is mounted for read and write access is a read/write file system.

Shared file system environment
The shared file system environment refers to a sysplex that has a BPXPRMxx specification of SYSPLEX(YES).

Sysplex
The term sysplex as it applies to zFS, means a sysplex that supports the z/OS UNIX shared file system environment. That is, a sysplex that has a BPXPRMxx specification of SYSPLEX(YES).

Sysplex-aware
Pertains to a physical file system that handles file requests for mounted file systems locally instead of shipping function requests through z/OS UNIX.

Sysplex-aware PFS
A physical file system (PFS), for example zFS, is sysplex-aware or non-sysplex aware for a particular mount mode (read-only or read/write) in a shared file system environment. When it is sysplex-aware, the PFS is capable of handling a local mount on the system that is not the z/OS UNIX owning system. The PFS that is sysplex-aware can avoid z/OS UNIX function shipping for that mode. Both HFS and zFS file systems are always sysplex-aware for read-only mounts. HFS is always non-sysplex aware for read/write mounts and always results in z/OS UNIX function shipping from systems that are not the z/OS UNIX owning system. As of z/OS V1R13, zFS always runs sysplex-aware (SYSPLEX=FILESYS) in a shared file system environment. Individual file systems can be non-sysplex aware or sysplex-aware, with the default being non-sysplex aware.

Sysplex-aware file system
A file system can be mounted sysplex-aware or non-sysplex aware. When a file system is mounted sysplex-aware, it means that the file system is locally mounted on every system (when the PFS is capable of handling a local mount on every system - that is, the PFS is running sysplex-aware) and therefore, file requests are handled by the local PFS. All read-only mounted file systems are always mounted sysplex-aware (see Figure 12 on page 50). HFS read/write mounted file systems are always mounted non-sysplex aware. This means that file requests from non z/OS UNIX owning systems are always function-shipped by z/OS UNIX to the z/OS UNIX owning system where the file system is locally mounted and the I/O is actually done.

Beginning with z/OS V1R11, zFS read/write mounted file systems can be mounted sysplex-aware or non-sysplex aware.

zFS address space
Because zFS can run in its own colony address space or inside the OMVS address space, which is the address space used by z/OS UNIX, any reference to the zFS address space will mean the address space in which zFS is running.

zFS aggregate
The data set that contains a zFS file system is called a zFS aggregate. A zFS aggregate is a Virtual Storage Access Method (VSAM) linear data set. After the zFS aggregate is defined and formatted, a zFS file system is created in the aggregate. In addition to the file system, a zFS aggregate contains a log file and a bitmap describing the free space. A zFS aggregate has a single read/write zFS file system and is sometimes called a compatibility mode aggregate. Compatibility mode aggregates are similar to HFS.

Restriction: zFS does not support the use of a striped VSAM linear data set as a zFS aggregate. If you attempt to mount a compatibility mode file system that had previously been formatted and is a striped VSAM linear data set, it will only mount as read-only. zFS does not support a zFS aggregate that has guaranteed space.
**zFS file system**
Refers to a hierarchical organization of files and directories that has a root directory and can be mounted into the z/OS UNIX hierarchy. zFS file systems are located on DASD.

**zFS Physical File System (PFS)**
Refers to the code that runs in the zFS address space. The zFS PFS can handle many users accessing many zFS file systems at the same time.

**ZFS PROC**
The PROC that is used to start ZFS. It is typically called ZFS. If ZFS is running in the OMVS address space, then this refers to the OMVS PROC.

---

**What's new or changed for zFS in z/OS V2R3**

A new `zfsadm shrink` command makes zFS aggregates smaller. Unused free space can be released from existing aggregates to more efficiently use DASD space.

User data in zFS file systems can be encrypted, compressed, or both. This provides additional security and the ability for files to be stored on disk in a compressed format that requires less space.

Some attributes assigned to file systems when they are mounted can be dynamically changed using the `zfsadm chaggr` command without having to unmount and remount the file system.

A mounted file system can be verified by an online salvage utility. The file system can also be repaired, if needed. The online salvage is done with the `zfsadm salvage` command.

zFS aggregates that are created using the new ZFS keyword on the IDCAMS DEFINE CLUSTER command, or the `zfsadm define` command, do not have to be formatted in a separate step prior to being mounted. zFS will automatically format them during mount. File systems formatted during mount will use default values for all of the formatting keywords.

New IOEFSPRM configuration options were added to supply global default values during formatting:

- `-format_encryption`
- `-format_compression`
- `-format_perms`

With z/OS V2R3, the zFS defaults for `format_aggrversion` and `change_aggrversion_on_mount` will favor the creation of version 5 aggregates and the conversion of version 4 aggregates to version 5 at mount time. Once an aggregate is at version 5, any new files or directories will also be version 5. For a converted aggregate, the old files and directories will remain version 4. A version 5 aggregate can be converted back to version 4 by using the `ioefsut1 converttov4` batch utility if the limits of a version 4 aggregate have not been exceeded. Note that Version 5 aggregates cannot be mounted on z/OS V1R13.

Health check ZFS_VERIFY_COMPRESSION_HEALTH was added. For more information about the health check, see *IBM Health Checker for z/OS User’s Guide*.

For information about interface changes in zFS, see “Summary of changes for zFS for z/OS Version 2 Release 3 (V2R3)” on page xvi.

---

**What's new or changed for zFS in z/OS V2R2**

In z/OS V2R2, zFS caches were moved above the 2 G addressing bar to allow for the use of very large zFS caches. These IOEFSPRM configuration variables were changed to support the following ranges of values:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>vnode_cache_size</td>
<td>1000 to 10000000</td>
</tr>
<tr>
<td>meta_cache_size</td>
<td>1 M to 64 G</td>
</tr>
<tr>
<td>token_cache_size</td>
<td>20480 to 20000000</td>
</tr>
</tbody>
</table>
Variable | Range of values
---|---
trace_table_size | 1 M to 65535 M
xcf_trace_table_size | 1 M to 65535 M

With the zFS caches above the 2-G addressing bar, zFS can now be run inside the OMVS address space. This change yields improved performance for each file or directory operation.

The metaback cache is no longer a separate cache in a data space. It is combined with meta_cache_size into one single metadata cache. For simplicity and to avoid future confusion, update the IOEFSPRM configuration file to combine these two options and remove the metaback_cache_size setting from the file.

zFS performance counters were changed from 4 bytes to 8 bytes. This change allows for monitoring of zFS performance over longer periods of time before the counters wrap. The counters are made available via the zFS Statistics Application Programming Interfaces. This information is available in the zFS modify and zfsadm query command reports.

- New reports are available that can be printed with the zfsadm query command using the keywords -stkm, -ctkc, and -svi. This information is also available in new Application Programming Interfaces for Client Token Caching Component, Server Token Manager, and Statistics from the Server Vnode Interface. For more information about the keywords, see “zfsadm query” on page 213.

The zfsadm -storage report now contains information about storage usage above the 2 G bar.

The new zfsadm fsinfo command displays detailed information for one or more file systems. File systems can be specified with a specific name, or in a group by using a common prefix or common suffix. They can also be selected by specifying common attributes. Another way to obtain the detailed information is by using the new File System Information Application Programming Interface or the modify zfs,fsinfo command.

zFS is using a better performing method for handling the writing of records to the zFS aggregate log. The new logging method displays different statistics in the zfsadm query -logcache command and in the MODIFY ZFS,QUERY,LOG performance report. The Statistics Log Cache Information Application Programming Interface will also return new statistics pertaining to this new logging method.

Health checks ZOSMIGV1R13_ZFS_FILESYS and ZOSMIGREC_ZFS_RM_MULTIFS were removed, and CACHE_REMOVALS was added. For more information, see z/OS Migration.

For information about interface updates in V2R2, see “Summary of changes for zFS for z/OS Version 2 Release 2 (V2R2)” on page xx.

What's new or changed for zFS in z/OS V2R1

Beginning with z/OS V2R1, zFS no longer supports multi-file system aggregates and clones. As a result, the following zfsadm commands are no longer supported:

- zfsadm clone
- zfsadm clonesys
- zfsadm create
- zfsadm lsquota
- zfsadm rename
- zfsadm setquota

The following options are no longer supported on zfsadm config:

- -fsgrow
- -user_cache_readahead

The following options are no longer supported on zfsadm configquery:
The following pfsc1 subcommands are no longer supported:
- On the Aggregate command:
  - Create File System
- On the File System command:
  - Clone File System
  - Rename File System
  - Set File System Quota
- On the Config command:
  - Query auto_attach setting
  - Query fsgrow setting
  - Set fsgrow
  - Set user_cache_readahead

If you are using multi-file system aggregates or clones, you must stop using them. Be sure that you complete the migration actions described in z/OS Migration.

The zFS salvager program (ioeagslv) has been improved in z/OS V2R1:
- It can process larger zFS file systems by using storage above the 2 GB bar.
- It can complete its repair processing without needing to be run multiple times.
- All messages that it issues have message numbers.
- The verify option (-verifyonly) replays the log when necessary. This replay avoids reports of inconsistencies that occur when the log has not been replayed.

Quiesce processing for zFS file systems has been modified in z/OS V2R1. The zFS commands and zFS APIs used to quiesce and unquiesce zFS file systems are unchanged, but the way quiesce works internally and the way the quiesce status is displayed are modified.

In z/OS V2R1, the name "zSeries File System" was changed to "z/OS File System". The document z/OS Distributed File Service zSeries File System Administration was retitled to z/OS Distributed File Service zFS Administration.

Beginning with z/OS V2R1, zFS provides an optional, new format zFS aggregate, the version 1.5 aggregate. The current zFS aggregates are version 1.4 aggregates. The main purpose of the version 1.5 aggregate is to support a new directory format (extended (v5) directory) that will scale better when the directory contains many names (over 10,000). Since the format of a new directory is different in a version 1.5 aggregate, zFS provides toleration APAR OA39466 to cause a mount of a version 1.5 aggregate in an earlier release to fail. Earlier releases cannot access extended (v5) directories or version 1.5 aggregates. In order to control the transition to the new format directories, extended (v5) directories can only be created in version 1.5 aggregates. To create or change to a version 1.5 aggregate, you must explicitly request it. By default, aggregates created in z/OS V2R1 are version 1.4 aggregates. You should only create or change to a version 1.5 aggregate if you are sure you will not run releases prior to z/OS V2R1. Over time (possibly several releases), most zFS aggregates will be version 1.5 aggregates. IBM is likely to then change the default to version 1.5.

zFS toleration APAR OA39466 applies to z/OS V1R12 and V1R13.

zFS recommends that you should begin using the new zFS batch utility program IOEFSUTL. It contains all the function of the zFS format utility (IOEAGFMT) and the zFS salvage utility (IOEAGSLV). IOEFSUTL supports both version 1.5 aggregates and version 1.4 aggregates.

Beginning with z/OS V2R1, the batch utility ioeagfmt requires that the ZFS PFS be active.
New IOEPRMxx configuration options control what version an aggregate is formatted as by default (format_aggrversion), whether a version 1.4 aggregate is changed to a version 1.5 aggregate on mount (change_aggrversion_on_mount ) and whether directories are converted to extended (v5) directories as they are accessed (converttov5).

A new MOUNT PARM controls whether a particular zFS aggregate's directories are converted to extended (v5) directories as they are accessed (CONVERTTOV5).

zFS has enhanced its support for the backup change activity flag in the VTOC (D1DSCHA in the Format 1/8). This flag indicates whether a backup of the file system is needed (that is, data has been modified in the file system since the last backup).

Beginning with z/OS V2R1, the default value for IOEPRMxx configuration options user_cache_size, meta_cache_size, and metaback_cache_size are now calculated based on the amount of real storage in the system.

Beginning with z/OS V2R1, the default will be to create zFS auditfids during aggregate formatting.

A new configuration variable was added to IOEFSPRM: user_running_hangdump.

To help alleviate the version 4 large directory performance problem before migrating to version 1.5 aggregates, zFS will allow the creation of new Large Fast Lookup Cache buffers above the bar (64-bit storage) that will be used to fully cache large directories. This is done with a new IOEPRMxx configuration option flc. This option will only be valid in releases z/OS V1R13 and V2R1. It is available on z/OS V1R13 in APAR OA40530.
Chapter 2. Installing and configuring zFS

zFS is part of the Distributed File Service base element of z/OS. Before using the zFS support, you must install the z/OS release, the Distributed File Service, and the other base elements of z/OS using the appropriate release documentation.

Note: If you are only using the zFS support of the Distributed File Service (and not the SMB server support of the Distributed File Service), SMB does not need to be configured. See z/OS Distributed File Service SMB Administration for more information about SMB.

To use the zFS support, you must configure the support on the system. Configuration includes the following administrative tasks:

- Decide if you want to run zFS in its own colony address space or in the OMVS address space. For more information that you can use to help make this decision, see “zFS running in the z/OS UNIX address space” on page 16.
- Define the zFS physical file system to z/OS UNIX.
- Create or update the zFS parameter data set (IOEFSPRM); see “IOEFSPRM” on page 227.
- Define zFS aggregates and file systems.
- Create mount points and mount zFS file systems.
- Change owner/group and set permissions on the file system root.
- Optionally, add MOUNT statements in your BPXPRMxx member to cause zFS file systems to be mounted at IPL.

zFS installation and configuration steps

To install, configure, and access zFS, you must perform the following administrative steps:

1. Install and perform postinstallation of Distributed File Service by following the applicable instructions in z/OS Program Directory or in ServerPac: Installing Your Order. Following is a summary of the information that is contained in those documents:
   a. Ensure that the target and distribution libraries for Distributed File Service are available.
   b. Run the prefix.SIOESAMP(IOEISMKD) job from UID 0 to create the symbolic links that are used by Distributed File Service. This job reads the member prefix.SIOESAMP(IOEMKDIR) to delete and create the symbolic links.
   c. Ensure that the DDDEFs for Distributed File Service are defined by running the prefix.SIOESAMP(IOEISDDD) job.
   d. Install the Load Library for Distributed File Service. The Load Library (hlq.SIEALNKE) must be APF-authorized and must be in link list.
   e. Install the samples (hlq.SIOESAMP).
   f. Install the sample PROC for ZFS (hlq.SIOEPROC).
   g. One method of providing an IOEFSPRM configuration file is to define it as a data set with an IOEZPRM DD card. If zFS is to run in the OMVS address space, the IOEZPRM DD card should be placed in the OMVS PROC. If zFS is to run in its own colony address space, create a JCL PROC for the zFS started task in SYS1.PROCLIB by copying the sample PROC from the previous step.

   The DDNAME IOEZPRM identifies the optional zFS configuration file. Although this DD statement is optional, it is recommended that it be included to identify the parameter data set to be used for zFS. For now, it is suggested that this DD refer to a PDS with a member called IOEFSPRM that has a single line that begins with an asterisk (*) in column 1. Subsequent modifications can be made to the IOEFSPRM member, see “IOEFSPRM” on page 227.
As the preferred alternative to the IOEZPRM DDNAME specification, delete the IOEZPRM DDNAME and use the IOEPRMxx parmlib member. In this case, the member has the name IOEPRMxx, where you specify xx in the parmlib member list. See “IOEFSPRM” on page 227 for more information.

To run zFS so that it is not under control of JES, see step 2. You might want to do this so that zFS does not interfere with shutting down JES.

h. Add the following RACF® commands:

```
ADDGROUPE DFSGRP SUPGROUP(SYS1) OMVS(GID(2))
ADDSER DFS OMVS(HOME('/opt/dfslocal/home/dfscntl') UID(0))
DFTLGROPE DFSGRP AUTHORITY(USE)UACC(NONE)
RDEFINE STARTED DFS.* STDATA(USER(DFS))
RDEFINE STARTED ZFS.* STDATA(USER(DFS))
SETROPTS RACLIST(STARTED)
SETROPTS RACLIST(STARTED) REFRESH
```

zFS specifies the DFS user ID in the preceding commands. A user ID other than DFS can be used to run the zFS started task if it is defined with the same RACF characteristics as shown for the DFS user ID. If zFS is to run in the OMVS address space, it will run under the OMVS user ID. For this reason, the OMVS user ID should be given the same RACF characteristics as the DFS user ID. The user ID that is used will be referred as the DFS user ID.

The DFS user ID must have at least ALTER authority to all VSAM linear data sets that contain zFS aggregates.

If there are encrypted zFS aggregates, the DFS user ID must also have at least READ access to any CSFKEYS profiles for aggregates that are encrypted. If ICSF is configured with CHECKAUTH(YES), the DFS user ID must also have at least READ access to the CSFKRR2 CSFSERV profile. For more information about the CSFKEYS and CSFSERV profiles and the encryption of data sets, see Data Set Encryption in z/OS DFSMS Using Data Sets.

As an alternative to permitting the DFS user ID to all of the necessary security profiles, you can assign the zFS started task the TRUSTED attribute or you can assign the user ID of the zFS started task the OPERATIONS attribute.

2. Create a BPXPRMxx entry for zFS.

Add a FILESYSTYPE statement to your BPXPRMxx parmlib member:

```
FILESYSTYPE TYPE(ZFS) ENTRYPOINT(IOEFSCM) ASNAME(ZFS)
```

Specifying the ASNAME(ZFS) keyword causes zFS to run in its own colony address space. To have zFS run in the OMVS address space, omit the ASNAME keyword.

```
FILESYSTYPE TYPE(ZFS) ENTRYPOINT(IOEFSCM)
```

**Recommendation:** Specify KERNELSTACKS(ABOVE) when zFS is running in the OMVS address space.

Update your IEASYSxx parmlib member to contain the OMVS=(xx,yy) parameter for future IPLs.

If necessary, you can specify that zFS should not be only run under control of JES by including SUB=MSTR. For example:

```
FILESYSTYPE TYPE(ZFS) ENTRYPOINT(IOEFSCM) ASNAME(ZFS, 'SUB=MSTR')
```

To use the IOEPRMxx parmlib members (mentioned in step 1.g), specify the xx values in the FILESYSTYPE statement for zFS as in the following example:

```
FILESYSTYPE TYPE(ZFS) ENTRYPOINT(IOEFSCM) ASNAME(ZFS, 'SUB=MSTR')
PARM('PRM=(01,02,03)')
```

In this case, you must not have an IOEZPRM DD statement in your ZFS PROC. Step 4 contains an explanation as to why you should not have an IOEZPRM DD. For more information about using IOEPRMxx, see “IOEFSPRM” on page 227.

3. Run the dfs_cpfiles program.
Running this program as described in z/OS Program Directory is recommended even if you plan to only use zFS support. The only zFS configuration file is the zFS configuration file, which is not created by the dfs_cpfiles program. But, to complete the installation of Distributed File Service, run the dfs_cpfiles program to create other files that are needed by the SMB server. This avoids problems if SMB is later activated.

To run the dfs_cpfiles program:

- Log on as root (UID 0) on the local z/OS system.
- From the z/OS UNIX shell, enter /usr/lpp/dfs/global/scripts/dfs_cpfiles.

4. (Optional) Create or update the zFS configuration options file (IOEPRMxx, also known as IOEFSPRM).

The zFS configuration options file is optional. There are two methods to specify the zFS configuration options file: use IOEPRMxx in the parmlib or use an IOEZPRM DD statement in the PROC that is used to start the address space where zFS is running.

- As the preferred alternative to the IOEZPRM DD statement, the IOEFSPRM member can be specified as a true parmlib member. In this case, the member has the name IOEPRMxx, where xx is specified in the parmlib member list. You must omit the IOEZPRM DD statement in the PROC that is used to start the address space in which zFS will run. The IOEPRMxx configuration options file can be specified with no options contained in it. Options are only required if you want to override the default zFS options. As mentioned in step 1.g, it is recommended that you create an empty IOEPRMxx parmlib member. The IOEPRMxx member should only contain one line that is a comment (an asterisk (*) in column 1). See “IOEFSPRM” on page 227 for more information.

- If you use the IOEZPRM DD statement, the PDS (organization PO) to which it points should have a record format of FB with a record length of 80. The block size can be any multiple of 80 that is appropriate for the device. A sample IOEFSPRM is provided in hlq.SIOESAMP(IOEFSPRM). IOEFSPRM is also known as IOEZS001. See “IOEFSPRM” on page 227 for a description of the IOEFSPRM options. Update the IOEZPRM DD statement in the OMVS or ZFS PROC to contain the name of the IOEFSPRM member, as shown in the following example:

```
IOEZPRM DD DSN=SYS4.PVT.PARMLIB(IOEFSPRM),DISP=SHR
```

If you are running a sysplex, you must have different zFS configuration files for different systems. Chapter 5, “Using zFS in a shared file system environment,” on page 49 explains why different zFS configuration files are required. In this case, you should also specify a system qualifier in the data set name in the IOEZPRM DD, as shown in the following example:

```
IOEZPRM DD DSN=SYS4.&SYSNAME..PARMLIB(IOEFSPRM),DISP=SHR
```

5. (Optional) Preallocate data sets for debugging.

This step is optional because trace information is always available in the dump data set, and can be requested only by IBM Service. If needed, allocate the zFS trace output data set as a PDSE with RECFM=VB, LRECL=133 with a primary allocation of at least 50 cylinders and a secondary allocation of 30 cylinders. The name of this trace output data set should be specified in the trace_dsn option in the IOEFSPRM file. Next, allocate a debug settings data set as a PDS member with an LRECL=80. Add one comment line in the member (use a /* followed by */). Specify the name of this debug settings data set member in the debug_settings_dsn option of the IOEFSPRM file. Perform this process for each member of the sysplex.

6. Create a zFS (compatibility mode) file system.

A zFS file system resides in a zFS aggregate. A zFS aggregate is a VSAM linear data set. See Chapter 4, “Creating and managing zFS file systems using compatibility mode aggregates,” on page 21 for details on creating zFS file systems.

Beginning in z/OS V2R1, ioeagfmt fails if the zFS PFS is not active on the system.

7. Create a directory and mount the zFS file system on it.

You can create a directory with the z/OS UNIX mkdir command or you can use an existing directory. The TSO/E MOUNT command or the /usr/sbin/mount REXX exec can be used to mount the zFS file system.
system on the directory. See Chapter 4, “Creating and managing zFS file systems using compatibility mode aggregates,” on page 21 for details on mounting zFS file systems.

**Note:** Steps 6 and 7 can be repeated as many times as necessary for each permanently mounted zFS file system. Only step 6 is needed for zFS automounted file systems (assuming that the automount file system has been set up.)

8. Add mount statements to BPXPRMxx members to mount the zFS file systems on the next IPL.

For example:

```bash
MOUNT FILESYSTEM('OMVS.PRIV.COMPAT.AGGR001') TYPE(ZFS) MOUNTPOINT('/etc/mountpt')
```

All MVS data sets that are specified in DD statements in the zFS PROC, in options in the IOEFSPRM configuration file, and in MOUNT statements in BPXPRMxx must be available at IPL time. If an MVS data set is migrated by hierarchical storage management (HSM), then the initialization of zFS might wait indefinitely for the data set recall. This hang on one system can lead to a sysplex-wide hang. Any ARC0055A message that is issued for the migrated data set will need a reply to prevent this hang.

---

**Applying required APARs for z/OS V2R3**

In z/OS V2R3, in addition to the “zFS installation and configuration steps” on page 11, you must apply zFS coexistence function, using the following APAR procedure:

1. Install APAR OA51692 on all z/OS V2R1 and z/OS V2R2 systems. This APAR is conditioning function for zFS on z/OS V2R1 and V2R2. Make APAR OA51692 active on all systems through a rolling IPL.

---

**Specifying zFS file systems as sysplex-aware**

This section helps you determine whether to make a zFS read/write file system be sysplex-aware.

If you are running your sysplex in a shared file system environment, where BPXPRMxx specifies SYSPLEX(YES), zFS is always enabled to allow zFS read/write sysplex-aware file systems (zFS runs sysplex=filesys). You can individually choose which file systems are sysplex-aware for read/write and which ones are not. The default is that zFS read/write file systems will not be sysplex-aware. A newly mounted zFS read/write file system will be sysplex-aware if you specify the RWSHARE MOUNT PARM, as shown:

```bash
MOUNT FILESYSTEM('OMVS.PRIV.COMPAT.AGGR001') TYPE(ZFS) MOUNTPOINT('/etc/mountpt') PARM('RWSHARE')
```

As an alternative, you can specify sysplex_filesys_sharemode=rwshare in your IOEFSPRM. The default is changed so that each zFS read/write file system is mounted sysplex-aware unless you explicitly specify the NORWSHARE MOUNT PARM.

Typically, if you make a zFS read/write file system sysplex-aware, you see a performance improvement in most shared file system environments when accessing the data from a system that is not the zFS owner. However, some servers cannot fully support zFS read/write file systems that are sysplex-aware.

- The z/OS Distributed File Service SMB server cannot export any zFS read/write file systems that are sysplex-aware.
- The Fast Response Cache Accelerator support of the IBM HTTP Server for z/OS V5.3 uses an API called register file interest (BPX1IOC using the Iocc#RegFileInt subcommand). This API cannot support zFS sysplex-aware read/write file systems, so therefore the Cache Accelerator support is not able to cache static Web pages contained in files in a zFS read/write sysplex-aware file system. Other servers that use this API can also be impacted. Generally, these are servers that cache files and must be aware of file updates from other sysplex members without having the server read the file or the file modification timestamp.
- The Policy Agent (Pagent) server, which is part of the z/OS Communications Server, cannot export any zFS read/write file systems that are sysplex-aware.
If you are using any of these servers, ensure that any zFS read/write file systems that are accessed by these servers are non-sysplex aware.

There are some modifications to the way file system ownership works for zFS read/write sysplex-aware file systems. These modifications can cause some operational differences. For information about file system ownership, see Chapter 5, “Using zFS in a shared file system environment,” on page 49.

### Using zFS read/write sysplex-aware file systems

When you run zFS in a shared file system environment, the zFS PFS runs as *sysplex-aware*. However, by default, each zFS file system is mounted as *non-sysplex aware*. zFS does allow zFS read/write file systems to run as sysplex-aware. This must be explicitly requested on a file system basis, using either the RWSHARE mount parameter or the sysplex_filesys_sharemode=rwshare configuration option.

Consider which zFS read/write file systems you might want to be sysplex-aware. Good candidates are zFS read/write file systems that are accessed from multiple systems or are mounted with AUTOMOVE and might be moved by z/OS UNIX (as a result of a shutdown or IPL) to systems that do not necessarily do the most accesses. Be aware that RWSHARE file systems use more virtual storage in the zFS address space than NORSHARE file systems. Beginning in z/OS V2R2, this storage is 64-bit storage (above the 2 G line). Be careful that you do not use more real or auxiliary storage in the system than is needed. See the sample zFS query report “STOR” on page 81 for information about monitoring storage usage in the zFS address space. Generally, the system-specific file system (and /dev, /etc, /tmp, /vaz) should be mounted as NORSHARE and UNMOUNT because they typically are accessed only from the owning system.

zFS read-only mounted file systems are not affected by this support. However, if you remount a read-only file system to read/write by using the chmount command or the TSO/E UNMOUNT REMOUNT command, this is treated like a primary mount on the current z/OS UNIX owning system. In this case, mount parameters (such as RWSHARE or NORSHARE) or mount defaults (such as the current sysplex_filesys_sharemode setting on that system) take effect when it is mounted read/write. When you remount back to read-only, those mount options are irrelevant again.

**Note:** These mount parameters and mount defaults do not take effect when a remount to the same mode is run.

The sysplex_filesys_sharemode option on a system specifies if a zFS read/write file system will be mounted as sysplex-aware when a mount is issued on that system without specifying either NORSHARE or RWSHARE in the MOUNT PARM. The default value for sysplex_filesys_sharemode is norwshare. A mount for a zFS read/write file system that does not have NORSHARE or RWSHARE specified in the MOUNT PARM results in the file system being non-sysplex aware. If you want zFS read/write mounts to be sysplex-aware, then specify sysplex_filesys_sharemode=rwshare. This option can be specified in the IOEFSPRM configuration options file and takes effect on the next IPL (or restart of zFS). It can also be specified dynamically with the zfsadm config -sysplex_filesys_sharemode command. Typically, you should specify the same sysplex_filesys_sharemode value on all your systems. Otherwise, z/OS UNIX file system ownership movement might change the sysplex-awareness of a file system that does not have NORSHARE or RWSHARE specified in the MOUNT PARM.

If any zFS read/write file systems were previously mounted as NORSHARE, they will usually remain non-sysplex aware until they are unmounted and then mounted back on the RWSHARE system. However, there are situations when the sysplex awareness might change. See “Changing zFS attributes on a mounted zFS compatibility mode file system” on page 41 for more information.

Your sysplex root file system should be read-only. However, if your sysplex root file system is normally read/write, you should make it sysplex-aware. You cannot unmount the sysplex root file system so you need an alternative method. One method is to remount your sysplex root to read-only, move z/OS UNIX ownership of the file system, if necessary, to a system that has sysplex_filesys_sharemode=rwshare, and then remount the sysplex root back to read/write. You might want to update your ROOT statement in BPXPRMxx to add PARM('RWSHARE') to ensure that you do not lose the sysplex-aware attribute if the ROOT is mounted again. In this case, you might see a USS_PARMLIB health check message indicating that your BPXPRMxx ROOT PARM does not match your current sysplex root PARM. This behavior is expected and is normal.
Changing the sysplex-awareness of a mounted zFS read/write file system

In a shared file system environment, after a zFS read/write file system is mounted it is either sysplex-aware or non-sysplex aware. You can determine the sysplex-awareness of a mounted zFS read/write file system by using the `zfsadm aggrinfo -long` command. If it displays sysplex-aware, then it is sysplex-aware. If it is blank, then it is non-sysplex aware.

You can also use FSINFO to determine sysplex-awareness of a mounted zFS file system. The status field will show RS when mounted sysplex aware (RWSHARE), and will show NS when mounted non-sysplex aware (NORWSHARE).

Alternatively, you can also issue the `f zfs,query,file` console command. As indicated in Table 3 on page 71, an "S" indicates that the zFS read/write file system is mounted sysplex aware. Because you do not have to be running in the shell, this command can be useful if a file system is under recovery or having other problems.

You can change the sysplex-awareness of a mounted zFS read/write file system by using the `zfsadm chaggr` command if all systems in the sysplex are at least the z/OS V2R3 level. Otherwise, use the following method:

- Unmount the file system.
- Specify the MOUNT PARM (RWSHARE to make it sysplex-aware; NORWSHARE to make it non-sysplex aware).
- Mount the file system again.

If you want to change the sysplex-awareness and you have not specified either the RWSHARE or NORWSHARE MOUNT PARM, you can change the sysplex-awareness with remount. To do so:

- Remount the file system to read-only.
- Move z/OS UNIX ownership of the file system (if necessary) to a system that has `sysplex_filesys_sharemode` specified to the sharemode that you want (RWSHARE or NORWSHARE).
- Remount the file system back to read/write.

zFS running in the z/OS UNIX address space

In releases before z/OS V2R2, the amount of 31-bit virtual storage that was needed by both z/OS UNIX and zFS combined would have exceeded the size of a 2 GB address space. Due to that size limitation, zFS and z/OS UNIX could not coexist in the same address space.

In z/OS V2R2, zFS caches are moved above the 2 GB bar into 64-bit storage. You can now choose to have zFS run in its own colony address space or in the address space that is used by z/OS UNIX, which is OMVS.

When running zFS in the OMVS address space, each file system vnode operation (such as creating a directory entry, removing a directory entry, or reading from a file) will have better overall performance. Each operation will take the same amount of time while inside zFS itself. The performance benefit occurs because z/OS UNIX can call zFS for each operation in a more efficient manner.

Some inherent differences exist when zFS is run in the OMVS address space.

1. MODIFY commands must be passed to zFS through z/OS UNIX. Use the form `MODIFY OMVS,pfs=zfs,cmd`. For more information, see the section on passing a MODIFY command string to a physical file system (PFS) through a logical file system (LFS) in z/OS MVS System Commands. This form of the MODIFY command can be used whether zFS is in its own address space or in the OMVS address space.
   
   **Note:** When zFS is running in the OMVS address space, any zFS MODIFY commands that are issued through an automated process or system automation must be changed to accommodate the new command format.

2. The CANCEL ZFS command is not available.
3. When the IOFSPRM configuration file location is defined by the IOEZPRM DD card, it will need to be placed in the OMVS PROC. For more information, see Chapter 12, “The zFS configuration options file (IOEPRMxx or IOEFSPRM),” on page 227.

4. zFS will run under the OMVS user ID instead of the zFS user ID (DFS).

5. You can determine if zFS is in its own address space by issuing D OMVS,PFS. If the output shows an ASNAME value, zFS is running as a colony address space. Otherwise, the lack of an ASNAME value means that zFS is running in the OMVS address space.
Chapter 3. Managing zFS processes

Managing zFS processes includes starting and stopping zFS, as well as determining zFS status.

Starting zFS

zFS is started by z/OS UNIX, based on the FILESYSTYPE statement for zFS in the BPXPRMxx parmlib member. Beginning in z/OS V2R2, if there is no ASNAME keyword on the FILESYSTYPE statement, zFS is started inside the OMVS address space (the address space used by z/OS UNIX). If there is an ASNAME keyword, zFS is started in its own colony address space.

**Requirement:** Before zFS can start in its own colony address space, a ZFS PROC must be available.

zFS can be started at IPL if the BPXPRMxx parmlib member is in the IEASYSxx parmlib member’s OMVS=(xx,yy) list. To start it later, use the SETOMVS RESET=(xx) operator command.

Stopping zFS

In general, do not stop zFS. Stopping zFS is disruptive to applications that are using zFS file systems. zFS stops automatically when you shut down z/OS UNIX. To shut down an LPAR or to re-IPL an LPAR, use the MODIFY OMVS,SHUTDOWN operator command to shut down z/OS UNIX. This action synchronizes data to the file systems and unmounts or moves ownership in a shared file system environment. A planned system shutdown must include the unmount or move of all owned file systems and the shut down of zFS. The MODIFY OMVS,SHUTDOWN command unmounts and moves the owned file systems and shuts down zFS. For shutdown procedures using F OMVS,SHUTDOWN, see Planned shutdowns using F OMVS,SHUTDOWN in z/OS UNIX System Services Planning.

zFS can be stopped using the MODIFY OMVS,STOPPFS=ZFS operator command. Automatic ownership movement can occur for both the z/OS UNIX owner and the zFS owner. See z/OS UNIX System Services Planning for information about the various automove settings for z/OS UNIX file system ownership. When z/OS UNIX notifies zFS that a shutdown is going to occur, zFS aggregate ownership moves to other zFS systems in the shared file system environment. z/OS UNIX then processes its file system ownership changes, or unmounts, as appropriate.

When zFS is stopped, you receive the following message (after replying Y to message BPXI078D):

nn BPXF032D FILESYSTYPE ZFS TERMINATED. REPLY ‘R’ WHEN READY TO RESTART. REPLY ‘I’ TO IGNORE.

When an LPAR is shut down without the orderly shutdown of zFS, it is likely that recovery actions (automatic recovery on the next mount; if the mount fails, it might be necessary to manually run salvager) will be necessary to bring zFS aggregates back to a consistent state. In addition, some file activity can be lost.

To restart zFS, reply r to message nn. (For example, r 1, r). If you want zFS to remain stopped, you can reply 1 to remove the prompt. In this case, zFS can be redefined later using the SETOMVS RESET=(xx)operator command. However, this can result in zFS file systems becoming NOT ACTIVE. An unmount and remount is required to activate a file system that is NOT ACTIVE. If you plan to restart zFS, you should reply r to the message.

**Note:** Stopping zFS can have shared file system (sysplex) implications. See Chapter 5, “Using zFS in a shared file system environment,” on page 49 for information about shared file systems.

If zFS has an internal failure, it typically does not terminate. It might disable an aggregate (see “Diagnosing disabled aggregates” on page 101). If it is a case where it does terminate, normally zFS will restart automatically. Otherwise, message BPXF032D (the same message you receive when the MODIFY OMVS,STOPPFS=ZFS operator command is used) is issued and a reply is requested.
On z/OS V1R13 and later systems, if an internal problem occurs, zFS attempts an internal restart. It internally remounts any zFS file systems that were locally mounted, without requiring any support from z/OS UNIX. The zFS ownership for aggregates that are owned on the system that is internally restarted might be moved (by zFS for sysplex-aware file systems) to another system. For more information, refer to Step “10” on page 100.

**Determining zFS status**

To determine if zFS is currently active, issue the D OMVS,PFS command. The column titled ST (for STatus) will contain an A if zFS is active. It will contain an S (Stopped) if it is not.

To display zFS internal restart information, issue the MODIFY ZFS,QUERY,STATUS operator command.

Beginning in z/OS V1R11, you can issue D OMVS,P to display the state of the PFS, including the start or exit timestamp. Message BPXO068I returns the PFS in one of the following possible states:

- **A**
  - Active; the timestamp is the start time of the PFS.

- **I**
  - Inactive. When the PFS is inactive with no timestamp, the PFS address space has not yet started. When the PFS is inactive with timestamp, the PFS has stop at that time.

- **S**
  - Stopped; it is waiting for a reply of R to restart or I to terminate the PFS.

- **U**
  - Unavailable.

For more information, see *z/OS MVS System Messages, Vol 3 (ASB-BPX)*.
Chapter 4. Creating and managing zFS file systems using compatibility mode aggregates

A zFS file system is created in a zFS aggregate (which is a VSAM linear data set). In a compatibility mode aggregate, the aggregate and the file system are created at the same time. For simplicity, we refer to a file system in a compatibility mode aggregate as a compatibility mode file system, or just as a file system. A compatibility mode file system is created by using the ioeagfmt utility, which is described in “ioeagfmt” on page 118.

Creating a compatibility mode aggregate

Creating a compatibility mode aggregate is typically a two-step process.

1. First, use IDCAMS to create a VSAM linear data set.

   **Note**: Carefully consider defining the aggregate as extended format, extended addressability, and with a secondary allocation size. If you do not use these attributes in the beginning, to add them, you will need to define and format a new zFS aggregate, migrate the data from the original file system into the new one, unmount the original, and then mount the new one. You might want to extend beyond the 4 G aggregate size because version 1.5 aggregates can be much larger than version 1.4 aggregates, or because secondary extents are required to dynamically grow the aggregate, and dynamic grow (aggrgrow) is the default. For more information, see “Dynamically growing a compatibility mode aggregate” on page 26.

2. Then format the VSAM linear data set as a compatibility mode aggregate and create a file system in the aggregate using ioeagfmt (see “ioeagfmt” on page 118). Before you can issue ioeagfmt, you must have UPDATE authority to the VSAM linear data set. If you specified -owner, -group, or -perms to override the default values, you must also be UID 0 or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIX UNIXPRIV class.

Beginning in z/OS V2R3, you do not have to explicitly format the VSAM linear data set if it is created with the zfsadm define command, or if it is created with the ZFS keyword on the IDCAMS DEFINE CLUSTER command. It will be automatically formatted the first time it is mounted. For more information about aggregates being formatted during mount processing, see “MOUNT” on page 140.

Beginning in z/OS V2R1, ioeagfmt fails if the zFS PFS is not active on the system. In addition, if the zFS started task does not have the TRUSTED attribute or the OPERATIONS attribute, the DFS user ID must have at least ALTER authority to all VSAM linear data sets that contain zFS aggregates. For details, see z/OS Security Server RACF Security Administrator’s Guide.

You can also create a compatibility mode aggregate by using the ISHELL, or the automount facility, or the zfsadm define and zfsadm format commands.

- For more information about ISHELL, see z/OS UNIX System Services User's Guide.
- For more information about automount, see z/OS UNIX System Services Planning.
- For more information about the zfsadm define command, see “zfsadm define” on page 176.
- For more information about the zfsadm format command, see “zfsadm format” on page 192.

The VSAM linear data set, the aggregate, and the file system all have the same name and that name is equal to the VSAM linear data set cluster name. The zFS file system is then mounted into the z/OS UNIX hierarchy.
Rule: The Control Interval (CI) size of a VSAM linear data set that is formatted as a zFS aggregate must be 4 K, which is the default for IDCAMS. As such, it is not specified in the following figure, which shows an example of a job that creates a compatibility mode file system.

```
//USERIDA  JOB  ,'Compatibility Mode',
//         CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSPRINT=H
//SYSDUMP DD SYSDUMP=H
//AMSDUMP DD AMSDUMP=H
//DASD0 DD DASD0=OLD,UNIT=3390,VOL=SER=PRV000
//SYSDUMP DD SYSDUMP=H
//SYSDUMP DD
//DEFINe CLUSTER (NAME(OMVS.PRV.COMPAT.AGGR001) -
//  VOLUMES(PRV000) -
//  ZFS CYL(25 0) SHAREOPTIONS(3))
//CREATE EXEC PGM=IOEAGFMT,REGION=0M,
//  PARM=('-aggregate OMVS.PRV.COMPAT.AGGR001 -compat')
//SYSPRINT DD SYSPRINT=H
//STDOUT DD STDOUT=H
//STDERR DD STDERR=H
//SYSDUMP DD SYSDUMP=H
//CEEDUMP DD CEEDUMP=H

The -compat parameter in the CREATE step tells ioeagfmt to create a compatibility mode file system. The -compat parameter is the default, but ignored, and zFS always formats a compatibility mode file system. The result of this job is a VSAM linear data set that is formatted as a zFS aggregate and contains one zFS file system. The zFS file system has the same name as the zFS aggregate (and the VSAM linear data set). The size of the zFS file system (that is, its available free space) is based on the size of the aggregate.

```
//USERIDA  JOB  ,'Compatibility Mode',
//         CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSPRINT=H
//SYSDUMP DD SYSDUMP=H
//AMSDUMP DD AMSDUMP=H
//DASD0 DD DASD0=OLD,UNIT=3390,VOL=SER=PRV000
//SYSDUMP DD SYSDUMP=H
//SYSDUMP DD
//DEFINe CLUSTER (NAME(OMVS.PRV.COMPAT.AGGR001) -
//  VOLUMES(PRV000) -
//  ZFS CYL(25 10) SHAREOPTIONS(3))
//CREATE EXEC PGM=IOEFSUTL,REGION=0M,
//  PARM=('-aggregate OMVS.PRV.COMPAT.AGGR001 -compat')
//SYSPRINT DD SYSPRINT=H
//STDOUT DD STDOUT=H
//STDERR DD STDERR=H
//SYSDUMP DD SYSDUMP=H
//CEEDUMP DD CEEDUMP=H

```

Figure 2: Example job to create a compatibility mode file system using IOEFSUTL

The ioeufsutl format utility can also be used to format a compatibility mode file system. It has options similar to ioeagfmt and the same authority requirements. The -compat option is not needed or allowed. The ioeufsutl format utility only formats compatibility mode aggregates. You are encouraged to use the ioeufsutl format utility rather than the ioeagfmt utility.

The default for the size of the aggregate is the number of 8 KB blocks that fits in the primary allocation. You can specify a -size option giving the number of 8 KB blocks for the aggregate.

- If you specify a number that is less than (or equal to) the number of blocks that fits into the primary allocation, the primary allocation size is used.
- If you specify a number that is larger than the number of 8 KB blocks that fits into the primary allocation, the VSAM linear data set is extended to the size specified if the total size will fit in the primary allocation and a single extension. A secondary extension cannot be used; instead, see “Growing a compatibility mode aggregate” on page 26. The single extension must be no larger than a single volume. This occurs during its initial formatting. Sufficient space must be available on the volume. Multiple volumes can be specified on the DEFINE of the VSAM linear data set. The multiple volumes are used during extension of the data set later. If you want to create a multi-volume data set initially that is larger than two volumes, see “Creating a multi-volume compatibility mode aggregate” on page 27. DFSMS decides when to allocate on these volumes during extension. Any VSAM linear data set greater than 4 GB can be specified by using the extended format and
extended addressability capability in the data class of the data set. See z/OS DFSMS Using Data Sets for information about VSAM data sets greater than 4 GB in size.

**Restriction:** zFS does not support the use of a striped VSAM linear data set as a zFS aggregate. If you attempt to mount a compatibility mode file system that was previously formatted and is a striped VSAM linear data set, it is mounted as read-only.

There are several other options to use when you create a compatibility mode file system that set the owner, group, and the permissions of the root directory.

- The -owner option specifies the owner of the root directory.
- The -group option specifies the group of the root directory.
- The -perms option specifies the permissions on the root directory.

Now, you can mount the zFS file system into the z/OS UNIX hierarchy with the TSO/E MOUNT command. For example, the following command mounts the compatibility mode file system that was created.

```
MOUNT FILESYSTEM('OMVS.PRV.COMPAT.AGGR001') TYPE(ZFS) MODE(RDWR) MOUNTPOINT('/usr/mountpt1')
```

Alternatively, as the following example shows, you can use the z/OS UNIX mount shell command to mount the compatibility mode file system that was created.

```
/usr/sbin/mount -t ZFS -f OMVS.PRV.COMPAT.AGGR001 /usr/mountpt1
```

These examples assume that the directory /usr/mountpt1 exists and is available to become a mount point. For more information about mount points, see z/OS UNIX System Services Planning.

### Using version 1.5 aggregates and extended (v5) directories

**CAUTION:** Do not use zFS version 1.5 aggregates until you have finished migrating all of your systems to z/OS V2R1 or later. Version 1.5 aggregates are not supported on releases prior to z/OS V2R1. All systems in a sysplex must be a V2R1 level or later before any version 1.5 aggregates on any system in the sysplex are implemented.

Beginning in z/OS V2R1, zFS supports a new version aggregate, the version 1.5 aggregate. The current aggregates are version 1.4 aggregates. Version 1.5 aggregates support extended (v5) directories. Extended (v5) directories provide the following benefits:

- They can support larger directories with performance.
- They store names more efficiently than v4 directories.
- When names are removed from extended (v5) directories, the space is reclaimed, when possible, unlike v4 directories where space is not reclaimed until the directory is removed.

Version 1.5 aggregates have a larger architected maximum size than version 1.4 aggregates (approximately 16 TB versus approximately 4 TB). Also, extended (v5) directories can support more subdirectories than v4 directories (4G-1 versus 64K-1).

Because version 1.5 aggregates will benefit all environments that consist of systems that are all at release z/OS V2R1 or later, you are encouraged to use this function after all or your systems have been migrated to z/OS V2R1 or later. Version 1.5 aggregates can contain both extended (v5) directories and v4 directories and either can be a subdirectory of the other, while version 1.4 aggregates cannot contain extended (v5) directories. Version 1.5 aggregates can be mounted on directories that are contained in version 1.4 aggregates, and the reverse is also allowed.

### Creating a version 1.5 aggregate

A version 1.5 aggregate can be created using one of the following methods:

- Formatting a VSAM linear data set as a version 1.5 using the zFS ioefsut1 format batch utility.
- Using the zFS ioeagfmt batch utility.
• Via the Format Aggregate API.
• Using the zfsadm format command.

You can specify the default version that is formatted by setting the IOEFSPRM configuration option format_aggrversion to 4 or 5. The format_aggrversion value from the zFS PFS is used when any formatting method is used without the -version4 or -version5 parameters. Beginning in z/OS V2R3, formatting version 1.5 aggregates is the default.

The zFS format utilities ioeagfmt and ioefsutl format both request the value of the format_aggrversion configuration option from the zFS kernel when determining the default aggregate version for the format. If the zFS PFS is down, both utilities will simply fail. Formatting of a version 1.5 aggregate is not allowed when a z/OS V1R13 system is in a shared file system environment when using the batch utility ioeagfmt, the zfsadm format command or the Format Aggregate API.

Following is an example of a job to create and format a version 1.5 aggregate:

```
//USERIDA JOB , 'Compatibility Mode',
// CLASS=A, MSGCLASS=X, MSGLEVEL=(1,1)
//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//AMSDUMP DD SYSOUT=H
//DASD0 DD DISP=OLD,UNIT=3390,VOL=SER=PRV000
//SYSIN DD *
//DEFINE CLUSTER (NAME(OMVS.PRV.COMPAT.AGGR001) -
// VOLUMES(PRV000) -
// ZFS CYL(25 10) SHAREOPTIONS(3))
/*
//CREATE EXEC PGM=IOEFSUTL,REGION=0M,
// PARM=('format -aggregate OMVS.PRV.COMPAT.AGGR001 -version5')
//SYSPRINT DD SYSOUT=H
//STDOUT DD SYSOUT=H
//STDERR DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP DD SYSOUT=H
/*
```

The zfsadm format command can also be used to format a version 1.5 aggregate. For example:

```
# zfsadm define -aggr OMVS.PRV.ZFS.AGGR005.LDS0005 -volumes PRV000 -cyl 10 5
IOEZ00248I VSAM linear dataset OMVS.PRV.ZFS.AGGR005.LDS0005 successfully created.
# zfsadm format -aggr OMVS.PRV.ZFS.AGGR005.LDS0005 -version5
IOEZ00077I HFS-compatibility aggregate OMVS.PRV.ZFS.AGGR005.LDS0005 has been successfully created
```

**Converting an existing aggregate to version 1.5**

An existing version 1.4 aggregate can be changed to a version 1.5 aggregate and, optionally, existing directories that are contained in the aggregate can be converted to extended (v5) directories. Use any one of the following methods to change an aggregate to version 1.5.

• Explicitly, for a mounted aggregate that uses the zfsadm convert-aggrversion command, or
• Automatically, on mount when the change_aggrversion_on_mount configuration option is on (set in IOEPRMxx or using the zfsadm config command), or
• Automatically, on mount when the converttov5 configuration option is on (set in IOEPRMxx or using the zfsadm config command), or
• Automatically, on mount when the CONVERTTOV5 MOUNT PARM is specified, or
• Offline, using the IOEFSUTL converttov5 batch utility with the -aggrversion_only option.

**Note:** Beginning in z/OS V2R3, the default value of change_aggrversion_on_mount is ON. The CONVERTTOV5 option and MOUNT PARM will also cause accessed directories to be converted to extended (v5) directories after the aggregate is converted to version 1.5.
An aggregate is not automatically changed if the NOCONVERTTOV5 MOUNT PARM is specified. An aggregate is not explicitly or automatically changed if there are earlier release systems (prior to z/OS V2R1) in the shared file system environment.

Following is an example of the `zfsadm convert` command to change a version 1.4 aggregate to a version 1.5 aggregate without converting any directories to extended (v5) directories:

```
# zfsadm convert -aggrversion OMVS.PRV.ZFS.AGGR005.LDS0005
IOEZ00810I Successfully changed aggregate OMVS.PRV.ZFS.AGGR005.LDS0005 to version 1.5
```

### Converting an existing v4 directory to an extended (v5) directory

Once an aggregate is a version 1.5 aggregate, new directories that are created in it will be extended (v5) directories. Existing directories can be converted to extended (v5) directories:

- Explicitly, one at a time, for a mounted aggregate by using the `zfsadm convert -path` command, or
- Automatically, as they are accessed, for a mounted aggregate when the aggregate has the converttov5 attribute, or
- Offline, converting all directories by using the `ioefsutl converttov5` batch utility.

Existing directories in a version 1.5 aggregate are not automatically converted if the NOCONVERTTOV5 MOUNT PARM is specified. Explicit and offline directory conversion will change the aggregate from version 1.4 to 1.5, if necessary.

Following is an example of the `zfsadm convert` command to convert a v4 directory to an extended (v5) directory:

```
# zfsadm convert -path /home/suimgkp/zfsmnt5
IOEZ00791I Successfully converted directory /home/suimgkp/zfsmnt5 to version 5 format.
```

Converting a directory from version 1.4 to an extended (v5) directory requires both versions of the directory to exist on disk at the same time, temporarily. If the aggregate becomes full during the allocation of the new directory, a dynamic grow is attempted. If there is not enough space to complete the conversion, the new directory is deleted and the conversion operation fails. See “Dynamically growing a compatibility mode aggregate” on page 26 for information about controlling dynamic growth of an aggregate.

When the conversion is completed, the old directory is deleted. The size of the resulting new directory will vary based on the actual directory contents. In some cases, it may require more space than the original directory. In other cases, it might require less space.

If a system outage occurs during a directory conversion, the directory will be made consistent during log recovery processing. That is, either the old directory will exist or the new directory will exist, but both will not exist.

### Guidelines for v4 to v5 conversion

Extended (v5) directories have better performance than v4 directories of the same size. For optimal performance after all systems at your site have been migrated to z/OS V2R1 or later, all of the directories should be converted from v4 to v5 even though support will continue to be provided for v4 directories. To convert selected file systems or directories, you can use automatic methods (such as specifying the MOUNT parameters or by using the offline conversion utility). You can also convert them explicitly with the `zfsadm convert` command.

If your installation exports zFS file systems to NFS or SMB, it is recommended that the `zfsadm convert` command not be used for conversions for directories that are exported by these servers. In rare cases, remote applications can get unexpected errors if a directory being manually converted is simultaneously being accessed by NFS or SMB users. Use one of the other methods for the conversion, such as offline conversion or the CONVERTTOV5 MOUNT parameter, for these file systems. These methods will ensure that each individual directory is completely converted before it can be exported.

If you are not planning to convert all file systems to v5, then it is best to at least do the most active file systems or the file systems with large directories. A directory will get a nontrivial benefit by conversion to
v5 if it has 10000 entries or more (a length of approximately 800 K or more). You can determine the most active file systems by issuing MODIFY ZFS,QUERY,FILESETS or by using the wjfsmon tool. The number of entries in a directory can be determined by issuing the command df -t. The approximate rate of conversion for the directories is between 3500 (for a z9® machine) and 10000 (for a zEC12 machine) directory entries per second, depending on your processor.

After you decide that a file system is going to be converted to v5, you need to decide what conversion method to use. If the file system can be unmounted, the ioefsutl converttov5 batch utility or MOUNT parameters can be used. If it cannot be unmounted and it is not exported by NFS or SMB servers, use the zfsadm convert command. If it is exported by NFS or SMB servers, add the converttov5 attribute to the mounted aggregate. See “Changing zFS attributes on a mounted zFS compatibility mode file system” on page 41 for instructions about how to add the converttov5 attribute to the mounted file system.

**Migrating data to version 1.5 aggregates**

Data can be migrated from HFS file systems into a version 1.5 aggregate in much the same manner as it would be migrated into a version 1.4 aggregate. You can also copy data from a version 1.4 aggregate to a version 1.5 aggregate with the z/OS UNIX shell command pax. For more information, see Chapter 7, “Migrating data from HFS or zFS to zFS,” on page 63.

**Growing a compatibility mode aggregate**

If a compatibility mode aggregate becomes full, the administrator can grow the aggregate (that is, cause an additional allocation to occur and format it to be part of the aggregate). This is accomplished with the zfsadm grow command. There must be space available on the volume to extend the aggregate's VSAM linear data set. The size that is specified on the zfsadm grow command must be larger than the current size of the aggregate.

For example, suppose a two cylinder (primary allocation, 3390) aggregate has a total of 180 8-KB blocks and a (potential) secondary allocation of one cylinder. 180 8-KB blocks is 1440 KB. A zfsadm aggrinfo command for this aggregate might show 1440 KB. When you issue the zfsadm grow command with a larger size, the file system becomes larger because DFSMS is called to allocate the additional DASD space.

```
zfsadm aggrinfo omvs.prv.aggr003.lds0003
OMVS.PRV.AGGR003.LDS0003 (R/W COMP): 1279 K free out of total 1440
```

```
zfsadm grow omvs.orv.aggr003.lds0003 -size 1440
IOEZ00173I Aggregate OMVS.PRV.AGGR003.LDS0003 successfully grown
OMVS.PRV.AGGR003.LDS0003 (R/W COMP): 1279 K free out of total 1440
```

In the next example, notice that the zfsadm grow command indicates success, but the aggregate was not made any larger because the size specified on the command was the same as the existing size.

```
zfsadm grow omvs.prv.aggr003.lds0003 -size 1441
IOEZ00173I Aggregate OMVS.PRV.AGGR003.LDS0003 successfully grown
OMVS.PRV.AGGR003.LDS0003 (R/W COMP): 1279 K free out of total 1440
```

The aggregate now has a total size of 2160 KB. You can specify 0 for the size to get a secondary allocation size extension. The file system free space has also been increased based on the new aggregate size. Aggregates cannot be made smaller without copying the data to a new, smaller aggregate.

**Dynamically growing a compatibility mode aggregate**

An aggregate can be dynamically grown if it becomes full. The aggregate (that is, the VSAM linear data set) must have secondary allocation that is specified when it is defined and space must be available on the volume. The number of extensions that are allowed is based on DFSMS VSAM rules (see z/OS DFSMS
Using Data Sets). The aggregate is extended when an operation cannot complete because the aggregate is full. If the extension is successful, the operation is again transparently driven to the application.

An administrator can restrict aggregates from growing dynamically, either on an individual aggregate basis or globally. To restrict dynamic growing of a specific aggregate, use the NOAGGRGROW parameter on the MOUNT command (see “MOUNT” on page 140). To globally restrict dynamic growing of all aggregates, specify the aggrgrow=off option of the IOEFSPRM configurations option file (see “IOEFSPRM” on page 227).

If all systems in the shared file system environment are running release z/OS V2R3 or later, the aggrgrow attribute of a mounted file system can be dynamically changed by using the zfsadm chaggr command. See “zfsadm chaggr” on page 155 for more details about changing attributes of mounted file systems.

During the extension, a portion of the extension is formatted. Applications that cause new blocks to be allocated or that are reading a file that is being extended will wait. Other applications will not wait. Applications that must wait, will wait for the extension and the (portion) format. Look for HI-A-RBA, the size of the data set in bytes, and HI-U-RBA, how much of it is formatted in bytes. If the aggregate has previously been extended but not fully formatted (that is, the HI-U-RBA (or hi-used-RBA) is less than the HI-A-RBA (or hi-allocated-RBA)), zFS will format another portion of the existing extension to make more space available. You can determine the HI-U-RBA and HI-A-RBA by using the IDCAMS LISTCAT ALL utility against the zFS aggregate and looking for HI-U-RBA and HI-A-RBA in the job output. Dividing HI-A-RBA or HI-U-RBA by 8192 will convert them to the number of 8K blocks.

Each time zFS formats a portion of the extension or each time zFS dynamically grows the aggregate and formats a portion of the extension, zFS issues message IOEZ00312I. Then it issues one of the following messages:

- IOEZ00309I, when successful
- IOEZ00308E, when unsuccessful

When a dynamic extension fails (for example, because of insufficient space), zFS sets an internal indicator to avoid attempting another dynamic extension. This indicator can be reset by a successful explicit grow (for example, by using the zfsadm grow command) or by an unmount and mount of the file system.

Creating a multi-volume compatibility mode aggregate

Before you can create a large zFS aggregate (for example, ten full volumes), you must have the following prerequisites:

- Ten empty volumes.
- A DFSMS DATACLASS that provides extended addressability (because the total size is greater than 4 GB).
- A JOB that defines and formats the aggregate.

Assuming that:

- Each volume is a 3390 with 3338 cylinders, and 3336 of those cylinders are free,
- There are 15 tracks per cylinder,
- And that you can get six 8-KB blocks per track (15 x 6 = 90 8 KB blocks per cylinder),

you should get 90 x 3336 = 300,240 8-KB blocks per volume and 10 x 300,240 = 3,002,400 8-KB blocks in the aggregate. The example in the next paragraph is an example job that defines the VSAM linear data set in the first step and formats it as a zFS aggregate in the second step. The FORMAT step formats the primary allocation (3336 cylinders) and then extends the data set by the -grow amount (300,240 8-KB blocks) ten times (one extend for each full volume) until it reaches the total -size amount (3,002,400 8 KB blocks).
In the following example, 10 full volumes are allocated and formatted by using the -size and the -grow options on the IOEAGFMT step so that the result is a 10-volume (empty) file system. The -grow option is needed in order to allow the specification of a grow increment size that is less than the size of a volume.

```
//USERIDA JOB 'Multi-Volume',
//         CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//AMSDUMP DD SYSOUT=H
//SYSIN DD *
   DEFINE CLUSTER (NAME(OMVS.VOL10.COMPAT.AGGR001) -
                  VOLUMES(PRV000 PRV001 PRV002 PRV003 PRV004 -
                          PRV005 PRV006 PRV007 PRV008 PRV009) -
                  DATACLASS(EXTATTR) -
                  ZFS CYL(3336) SHAREOPTIONS(3))
/*
//FORMAT EXEC PGM=IOEAGFMT,REGION=0M,
// PARM=('aggregate OMVS.VOL10.COMPAT.AGGR001 -compat -size 3002400 -gX
//                    row 300240')
//SYSPRINT DD SYSOUT=H
//STDOUT DD SYSOUT=H
//STDERR DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP DD SYSOUT=H
/*
```

As another example, you could define a VSAM linear data set as before with 10 volumes but with a secondary allocation size of 3336 cylinders, as shown in the following example. Then, you could format only the first volume by leaving out the -size and the -grow and let zFS dynamic secondary allocation allocate and format the additional volumes (up to 9 more) as needed. The IOEPRMxx agggrow configuration option must be on.

```
//USERIDA JOB 'Multi-Volume',
//         CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//AMSDUMP DD SYSOUT=H
//SYSIN DD *
   DEFINE CLUSTER (NAME(OMVS.VOL10.COMAT.AGGR001) -
                  VOLUMES(PRV000 PRV001 PRV002 PRV003 PRV004 -
                          PRV005 PRV006 PRV007 PRV008 PRV009) -
                  DATACLASS(EXTATTR) -
                  ZFS CYL(3336 3336) SHAREOPTIONS(3))
/*
//FORMAT EXEC PGM=IOEAGFMT,REGION=0M,
// PARM=('aggregate OMVS.VOL10.COMAT.AGGR001 -compat')
//SYSPRINT DD SYSOUT=H
//STDOUT DD SYSOUT=H
//STDERR DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP DD SYSOUT=H
/*
```
Adding volumes to a compatibility mode aggregate

To add a candidate volume to a zFS aggregate, use the IDCAMS utility ALTER command with the ADDVOLUMES parameter. Figure 3 on page 29 shows an example job that adds two volumes to the (SMS-managed) OMVS.ZFS.AGGR1 zFS aggregate.

```
//SUIMGVMA JOB (ACCTNO),'SYSPROG',CLASS=A,
//MSGCLASS=H,MSGLEVEL=(1,1),NOTIFY=&SYSUID
//STEP01 EXEC PGM=IDCAMS
//SYSPRINT DD  SYSOUT=*
//SYSIN    DD  *
ALTER OMVS.ZFS.AGGR1.DATA -
   ADDVOLUMES(* *)
/*
```

Figure 3: Example job to add volumes to a zFS aggregate

In this case, DFSMS is choosing the particular candidate volumes. If you want to specify the volumes, use their volume serials in place of the asterisks. See z/OS DFSMS Access Method Services Commands for more information about IDCAMS ALTER ADDVOLUMES. DFSMS states, if an ALTER ADDVOLUMES is done to a data set already opened and allocated, the data set must be closed, unallocated, reallocated, and reopened before VSAM can extend onto the newly added candidate volume.

For zFS, this means that if the zFS aggregate is already attached when the ALTER ADDVOLUMES is done, it must be detached and attached again before zFS can extend to the newly added candidate volume. Compatibility mode aggregates must be unmounted and mounted again (because that is when they are detached and attached). You can use the remount capability of z/OS UNIX. For details, see the topic on Remounting a mounted file system in z/OS UNIX System Services Planning.

Increasing the size of a compatibility mode aggregate

If your zFS file system runs out of space, you have several options to increase its size.

- You can grow the aggregate. For more information, see “Growing a compatibility mode aggregate” on page 26.
- If you cannot grow the aggregate (because, for example, there is no more room on the volume), you can add a volume to the aggregate. For more information, see “Adding volumes to a compatibility mode aggregate” on page 29.
- If you cannot grow the aggregate and you cannot add a volume (because, for example, you do not have any more volumes available), you can copy the aggregate into a larger VSAM linear data set. There are two ways to copy the data:
  - You can copy each file and directory of the zFS aggregate to a larger data set.
  - You can copy the physical blocks of the zFS aggregate to a larger data set.
Copying each file and directory of the aggregate to a larger data set

One method to increase the size of a zFS aggregate is to copy each file and directory of the aggregate to a larger data set. Figure 4 on page 30 shows an example of this approach.

```plaintext
//SUIMGVMB JOB 'EXPAND AGGR WITH PAX',
//CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
/*/ Make sure you have no line numbers in this JCL
//DEFINE EXEC PGM=IDCMS
//SYSPIN DD * SYSSOUT
//SYSDN DD
// DEFINE CLUSTER (NAME(PLEX.NEW.AGGR002.LDS0002) -
// ZFS CYL(100 5) SHAREOPTIONS(3) -
// VOLUMES(CFC000 CFC001))
//*/
//FORMAT EXEC PGM=IOEAGFMT,REGION=0M,
// On the next line, aggregate and compat must be lower case
// PARM=('aggregater PLEX.NEW.AGGR002.LDS0002 -compat')
//SYSPRINT DD SYSSOUT=
//***************************************************************************
//**                                                               **
//**         use a ; at the end of each COMMAND                    **
//**                                                               **
//***************************************************************************
//PAX1     EXEC PGM=IKJEFT01,REGION=0M
//SYSTSRT DD SYSOUT=*
//SYSEXEC DD DSN=SYS1.SBPXEXEC,DISP=SHR
//SYTSIN DD *
//OSHELL /usr/sbin/mount -t ZFS -f PLEX.OLD.AGGR002.LDS0002 /service2
// /usr/sbin/mount -f ZFS -f PLEX.NEW.AGGR002.LDS0002 /service3
// cd /service2
// pax -rwvCMX -p eW . /service3
//***************************************************************************
//AGGRINF1 EXEC PGM=IOEZADM,REGION=0M,
// PARM=('aggrinfo PLEX.OLD.AGGR002.LDS0002 -long')
//SYSPRINT DD SYSSOUT=
//STDOUT DD SYSSOUT=
//STDERR DD SYSSOUT=
//SYSUDUMP DD SYSSOUT=
//CEEDUMP DD SYSSOUT=
//***************************************************************************
//AGGRINF2 EXEC PGM=IOEZADM,REGION=0M,
// PARM=('aggrinfo PLEX.NEW.AGGR002.LDS0002 -long')
//SYSPRINT DD SYSSOUT=
//STDOUT DD SYSSOUT=
//STDERR DD SYSSOUT=
//SYSUDUMP DD SYSSOUT=
//CEEDUMP DD SYSSOUT=
//***************************************************************************
```

Figure 4: Sample job to copy each file and directory of an aggregate to a larger data set

This approach uses the `pax` command to copy the individual files and directories into an already formatted and empty ZFS file system. Both file systems must be mounted. `pax` uses the z/OS UNIX file and directory APIs to read and write each individual file and directory of the hierarchy of the file system. (It does not copy lower mounted file systems because of the `-X` and `-M` options.) You can use the `ISHELL` command or the `automount` command with the `allocany` or `allocuser` keyword to create the new larger aggregate to copy into with `pax`, because they format the aggregate.

If you are running this job on a system that is running z/OS V1R13 or later, and the file system was written to using a prior release of z/OS, ZFS might use more DASD space for the same data than it did on the prior release. The increase in DASD space can occur for small files (1 KB in size or less) because beginning with z/OS VR13 ZFS does not store data in 1-KB fragments; instead, it stores data in 8-KB blocks. For example, if the file system contained 1000 files that are 1 KB in size, ZFS on z/OS V1R13 or later could use a
maximum of 10 cylinders more than on previous releases. You can determine how many files are in the file system that are 1 KB or less by using the following z/OS UNIX command:

```
find mountpoint -size -3 -type f -xdev | wc -l
```

After you successfully copy the data, when you are comfortable with the new, larger aggregate, you can delete the old aggregate.

**Copying the physical blocks of the aggregate to a larger data set**

Another method to increase the size of a zFS aggregate is to copy the physical blocks of the aggregate to a larger data set using the DFSMS REPRO command. This approach is normally faster than using the `pax` command. However, do not format the target zFS data set before using the REPRO command. Figure 5 on page 31 shows an example of this approach.

```
//SUGMVMB JOB , 'EXPAND AGGR WITH REPRO',
//         CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSPUT=H
//SYSin DD *
// DEFINE CLUSTER (NAME(PLEX.NEW.AGGR002.LDS0002) -
// ZFS CYL(100 5) SHAREOPTIONS(3) -
// VOLUMES(CFC000 CFC001))
/*
//LCAT1 EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//* This step should show a HI-U-RBA of 0
//* for PLEX.NEW.AGGR002.LDS002
//SYSin DD *
//LISTCAT ENTRIES(PLEX.OLD.AGGR002.LDS0002) -
//ALL
//LISTCAT ENTRIES(PLEX.NEW.AGGR002.LDS0002) -
//ALL
/*
//REPRO1 EXEC PGM=IDCAMS
//SYSPRINT DD SYSPUT=H
//* The next line guarantees that the file system is not mounted
//IN1 DD DSN=PLEX.OLD.AGGR002.LDS0002,DISP=OLD
//SYSin DD *
//REPRO -
//INFILE(IN1) -
//OUTDATASET(PLEX.NEW.AGRGR002.LDS0002)
/*
//LCAT2 EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//* This step should show the HI-U-RBA of
//* PLEX.NEW.AGGR002.LDS0002 equal to the HI-U-RBA
//* of PLEX.OLD.AGGR002.LDS0002
//SYSin DD *
//LISTCAT ENTRIES(PLEX.OLD.AGGR002.LDS0002) -
//ALL
//LISTCAT ENTRIES(PLEX.NEW.AGRGR002.LDS0002) -
//ALL
/*
```

*Figure 5: Sample job to copy the physical blocks of an aggregate to a larger data set*

Figure 6 on page 32 shows a zFS file system (PLEX.OLD.AGGR002.LDS0002) that is full and a newly-defined zFS data set (PLEX.NEW.AGRGR002.LDS0002 before the REPRO) that is larger. PLEX.NEW.AGGR002.LDS0002 has a larger HI-A-RBA than PLEX.OLD.AGGR002.LDS0002. When the blocks from PLEX.OLD.AGGR002.LDS0002 are copied into PLEX.NEW.AGRGR002.LDS0002 using REPRO, the result is PLEX.NEW.AGGR002.LDS0002 after REPRO. There is now room to add data to PLEX.NEW.AGGR002.LDS0002.
HI-U-RBA – The high-used relative byte address indicates how many bytes were written by zFS.

HI-A-RBA – The high-allocated relative byte address indicates how many bytes could be written by zFS into the current allocation.

**Figure 6: Copying blocks from a full zFS data set into a larger data set**

With this approach, the new VSAM linear data set must not be formatted as an empty zFS file system before the REPRO command is used. (If the new data set was formatted, the REPRO would copy blocks to the end of the primary allocation, not the beginning. The data blocks being copied contain all the file system data and the file system information, so formatting is not necessary.) Neither file system needs to be mounted. REPRO uses native VSAM calls to read and write the blocks.

Follow these guidelines:

- When you issue the REPRO command, do not use the z/OS UNIX `ishell` command or the z/OS UNIX `automount` command with the allocany or allocuser keyword, because those commands will automatically format the aggregate.
- Do not use this approach to copy an HFS file system to a zFS file system because you will be copying the physical blocks of the file system (not the individual files) and the internal format of HFS file systems is different than the internal format of zFS file systems.

Notice that the ZFS attribute is not set in the LISTCAT output for the target data set (PLEX.NEW.AGGR002.LDS0002). It is set the first time the zFS file system is mounted read-write.

Now the new aggregate can grow into the available space in the allocated portion of the data set or even extend to additional extents if there is space on the volume.

After you successfully copy the data, when you are comfortable with the new, larger aggregate, you can delete the old aggregate.

**Encrypting and compressing zFS file system data**

New zFS file system data can be encrypted and compressed. The file system can be defined and formatted so that any data added to them is automatically encrypted, compressed, or both. After a file system is encrypted or compressed, additional new entries will also be encrypted or compressed. Use `format_encryption=on` or `format_compression=on` in your IOEFSPRM configuration file if you want data in all new zFS file systems to be automatically encrypted, compressed, or both. The default for both is off.
Existing zFS file system data can be encrypted and compressed. Encrypting or compressing an existing file system is a long-running administrative command. Operator messages are issued during the operation, and the progress of the operation can be monitored with FSINFO. During this process, background tasks on the zFS owning system will process every object in the file system. Application access is fully allowed to the file system during the operation.

The encryption process

The encryption process uses the VSAM encryption support that is provided by DFSMS. When zFS encrypts a file system, it encrypts all security information, access control lists, symbolic link contents, and file contents. For more detailed information about encrypting data sets, review the following documentation:

- Data Set Encryption in z/OS DFSMS Using Data Sets.
- Storage administration (STGADMIN) profiles in the FACILITY class in z/OS DFSMSdfp Storage Administration. It contains information about the STGADMIN.SMS.ALLOW.DATASET.ENCRYPT profile.

Restrictions:

1. Do not enable encryption for any file system until you migrate all of your systems to z/OS V2R3. Because encryption is not supported before z/OS V2R3, all systems in a sysplex must be at least z/OS V2R3 before encryption can begin. Also, do not begin the encryption process until you know that no system will be regressed to an earlier release.

   Decryption is supported. However, the decryption process does not remove key labels. File systems that have had key labels assigned cannot be mounted on a release prior to V2R3, even if those file systems have not been encrypted or are currently not encrypted. Therefore, if there is no zFS system in the shared file system environment that is eligible to own a file system with a key label assigned to it, the file system will be inaccessible.

2. Version 1.4 aggregates cannot be encrypted.

3. Key labels cannot be changed or removed after you assign them.

4. You cannot encrypt or decrypt an aggregate that is in a partially compressed or partially decompressed state. In other words, if compression or decompression was stopped for an aggregate, you cannot encrypt or decrypt it until after the compression or decompression is completed.

5. New file systems should be defined with the DFSMS extended format option.

Because encryption affects performance of file I/O paths, user file cache performance is important. Even though the default cache size is often sufficient, ensure that the zFS user cache is large enough. Also, consider pairing encryption with compression. If the compression is done first, the amount of data to be encrypted is smaller, which might slightly improve performance.

For any ICSF considerations when you enable encryption, see Starting and stopping ICSF in z/OS Cryptographic Services ICSF System Programmer’s Guide.

Creating a new file system that is always encrypted on DASD

You can create a new file system that is always encrypted on DASD by either defining a VSAM data set that has a key label. You can also format an encryption-eligible VSAM linear data set and create a zFS file system that is always encrypted on disk.

Defining a VSAM linear data set that has a key label

You can define a new VSAM data set that is always eligible for encryption by assigning the data set a key label.

Extended format VSAM data sets record the encryption status for each control interval in the dataset, providing improved integrity checking. Therefore, it is recommended that new zFS data sets be defined with the extended format option.

These requirements must be met when you assign a key label to a data set:
1. Integrated Cryptographic Service Facility (ICSF) must be active.
2. The key label should exist in ICSF.

To create a VSAM linear data set with a key label, use one of the following commands:

- The `zfsadm define` command with the `-keylabel` keyword.
- The IDCAMS command DEFINE CLUSTER command with the ZFS and KEYLABEL keywords.

In these two commands, the specification of a key label can be replaced with the specification of a data class that has a key label.

If you are using the IDCAMS command DEFINE CLUSTER to create an aggregate that is to be encrypted, using the ZFS keyword instead of LINEAR is strongly recommended. The encryption support provided by DFSMS is normally only allowed for SMS-managed extended format data sets. ZFS aggregates are exempt from this restriction. Use of the ZFS keyword instead of LINEAR will allow key labels to be assigned to any VSAM linear data set that is supported by ZFS.

For more information about the DEFINE CLUSTER command, see DEFINE CLUSTER in z/OS DFSMS Access Method Services Commands.

### Formatting an encryption-eligible VSAM linear data set and creating a zFS file system that is always encrypted on disk

You can format a VSAM linear data set that has a key label to create a zFS file system whose contents are always encrypted on disk by using one of the following methods:

- Explicitly use the `-encrypt` keyword if you are using formatting methods `ioeagfmt`, `ioefsutl format`, or the `zfsadm format` command.
- Use a global default with IOEFSPRM configuration option `format_encryption=on`.

To format an unencrypted file system that does not have a key label, you can override the IOEFSPRM configuration option `format_encryption=on` by specifying the `-noencrypt` keyword.

To format a VSAM linear data set with a key label to create a zFS file system whose contents are not to be encrypted on disk, you can override the IOEFSPRM configuration option `format_encryption=on` by specifying the `-noencrypt` keyword.

If you format a VSAM linear data set that has a key label and do not use the `-encrypt` keyword or the `format_encryption=on` configuration option, the contents of the resulting zFS file system will not be encrypted on disk until you use the `zfsadm encrypt` command. Even though a zFS file system with a key label might not be encrypted on disk, ICSF still needs to be active before zFS can mount it.

The following example is JCL for defining and formatting an aggregate with a key label.

```jcl
//ZDEFFMT JOB , 'DEFINE AND FORMAT with ENCRYPTION',
  //    MSGCLASS=H,
  //    CLASS=A,
  //    TIME=(1440), MSGLEVEL=(1,1)
  /*---------------------------------------------------
  /*  DEFINE FORMAT ENCRYPT
  /*---------------------------------------------------
  /*
  /*DEFINE EXEC PGM=IDCAMS
  //SYSPRINT DD SYSOUT=H
  //SYSTHDR DD SYSOUT=H
  //AMSDUMP DD SYSOUT=H
  //DASD0 DD DISP=OLD,UNIT=3390, VOL=SER=SMBRS3
  //SYSIN DD *
  DEFINE CLUSTER (NAME(SUIMGNS.HIGHRISK.TEST) -
  ZFS CYL(2 0) SHAREOPTIONS(3) -
  KEYLABEL(PROTKEY.AES.SECURE.KEY.32BYTE))
  /*
  /*CREATE EXEC PGM=IOEFSUTL, REGION=0M,
  //PARM=('format -aggregate SUIMGNS.ENCRYPT.TEST -encrypt')
  //SYSPRINT DD SYSOUT=H
  //STDOUT DD SYSOUT=H
```
The following example uses `zfsadm define` to define a zFS aggregate with a key label.

```
zfsadm define -aggregate PLEX.DCEIMGNJ.ENC -keylabel PROTKEY.AES.SECURE.KEY.32BYTE -cyl 500 100
IOEZ00248I VSAM linear dataset PLEX.DCEIMGNJ.ENC successfully created.
```

The following example uses `zfsadm format` to format a zFS aggregate with encryption.

```
zfsadm format -aggregate PLEX.DCEIMGNJ.ENC -encrypt
IOEZ00077I HFS-compatibility aggregate PLEX.DCEIMGNJ.ENC successfully created.
```

### Encrypting existing file system data

Existing zFS file systems can be encrypted. The zFS aggregate that contains these file systems does not need to be SMS-managed extended format.

Before file system data can be encrypted, these requirements must be met:

1. Integrated Cryptographic Service Facility (ICSF) must be active.
2. The file system that contains the data to be encrypted must be mounted in read/write mode.

**Important:** Before an existing file system has a key label assigned to it, or is encrypted for the first time, do a full backup of the file system.

If you must back out to a release that is prior to V2R3, any file systems that are encrypted or have key labels assigned to them cannot be owned on a system running the prior release. You may also need to back out the file system by taking one of the following actions:

- Restore a version of the file system that was backed up prior to encrypting it or assigning a key label to it.
- Create a new file system that does not have a key label assigned to it and follow the migration procedures in Chapter 7, “Migrating data from HFS or zFS to zFS,” on page 63.

If you cancel an encryption that is in progress, the file system remains partially encrypted. However, leaving file systems partially encrypted might have performance impacts. You can resume the encryption later with another `zfsadm encrypt` command.

Use the `zfsadm encrypt` command to encrypt the existing file system. You can use the `-cancel` option to cancel the encryption of the existing file system or reverse it with the `zfsadm decrypt` command. If the file system does not have a key label, you can specify it when you are encrypting it with the `zfsadm encrypt` command by specifying the `-keylabel` keyword.

The following example uses `zfsadm encrypt` to encrypt the data in an existing zFS aggregate.

```
zfsadm encrypt -aggregate PLEX.DCEIMGNJ.BIGENC -keylabel PROTKEY.AES.SECURE.KEY.32BYTE
IOEZ00877I Aggregate PLEX.DCEIMGNJ.BIGENC is successfully encrypted.
```

The following example uses the `-cancel` option of `zfsadm encrypt` to cancel the encryption of a zFS aggregate.

```
zfsadm encrypt -aggregate PLEX.DCEIMGNJ.BIGENC -cancel
IOEZ00892I Aggregate PLEX.DCEIMGNJ.BIGENC encrypt or decrypt successfully canceled.
```
Then use `zfsadm fsinfo` to display the encryption status:

```
  zfsadm fsinfo -aggregate PLEX.DCEIMGNJ.BIGENC
  File System Name: PLEX.DCEIMGNJ.BIGENC
  *** owner information ***
  Status: RW,RS,EI,NC
  ...  
  Encrypt Progress: stopped, 23%
  ...
  Legend: RW=Read-write, RS=Mounted RWSHARE, EI=Partially encrypted 
          NC=Not compressed
```

**Monitoring and displaying the encryption status**

Use the `zfsadm fsinfo` command to monitor the encryption status. To display the encryption status, use either `zfsadm fileinfo` or `zfsadm fsinfo`.

The following example uses `zfsadm fsinfo` to monitor the encryption status:

```
  zfsadm fsinfo -aggregate  PLEX.DCEIMGNJ.BIGENC
  File System Name: PLEX.DCEIMGNJ.BIGENC
  *** owner information ***
  Status:              RW,RS,EI,NC
  ...  
  Encrypt Progress: running, 23% complete started at Nov 21 14:54:40 2016 task 57F5E0
  ...
  Legend: RW=Read-write, RS=Mounted RWSHARE, EI=Partially Encrypted 
          NC=Not compressed
```

The following example uses `zfsadm fileinfo` to display the encryption status.

```
  zfsadm fileinfo /tst/file
  path: /tst/file
  *** global data ***
  ...
  ctime     Nov 2 11:18:35 2015     create time Nov 2 11:18:35 2015 
  reftime   none
  encrypted not compressed
```

The following example uses `zfsadm fsinfo` with the `-basic` option to display the encryption status.

```
  zfsadm fsinfo -aggregate  PLEX.DCEIMGNJ.ENC2 -basic
  PLEX.DCEIMGNJ.ENC2                           DCEIMGNJ RW,RS,EN,NC
  Legend: RW=Read-write, RS=Mounted RWSHARE, EN=Encrypted, NC=Not compressed
```

**The compression process**

The compression process uses zEDC Express. The average amount of disk space that is saved per file averages approximately 65%, depending on the type of data that is being compressed.

If you cancel a compression that is in progress, the zFS file system will remain partially compressed. In a partially compressed file system, new files may or may not be compressed. You can resume the compression later with another `zfsadm compress` command.

The compression process is not mandatory. If the compression of a file does not reduce space, the file is left in its uncompressed format.

**Restrictions:**

1. Do not enable compression for any file system until you migrate all of your systems to z/OS V2R3. All systems in a sysplex must be at least z/OS V2R3 before any file systems are compressed because compression is not supported prior to z/OS V2R3. Also, do not use compression until you know that no system will be regressed to a prior release. Compressed file systems cannot be mounted on a release...
prior to V2R3. Therefore, if there is no zFS system in the shared file system environment that is eligible to own a compressed file system, the file system will be inaccessible.

Decompression is supported if there are pre-V2R3 systems in the sysplex in order to allow the compression to be backed out.

2. Only files larger than 8 K can be compressed. Directories and other control information inside the zFS file system are not compressed.

3. You cannot compress or decompress an aggregate that is in a partially encrypted or partially decrypted state. In other words, if an encryption or decryption process was stopped for an aggregate, you cannot compress or decompress that aggregate until after the encryption or decryption is completed.

**Defining a new file system that is always compressed**

The IOEFSPRM configuration option format_compression=on indicates a global default that is used by all formatting methods when determining the default compression behavior while formatting a new file system. This global compression default can be overridden by specifying the -nocompress keyword.

If IOEFSPRM configuration option format_compression=off is specified, all formatting methods can explicitly specify the -compress keyword to format the file system with compression.

The following example is JCL for defining and compressing a new aggregate.

```jcl
//ZDEFFMT JOB , 'DEF FORMAT COMPRESS', //    MSGCLASS=H, //    CLASS=A, //    TIME=(1440), MSGLEVEL=(1,1) //* DEFINE FORMAT COMPRESS //* DEFINE EXEC PGM=IDCAMS //SYSPRINT DD SYSOUT=H //SYSDUMP DD SYSOUT=H //AMSDUMP DD SYSOUT=H //DASD0 DD DISP=OLD,UNIT=3390,VOL=SER=SMBRS3 //SYSIN DD * DEFINE CLUSTER (NAME(SUIMGNS.HIGHRISK.TEST) - ZFS CYL(2 0) SHAREOPTIONS(3)) /*CREATE EXEC PGM=IOEFSUTL,REGION=0M, // PARM=('format -aggregate SUIMGNS.COMPRESS.TEST -compress') //SYSPRINT DD SYSOUT=H //STDOUT DD SYSOUT=H //STDERR DD SYSOUT=H //SYSDUMP DD SYSOUT=H //CEEDUMP DD SYSOUT=H
```

The following example uses the `zfsadm format` command with the -compress option to compress the new file system.

```
zfsadm format -aggregate PLEX.DCEIMGNJ.ENC -compress
```

IOEZ00077I HFS-compatibility aggregate PLEX.DCEIMGNJ.ENC was successfully created.

**Compressing existing file system data**

Use the `zfsadm compress` command to compress existing file system data. You can cancel compression with the -cancel option and reverse compression with the `zfsadm decompress` command.

Before file system data can be compressed, these requirements must be met:

- The file system that contains the data to be compressed must be mounted in read/write mode.
- To avoid performance issues when the file system data is compressed, ensure that the system has sufficient zEDC capacity. For more information about performance analysis, see `z/OS RMF User’s Guide`.

**Important:** IBM highly recommends backing up file systems before you begin the compression process.

**Tips to improve performance:**
1. If you are compressing data in a zFS aggregate, fixing the user file cache with the edcfixed option often results in CPU savings, especially if enough real memory is available to support fixing the user file cache and compression is used with zFS. If you are not compressing data in a zFS aggregate, then the edcfixed option of the user file cache might slightly reduce the CPU.

2. The zEDC user cache limit that can be fixed with the edcfixed option is 14 G but might be less, depending on real memory. To determine how much of the user file cache is fixed, use F ZFS,QUERY,VM or zfsadm query -usercache.

3. For optimum performance, use the health check ZFS_VERIFY_COMPRESSION_HEALTH to determine whether compression is being used and all user cache pages are registered with zEDC Express.

The following example uses the zfsadm compress command to compress the data in an existing aggregate.

```
zfsadm compress -aggregate PLEX.DCEIMGNJ.BIGENC
IOEZ00899I Aggregate PLEX.DCEIMGNJ.BIGENC is successfully compressed.
```

The following example shows a file that was compressed.

```
# zfsadm fileinfo -path testmtpt/file4
path: /home/suimgju/C01500/testmtpt/file4
*** global data ***
    fid                      5,1           anode                  291,1524
    length                  24960         format                 BLOCKED
    1K blocks               8             permissions            755
    uid,gid                 0,10          access acl             0,0
    dir model acl          na            file model acl         na
    user audit             F,F,F         auditor audit          N,N,N
    set sticky,uid,gid     0,0,0         seclabel               none
    object type            FILE          object linkcount       1
    object genvalue        0             dir version            na
    dir name count         na            dir data version       na
    dir tree status        na            dir conversion          na
    file format bits       0x0,0,0       file charset id        0x0
    file cver              none          charspec major,minor   na
    direct blocks          0x00000007    0x80000401    0x80000000    0x80000000
    indirect blocks        none
    reftime     none
    not encrypted                        compressed 24K saved
```

The following example uses the zfsadm compress command with the -cancel option to cancel a compression request.

```
zfsadm compress -aggregate PLEX.DCEIMGNJ.BIGENC -cancel
IOEZ00903I Aggregate PLEX.DCEIMGNJ.BIGENC compress or decompress successfully canceled.
```

Then use zfsadm fsinfo to display the status:

**Monitoring and displaying the compression status**

Use the zfsadm fsinfo command to monitor the compression status. To display the compression status, use either zfsadm fileinfo or zfsadm fsinfo.

The following example uses zfsadm fsinfo to monitor the compression status.

```
zfsadm fsinfo -aggregate  PLEX.DCEIMGNJ.BIGENC
File System Name: PLEX.DCEIMGNJ.BIGENC
*** owner information ***
          Status:          RW,RS,NE,CI
          Compress Progress: running, 48% started at Nov 21 16:34:40 2016 task 57F5E0
          ...
```
The following example uses `zfsadm fsinfo` with the `-basic` option to display the compression status.

```
zfsadm fsinfo -aggregate PLEX.DCEIMGNJ.BIGENC -basic
PLEX.DCEIMGNJ.BIGENC: DCEIMGNJ RW,RS,EI,CO
```

The following example uses `zfsadm query` with the `-compress` option to monitor the compression effectiveness and performance of zEDC services.

```
zfsadm query -compress
Compression calls: 246428 Avg. call time: 0.177
KB input 13190960 KB output 1971456
Decompression calls: 509140 Avg. call time: 0.154
KB input 4073128 KB output 21406072
```

The `zfsadm fileinfo` command shows an exact count of kilobytes saved for a file that is compressed. The following example uses `zfsadm fileinfo` to display the compression status.

```
zfsadm fileinfo /tst/myfile
path: /tst/myfile
*** global data ***
...mtime Nov 2 11:21:01 2015 atime Nov 2 11:21:01 2015
ctime Nov 2 11:21:01 2015 create time Nov 2 11:21:01 2015
reftime none
not encrypted
compressed 4762K saved
```

**Decreasing the size of a compatibility mode aggregate**

If a compatibility mode aggregate becomes too large, the administrator, or user that mounted the aggregate, can shrink the aggregate by using the `zfsadm shrink` command. Shrinking an aggregate releases a specified amount of free space from the VSAM linear data set.

For example, you have an aggregate that is 2000000 K in size. The size can be determined by using the `zfsadm fsinfo` command. This command also indicates the number of free 8 K blocks; in this example, it indicates 11000 free 8 K blocks, for a total of 88000 K. That number indicates that the new size of the aggregate must be in the range of approximately 1912008 K to 1999990 K. After the shrink operation is completed, the aggregate VSAM linear data set is smaller and the amount of free space in the aggregate is reduced by the difference between the old aggregate size and the new one.

The display:

```
zfsadm fsinfo -aggr omvs.prv.aggr003.lds0003
Part of the owner information could display:
Size: 2000000K Free 8K Blocks: 11000
zfsadm shrink -aggr omvs.prv.aggr003.lds0003 -size 1950000K
IOEZ00873I Aggregate OMVS.PRV.AGGR003.LDS0003 successfully shrunk.
zfsadm fsinfo -aggr omvs.prv.aggr003.lds0003
Part of the owner information could now show:
Size: 1950000K Free 8K Blocks: 4750
```

When a shrink operation is requested for an aggregate, an IOEZ00881I action message is displayed on the console. This message is removed when the shrink operation is completed or if the shrink operation is
interrupted by a shutdown, unmount with the force option, or a zfsadm shrink command with the -cancel option specified.

The actual process of shrinking an aggregate can be lengthy because zFS must scan every object in the file system to see whether it owns blocks in the portion of the aggregate to be released. If blocks are found, they are moved to the remaining portion. zFS then changes the size of the aggregate to the specified new size. After the size is changed, the DFSMSHsm PARTREL service is called to release the space. Even if the process of releasing the space fails, ZFS continues to operate with the new aggregate size.

Applications can continue to access the file system during the shrink operation, which can cause delays if the application needs to access blocks that are being moved by the shrink operation. To avoid these delays, it is recommended to shrink aggregates during periods of low file system activity, if possible.

Applications that are accessing the file system may also cause additional blocks to be allocated if data is added to files, or if files or directories are added to the file system. These new blocks that are allocated during a shrink operation are allocated in the portion aggregate that is to remain after the free space is released. If the aggregate runs out of free blocks in the portion of the aggregate that is to remain after the space is released, ZFS will automatically increase the new size that was specified on the zfsadm shrink command so that more free blocks will be made available. This process is called active increase. If active increase causes the new size to go back to the original size, the shrink operation will be considered to have failed. If active increase is not to be used during a shrink operation, the -noai keyword should be specified on the zfsadm shrink command.

The size of the aggregate can be increased again with the zfsadm grow command. The aggregate can also be dynamically grown if it becomes full, as explained in “Dynamically growing a compatibility mode aggregate” on page 26. Any space that is still allocated to the data set is used first before another attempt is made to allocate more space.

If you attempt to unmount a shrinking compatibility mode aggregate, the attempt fails unless you specify unmount force.

For more information about shrinking aggregates, see “zfsadm shrink” on page 222.

**Renaming or deleting a compatibility mode aggregate**

To rename a compatibility mode aggregate, use the IDCAMS ALTER command with the NEWNAME parameter. You cannot rename an aggregate if it is mounted.

After the rename is done, the name of the file system stored in the zFS aggregate will not match the aggregate name. This is a requirement for compatibility mode zFS aggregates. To reconcile the file system and aggregate name, the zFS file system must be mounted initially as read/write after the IDCAMS RENAME is complete. This allows ZFS to reconcile the file system name with the new aggregate name. After the name is reconciled, the aggregate can then be mounted read-only.

The example in Figure 7 on page 41 assumes that:

- The data component name is the same as the cluster name with DATA appended
- You want to rename both the cluster name and the data component name.
To delete a compatibility mode aggregate, use the IDCAMS utility DELETE command. You cannot delete an aggregate if it is mounted. Figure 8 on page 41 shows a sample job that deletes both the cluster name and the data component.

```
//SUIMGVMD JOB (ACCTNO),'SYSPROG',CLASS=A,
// MSGCLASS=H,MSGLEVEL=(1,1),NOTIFY=&SYSUID
//STEP01 EXEC PGM=IDCAMS
//SYSPRINT DD  SYSOUT=* 
//SYSIN    DD  *
      DELETE PLEX.JMS.AGGR006.LDS0006
     /*
Figure 8: Example job to delete a compatibility mode aggregate
```

See z/OS DFSMS Access Method Services Commands for information and restrictions on IDCAMS ALTER NEWNAME and DELETE.

### Changing zFS attributes on a mounted zFS compatibility mode file system

zFS attributes are assigned to a zFS compatibility mode file system when it is mounted. The attributes can be set by specifying a zFS MOUNT PARM or they can be set from the zFS default values of the system where the primary mount occurs. These attributes, which are generally only meaningful for read/write mounted file systems, include the following:

- AGGRFULL
- AGGRGROW
- CONVERTTOV5
- FSFULL
- RWSHARE
- NORWSHARE

These attributes typically remain with that file system until it is explicitly unmounted. When all systems are at z/OS V2R3, some of these attributes can be changed dynamically with the `zfsadm chaggr` command. Otherwise, they can only be changed when the file system is unmounted and remounted, as indicated in the rest of this section. For more information about `zfsadm chaggr`, see “zfsadm chaggr” on page 155.

If the file system's attributes were assigned from a zFS default set on the system, they can be changed in the following situations:

- The file system is NORWSHARE and z/OS UNIX ownership moves to another system with a different zFS default.
- The file system is remounted samemode and the z/OS UNIX owning system has a different default.
• The file system is remounted from read-only to read/write and the z/OS UNIX owning system has a different default.
• The file system is NOAUTOMOVE and the system is coming up with a different default.

The RWSHARE and NORWSHARE attributes of a compatibility mode file system may also be changed if they were assigned from a zFS default of the system on which they were mounted.

For example, there are several cases when the RWSHARE attribute of a file system may be changed to NORWSHARE:
• The file system is remounted from read-only to read/write and the z/OS UNIX owning system has a NORWSHARE default.
• The file system is NOAUTOMOVE and the system is coming up with a NORWSHARE default.

Similarly, if the NORWSHARE attribute was assigned from a zFS default, it may be changed to RWSHARE under the following situations:
• The file system has z/OS UNIX ownership moved to another system that has specified RWSHARE as the default.
• The file system is remounted from read-only to read/write and the z/OS UNIX owning system has an RWSHARE default.
• The file system is NOAUTOMOVE and the system is coming up with an RWSHARE default.

You can query the current default value of a zFS attribute by issuing the zfsadm configquery command. For example, to query the default value of the following attributes, you can issue the following commands:

```bash
zfsadm configquery -aggrfull
zfsadm configquery -convertto5
zfsadm configquery -fsfull
zfsadm configquery -aggrgrow
zfsadm configquery -sysplex_filesys_sharemode
```

You can change a zFS attribute on a mounted file system. To do so, take an appropriate action, as previously described for the attribute that you want to change. For example, to change the NORWSHARE attribute of a compatibility mode file system to RWSHARE, you can move the z/OS UNIX ownership of that file system to a different system that specifies RWSHARE as the zFS default.

Also, as the following examples show, you can change the zFS default values by issuing the zfsadm config command:

```bash
zfsadm config -aggrfull 95,5
zfsadm config -convertto5 on
zfsadm config -fsfull 90,10
zfsadm config -aggrgrow on
zfsadm config -sysplex_filesys_sharemode rwshare
```

**Tip:** Generally, to avoid getting unexpected attribute changes, it is best to have the zFS default values be the same on all members of the sysplex. However, if you want to change an attribute of a mounted file system, you can temporarily change a zFS default and then cause one of the situations that were previously described. For example, move the z/OS UNIX ownership of the file system to a different system where the zFS default has been temporarily changed, then change the default back to the original value. You can only change a zFS attribute of a mounted file system if you did not specify the attribute in a MOUNT PARM.

### Unmounting zFS file systems before copying or moving

When a user mounts (attaches) an aggregate to a particular system, zFS records the name of the system, the sysplex name (when it is a sysplex), and a time stamp in the zFS aggregate (in block zero of the aggregate). In addition, while the aggregate is mounted, zFS updates the time stamp every 30 seconds. If another system (that is not in the same sysplex) sharing the DASD attempts to mount the same aggregate,
zFS on that system recognizes that the system name in the aggregate is not blank and does not match this system. In this case, zFS waits 65 seconds to see if the time stamp is updated (by the original system). If the time stamp is updated in that 65-second period, zFS refuses to mount the aggregate and returns ENXIO (X’8A’) with reason code EF096058. As a result, zFS prevents a system from writing to a zFS aggregate that is mounted read/write on another system. If the time stamp is not updated, the mount succeeds after waiting for 65 seconds. A similar situation might occur when a copy was made of a zFS aggregate, or an entire DASD volume, while the zFS aggregates were mounted. In this case, when a mount is attempted of these copies, a 65-second block zero wait might be seen for each mount. This will be accompanied by an IOEZ00807I message that is issued by zFS.

When a zFS aggregate is unmounted (detached), the system name and the time stamp are cleared. In this case, the next mount does not wait because zFS knows that the aggregate is not currently mounted. If the aggregate is being mounted on a different member in the same sysplex after a failure, zFS does not wait because it recognizes that this is a different system that is in the same sysplex.

As a result, you can cause zFS to wait during mount unnecessarily and you can experience z/OS UNIX latch contention if you fail to unmount (detach) a zFS aggregate before copying it or moving it to another system.

Understanding zFS disk space allocation

Unlike releases prior to z/OS V1R13, data is not stored in 1 K fragments. Instead, the data is stored in 8 K blocks. Releases z/OS V1R13 and later can read data that is stored in fragments; however, when the data is updated, it is moved into 8 K blocks. Note that because previous releases of zFS can read an 8 K block that is not full, no toleration support is required on those systems. Also, in previous releases, when zFS stored data in fragments, data from multiple files typically resided in separate 8 K blocks.

However, there are certain cases when z/OS V1R13 and later will require more DASD space than zFS in previous releases. For example, if every file in the file system were 1 K or less, zFS on z/OS V1R13 or later releases could require up to twice as much DASD storage as previous releases. As a second example, because HFS uses 4 K blocks to store data and zFS uses 8 K blocks, if every file in the file system were 4K or less, zFS R13 could require up to twice as much DASD space to store these files. As another example, if the file system contained 1000 files that are 1 K in size, zFS in z/OS V1R13 and later releases could take a maximum of 10 cylinders more than zFS in previous releases. Typically, however, any increase in the DASD storage used by zFS V1R13 and later releases will be negligible. For example, the R13 version root file system that is copied using zFS R13 takes approximately 2% more space than the same file system copied using zFS R11. Note that zFS releases z/OS V1R13 and later packs multiple ACLs and symbolic links into an 8 K block, which previous releases did not do.

Another result of moving fragments into 8-KB blocks is that the following situation can occur:

- A zFS file system is full, and
- It is zFS-owned on a V1R13 or later system, and
- It has no secondary allocation specified, or cannot extend because there is no space on the volume, and
- You try to remove some files in order to free up some space, but the remove fails due to return code ENOSPC (133)

This failure can occur because you are trying to remove an entry from a directory that was created before z/OS V1R13 and is smaller than 7 KB, so it is stored in fragments. But the file system is zFS-owned on a z/OS V1R13 or later system and needs a free 8-KB block to do the remove. To resolve this problem, you must explicitly grow the file system in order to make free 8-KB blocks available. You can do this even if the zFS file system data set does not have a secondary allocation size specified. Free space on the volume is required. For example:

```
# rm /service6/testdir2/filea
rm: FSUM9195 cannot unlink entry "/service6/testdir2/filea":
EDC5133I No space left on device.
# zfsadm aggrinfo PLEX.JMS.AGGR006.LDS0006
PLEX.JMS.AGGR006.LDS0006 (R/W COMP): 21 K free out of total 7200
# zfsadm grow PLEX.JMS.AGGR006.LDS0006 7920
IOEZ00173I Aggregate PLEX.JMS.AGGR006.LDS0006 successfully grown
```
If you need to add a volume, you can add one using the IDCAMS ALTER command with the ADDVOLUMES option. For more information, see “Adding volumes to a compatibility mode aggregate” on page 29.

A zFS aggregate is an array of 8-KB blocks. Three special objects are present in all zFS aggregates. These objects take up space in an aggregate, which means that space cannot be used for user files:

**Log file**
Records metadata changes. By default, its size is 1% of the disk size. However, it will never be smaller than 14 blocks and it will never be larger than 16,384 blocks (128 MB).

**Bitmap**
Lists the blocks that are free on disk. The file size depends on the size of the aggregate.

**Aggregate File System List**
Describes the file systems that are contained in the aggregate. For compatibility mode aggregates it is usually only one 8-KB block.

The `zfsadm aggrinfo` command shows aggregate disk space usage. This is based on the number of 8-KB blocks. It subtracts the space that is reserved for the previous three objects in its calculations (and tells you this in the output). The `zfsadm aggrinfo` command shows output in units of 1-KB blocks. If you use the -long option of the `zfsadm aggrinfo` command, it shows the number of free 8-K blocks, the number of free 1 K fragments and the size (in K) taken up by the log file, the file system table, and the bitmap.

The zFS threshold monitoring function aggrfull reports space usage based on total aggregate disk size. It incorporates the space for the above three special objects when showing total disk space and amount that is used on disk in its messages. The aggrfull message shows units in 8 K blocks.

The `zfsadm aggrinfo` command shows the free space and the total aggregate size in 1-KB units.

The `df` command shows the file system free space, but because the `df` command shows things in 512-byte units, usually the `df` output for zFS is exactly twice the numbers that are shown for `zfsadm aggrinfo`.

zFS stores files on disk in one of three ways:

**Inline**
If the file is 52 bytes or less, it is stored in the same data structure on disk that holds the file status (such as owner, size, and permissions). A file 52 bytes or less takes no extra disk space.

**Fragmented**
On systems before z/OS V1R13, if the file is 7 KB or less and has never been larger than 7 KB, zFS stores it in 1-KB fragments; as such, it is stored in part of an 8-KB block. Multiple small files can share the same 8-KB block on disk. On z/OS releases z/OS V1R13 and later, zFS no longer stores files in 1-KB fragments.

**Blocked**
On systems before z/OS V1R13, if the file is over 7 KB, it is stored in one or more 8-KB blocks. On releases z/OS V1R13 and later systems, if a file is over 52 bytes, it is stored in one or more 8-KB blocks.

**How data is stored on systems before z/OS V1R13**
On systems before z/OS V1R13, zFS can store data in fragmented blocks to conserve disk space. On these systems, each small file does not need to use a full 8-KB block of disk space. However, as a result of this method of storing data, a problem can occur when data is stored using zFS. That is, the amount of free space that is displayed by the z/OS UNIX `df` command might not give the entire picture of free space. The `df -k` command displays free space in a file system in 1-KB units. In zFS, this space is a combination of full 8-KB blocks plus the free 1-KB fragments in fragmented blocks. For example, as Figure 9 on page 45 shows, if there were two 8-KB blocks and twenty 1-KB blocks that are left, `df -k` reports 36 KB available.
Because this is a combination of 8-KB blocks and 1-KB blocks, it is possible that many 1-KB blocks are available but no 8-KB blocks remain. As shown in Figure 10 on page 45 for example, if there were 0 8-KB blocks left and 20 1-KB blocks available, `df -k` reports 20 KB available. If you try to create a 10-KB file, you might think that there is plenty of space. However, a 10-KB file is larger than 7 KB, and therefore uses full 8 KB blocks. Because there are no 8-KB blocks available, there is no room for a 10 KB file, even though there is 20-KB free space.

Other rules can further restrict how free space is used. A file that is 7 KB must be stored in 7 contiguous fragments. Therefore, even if there is 20 KB available in the file system, if there is no fragmented block with 7 contiguous 1-KB blocks available, the file system will report that there is no space for the file. Also, a file that is stored as fragments cannot share the same 8-KB block as a directory stored as fragments.

Fragments save disk space, but make space allocation more complicated. To provide the maximum options for space allocation, you need to have free 8-KB blocks. The `agrgrow` option of MOUNT and `IOEFSPRM` indicates the number of free 8-KB blocks. If you are out of 8-KB blocks, you will be limited in how much additional file space that can be allocated in the file system. You should grow the aggregate or allow it to be dynamically extended.

When a zFS compatibility mode aggregate becomes full, you can make more space available. This happens automatically if you have specified `agrgrow` for the aggregate and you specified a secondary allocation size when you defined the aggregate (that is, the VSAM linear data set). You can increase the size of the aggregate with the `zfsadm grow` command. Of course, in each of these cases, you must have space available on the volume to extend into. Or, you might be able to erase some files from the file system to free up some space.
Note that because of the difference between how HFS and zFS manage disk space and block sizes, certain z/OS UNIX commands, such as `df` and `du` might display information differently.

**Support for type 30 SMF record**

The type 30 SMF record provides accounting information. z/OS UNIX contributes to them, in part, by providing a count of the number of blocks that are read from file system disk blocks, or written to file system disk blocks, during each operation performed in a UNIX file system by a user or an application. The SMF300FR and SMF300FW fields of the SMF record contain these counts. The zFS PFS provides the count of blocks that are involved in these I/O operations to z/OS UNIX in the OSI control block fields `readibc` and `writeibc`.

Due to the aggressive caching that zFS does with the contents of the disk blocks, it is not possible for zFS to provide an exact count of actual I/O operations that are done by each user or application. Instead, zFS provides a weighted cost estimation of the number of disk blocks an operation could read or write. This method of counting the blocks is not the same as that used by HFS, so comparisons of HFS versus zFS file systems will not be accurate. This method of counting the blocks should be consistent enough to allow the comparison of two users or applications accessing the same zFS file system. This will be true even if the file system is mounted RWSHARE and accessed from two different systems that are sharing it.

**Sharing zFS data in a non-shared file system sysplex**

For information about sharing zFS data in a shared file system in a multisystem sysplex environment, see Chapter 5, “Using zFS in a shared file system environment,” on page 49 and review “Unmounting zFS file systems before copying or moving” on page 42.

The only fully supported way to share zFS data between systems in a non-shared file system sysplex environment is read-only sharing, where a zFS file system is mounted read-only to each system. Results are undefined when a zFS file system is mounted read/write to one system and mounted read-only on another.

**Minimum and maximum file system sizes**

The minimum zFS compatibility mode aggregate size is six 3390 tracks, which hold thirty-six 8 KB blocks (six 8 KB blocks per track × 6 tracks). In the example in Figure 11 on page 47, DFSMS allocates 7 tracks. Six 8-KB blocks per track x 7 tracks is 42 8-KB blocks or 336 KB. This only leaves 184 KB of free space available for files and directories. Small file systems tend to fill up quickly because of block and fragment allocation and can appear to have free space when they really do not. (For more information, see “Understanding zFS disk space allocation” on page 43). Using such small file systems is not a good idea. You can permit the file system to grow automatically (you must have `aggrgrow=on` in the `IOESPRM` file, which is the default, or in the MOUNT PARM. You must also have a secondary allocation specified on the `zfsadm define` command, which is specified as 5 in Figure 11 on page 47). However, your log file size is very small and might cause contention. The log file size cannot be increased after the aggregate is formatted.
Version 1.5 aggregates

For a version 1.5 aggregate, the architected maximum size for compatibility mode aggregates is approximately 16 TB (4 KB x 4 GB). If you use 3390 DASD that has 262,668 cylinders per volume, you can create a compatibility mode aggregate of about 11,425,931,919,360 bytes.

262668 cylinders per volume
x 90 blocks per cylinder
x 8KB per block
x 59 volumes
----------------------------
10641 GB or 10.39 TB

Version 1.5 aggregates have a larger architected maximum size than version 1.4 aggregates (approximately 16 TB versus approximately 4 TB). Also, extended (v5) directories can support more subdirectories than v4 directories (4G-1 versus 64K-1).

Version 1.4 aggregates

For a version 1.4 aggregate, the architected maximum size for compatibility mode aggregates is approximately 4 TB (1 KB x 4 GB). If you use 3390 DASD that has 65,520 cylinders per volume, you can create a compatibility mode aggregate of about 2,850,088,550,400 bytes.

65520 cylinders per volume
x 90 blocks per cylinder
x 8KB per block
x 59 volumes
-----------------------------
2654 GB or 2.59 TB

Restriction: A ZFS version 1.4 compatibility mode aggregate is limited to 4 TB even on extended address volume (EAV) devices. A ZFS version 1.5 compatibility mode aggregate is limited to 16 TB even on extended address volume (EAV) devices.

The maximum number of objects (files, directories, and ACLs) in a ZFS file system is 4 G. The maximum size of a file is approximately 4 TB. The maximum size of a directory is 4 GB. There is a limit of 65,533 (64K-1) subdirectories in a directory for a v4 directory. There is a limit of 4,294,967,293 (4G-1) subdirectories in a directory for an extended (v5) directory. The maximum number of names in a directory is dependent on the length of the names. However, there is a known performance problem when you have a large number of names (hundreds of thousands or millions) in a single ZFS v4 directory. For best performance, use an extended (v5) directory in a version 1.5 aggregate. See “Using version 1.5 aggregates and extended (v5) directories” on page 23 for information about extended (v5) directories. If you must use a version 1.4 aggregate because you are still running releases prior to z/OS V2R1, try to spread names among many directories.

Do not use version 1.5 aggregates until you are sure you will not run any releases before z/OS V2R1.
v4 directory considerations

For v4 directions only, if you have long response times, you can get a first indication whether you might have a directory size problem by examining the output of the MODIFY ZFS,QUERY,KN operator command or the z/OS UNIX zfsadm query -knpfs command. Look at the Avg Time field on the lines for operations that require ZFS to search through names of a directory (for example, zfs_lookup, zfs_create, or zfs_remove). Typically, the average times should be on the order of a few milliseconds. If they are relatively large (perhaps ten to a hundred times larger than that), it is possible that you have a directory that is too large and is causing performance problems.

To determine how large a particular directory is (how many bytes the directory contains), use the ls -ld command against the directory to display its size in bytes. For example, if you suspect /zfsmnt5/testdir is too large, issue a command similar to the following one:

```
# ls -ld /zfsmnt5/testdir
drwxr-xr-x 2 GDOUG AUDIT 1638400 Jan 18 2007 /zfsmnt5/testdir
```

The output shows /zfsmnt5/testdir is over 1 MB and contains many names (or at one time contained many names).

Space is not reclaimed when names are removed from a v4 directory. Therefore, you must look at the size of the directory rather than the number of names it currently contains. To reclaim the space, you can remove the directory rather than erasing names within it, or you can convert it to an extended (v5) directory. So if the directory currently has few names, but is large, try using either one of the following sets of commands to make a new directory:

```
mkdir /zfsmnt5/testdir2
cp /zfsmnt5/testdir/* /zfsmnt5/testdir2
rm -r /zfsmnt5/testdir
mv /zfsmnt5/testdir2 /zfsmnt5/testdir
-or-
```

```
mkdir /zfsmnt5/testdir2
/samples/copytree /zfsmnt5/testdir /zfsmnt5/testdir2 (if testdir has subdirectories)
rm -r /zfsmnt5/testdir
mv /zfsmnt5/testdir2 /zfsmnt5/testdir
-or-
zfsadm convert -path /zfsmnt5/testdir
```

If the large directory had mount points that are contained in it, you must unmount those file systems and mount them onto the mount points in the new directory before you remove the large directory.

If the large directory is the root directory of a file system, you cannot remove it. You have two options:

- Copy the file system to another (new) file system and delete the original file system, or
- Convert the file system to a version 1.5 file system

See Chapter 7, “Migrating data from HFS or zFS to zFS,” on page 63 for information about copying one file system to another. For information about converting an existing file system to version 1.5, see “Using version 1.5 aggregates and extended (v5) directories” on page 23.

When you must have many file names in a single directory, it is best to use a version 1.5 directory for that application.
Chapter 5. Using zFS in a shared file system environment

zFS supports a shared file system capability in a multisystem sysplex environment. The term shared file system environment refers to a sysplex that has a specification of SYSPLEX(YES) in the BPXPRMxx parmlib member. That is, users in a sysplex can access zFS data that is owned by another system in the sysplex. For full sysplex support, zFS must be running on all systems in the sysplex in a shared file system environment.

To better understand the terminology and concepts in this section, review “Terminology and concepts” on page 4.

Overview of the shared file system environment

In a shared file system environment, file systems that are mounted read-only are always sysplex-aware.

Beginning with z/OS V1R13, zFS runs sysplex-aware on a file system basis (sysplex=filesys). That is, a system running zFS V1R13 or later in a shared file system environment is always capable of mounting zFS read/write file systems as sysplex-aware. The default is to mount all zFS read/write file systems as non-sysplex aware. However, you can specify that you want any individual zFS read/write file system to be sysplex-aware in one of two ways:

• You can specify the RWSHARE MOUNT PARM.
• You can specify the sysplex_filesys_sharemode=rwshare zFS configuration option in your IOEFSPRM file. This option sets the default to be that all zFS read/write file systems are sysplex-aware, unless you specify a MOUNT PARM of NORWSHARE to make a specific file system non-sysplex aware.

Beginning with z/OS V1R13, if you specify sysplex=on in your IOEFSPRM file, zFS runs with sysplex=filesys; however, it internally sets the sysplex_filesys_sharemode value to rwshare (if you did not explicitly specify a different sysplex_filesys_sharemode value in your IOEFSPRM file). This behavior makes zFS read/write mounted file systems sysplex-aware by default. You should change your sysplex specification to sysplex=filesys, and you should also specify sysplex_filesys_sharemode=rwshare if you want zFS read/write file systems to be sysplex-aware by default.

The following sections describe how the shared file system environment works using various configurations and the commands for determining the file system owner.

Read-only mounted file systems

When a file system is mounted read-only (such as on SY2), the mount request is sent to the local physical file system (in this case, zFS) and zFS opens the file system data set (for read). If the mount is successful on that system, z/OS UNIX records the mount and sends a signal to the other sysplex member systems to issue a "catch-up" mount on each system. Each z/OS UNIX on each other system then reads the couple data set (CDS) and determines that it needs to send a mount request to the local zFS for that file system. Each "local mount" causes zFS to open the data set (for read). In this way, the mount on SY2 causes the file system to be mounted on every member of the sysplex.
For read-only mounted file systems, file requests are sent directly to the local physical file system, which directly reads the file system data on DASD (see Figure 12 on page 50). That means each zFS on each system has the zFS file system opened (for read) and directly accesses the data. Read-only mounted file systems are referred to as being sysplex-aware.

**zFS support for read/write file systems with different levels of sysplex-awareness**

zFS allows individual zFS read/write file systems to be mounted sysplex-aware or non-sysplex aware. During mount processing, the sysplex-awareness of an individual zFS read/write file system can be controlled by the value that is specified on the mount PARM for that file system or by the sysplex_filesys_sharemode option that is specified in IOEFSRMP. Table 1 on page 50 summarizes how the sysplex awareness is determined.

<table>
<thead>
<tr>
<th>MOUNT PARM</th>
<th>Resulting awareness of the zFS read/write file system</th>
</tr>
</thead>
<tbody>
<tr>
<td>RWSHARE</td>
<td>Sysplex-aware</td>
</tr>
<tr>
<td>NORWSHARE</td>
<td>Non-sysplex aware</td>
</tr>
<tr>
<td>None specified</td>
<td>Determined by the value, if any, specified on the sysplex_filesys_sharemode option.</td>
</tr>
<tr>
<td></td>
<td>• rwshare. The file system is sysplex-aware.</td>
</tr>
<tr>
<td></td>
<td>• norwshare. The file system is non-sysplex aware.</td>
</tr>
<tr>
<td></td>
<td>• If a value is not specified, the file system defaults to be non-sysplex aware.</td>
</tr>
</tbody>
</table>

Figure 13 on page 51 shows one file system that is mounted NORWSHARE and the other mounted RWSHARE. They are both owned by z/OS UNIX on SY2. The NORWSHARE file system is a non-sysplex aware file system; it is only locally mounted on the z/OS UNIX owner and requests from z/OS UNIX clients are function shipped to the z/OS UNIX owner by z/OS UNIX.

- A df -v command for the NORWSHARE file system (FS1) from SY1 would display Client=Y, or a DOMVS,F command would display CLIENT=YES. The other file system is mounted RWSHARE. It is a sysplex-aware file system; it is locally mounted on all systems and z/OS UNIX does not normally function ship requests to the z/OS UNIX owner.

- A df -v command for the RWSHARE file system (FS2) from SY1 would display Client=N, or a DOMVS,F command would display CLIENT=N.
The following example shows the mount of a zFS read/write file system with a mount PARM of RWSHARE:

```
MOUNT FILESYSTEM('OMVS.PRIV.COMPAT.AGGR001') TYPE(ZFS) MODE(RDWR)
MOUNTPOINT('/usr/mountpt1') PARM('RWSHARE')
```

**zFS-enhanced sysplex-aware support**

Beginning in z/OS V1R13, zFS provides enhanced sysplex-aware support. When a zFS read/write file system is mounted sysplex-aware in a shared file system environment where all systems are running z/OS V1R13 or later, zFS can directly read and write zFS data from all of the V1R13 or later systems. If both the owning system and the requesting system are running z/OS V1R13 or later (and the file system is sysplex-aware), zFS directly accesses the file system. While zFS data is directly read and written, zFS metadata is normally read and written through the zFS owning system (SY2 in Figure 13 on page 51). In some cases, zFS metadata can be directly read.

![Figure 13: zFS read/write file systems sysplex-aware and non-sysplex aware on a file system basis.](image)

In the figure, FS2 is being directly accessed from all z/OS V1R13 or later systems.

There are some cases when an application running on a system (SY1) that is doing direct I/O can be affected by problems on the zFS owning system (SY2) such as a failing system or having I/O failures on the owning system during metadata updates. The application can also be affected if it needs to traverse a higher level directory contained in a file system that is owned by the failing system.

**zFS ownership versus z/OS UNIX ownership of file systems**

For zFS read/write sysplex-aware file systems, zFS takes responsibility for determining how to access the data. This means that zFS must have the concept of a file system owner to coordinate file requests. That system is the zFS owner. z/OS UNIX has its indication of owner, which is called the z/OS UNIX owner. The zFS owner is independent of the z/OS UNIX owner. The zFS owner is the system that coordinates file access. The z/OS UNIX owner generally does not have any performance implications when zFS runs sysplex-aware because file requests are sent to the local zFS rather than being function shipped to the z/OS UNIX owner. There are some cases when the z/OS UNIX owner is relevant (see “When is the z/OS UNIX owner important?” on page 53).

In Figure 14 on page 52, SY2 is the z/OS UNIX owner and the zFS owner. This is typically the case for the system where the mount was issued. If SY2 goes down, a new zFS owner is chosen randomly (such as SY3) and a new z/OS UNIX owner is chosen randomly (such as SY1) assuming it was mounted with AUTOMOVE. Figure 14 on page 52 shows the situation after SY2 has come back up. (zFS on SY1 communicates directly with zFS on SY3.) The fact that SY1 is the z/OS UNIX owner is not important for performance in this case.
For zFS non-sysplex aware file systems, the z/OS UNIX owner and the zFS owner are always the same system.

Figure 14: zFS sysplex-aware file system with new owner

Determining the file system owner

To determine the zFS owner of a zFS file system, use the `zfsadm lsaggr` command. To determine the z/OS UNIX owner, use the following commands:

- `df -v` shell command
- `D OMVS,F` operator command
- `F BPXOINIT,FILESYS=D,ALL` operator command

Figure 15 on page 52 shows the output of the `zfsadm lsaggr` command and the `df -v` command after the file system was mounted.

```
# zfsadm lsaggr
IOEZ001061 A total of 1 aggregates are attached
PLEX.JMS.AGGR008.LARGE08 SY2 R/W

# df -v
Mounted on     Filesystem                Avail/Total    Files      Status
/zfsmnt5       (PLEX.JMS.AGGR008.LARGE08) 2853944/3745440 4294917290 Available
ZFS, Read/Write, Device:26, ACLS=Y
File System Owner : SY2 Automove=Y Client=N
Filetag : T=off codeset=0
Aggregate Name : PLEX.JMS.AGGR008.LARGE08

Figure 15: zfsadm lsaggr and df -v output after mount
```

Figure 16 on page 52 shows the output of the `D OMVS,F` command after the file system was mounted.

```
D OMVS,F
BPX064SI 14.38.11 DISPLAY OMVS
OMVS 086E ACTIVE OMVS=(P0,VM)
ZFS 26 ACTIVE RDWR 02/02/2011 L=55
PATH=/zfsmnt5
NAME=PLEX.JMS.AGGR008.LARGE08 14.37.44 Q=0
OWNER=SY2 AUTOMOVE=Y CLIENT=N

Figure 16: D OMVS,F output after mount
```
Figure 17 on page 53 shows the output of the `zfsadm lsaggr` command and the `df -v` command after the file system was moved (as shown in Figure 14 on page 52) by both z/OS UNIX and zFS and SY2 has come back up. The `zfsadm lsaggr` and `df -v` commands are issued from SY2:

```plaintext
# zfsadm lsaggr
IOEZ00106I A total of 1 aggregates are attached
PLEX.JMS.AGGR008.LARGE08 SY3 R/W

# df -v
Mounted on Filesystem Avail/Total Files Status
/zfsmnt5 (PLEX.JMS.AGGR008.LARGE08) 2853944/3745440 4294917290 Available
ZFS, Read/Write, Device:26, ACLS=Y
File System Owner : SY1 Automove=Y Client=N
Filetag : T=off codeset=0
Aggregate Name : PLEX.JMS.AGGR008.LARGE08
```

Figure 17: `zfsadm lsaggr` and `df -v` output after movement

Figure 18 on page 53 shows the output of the `DOMVS,F` operator command after the file system was moved. Notice two important points:

- The zFS owner (SY3) and the z/OS UNIX owner (SY1) are different.
- The last `df -v` command reports that SY2 is not a client, even though SY2 is not the z/OS UNIX owner.

```plaintext
D OMVS,F
BPX0045I 14.38.11 DISPLAY OMVS
OMVS 000E ACTIVE OMVS=(P0,VM)
TYPENAME DEVICE --------STATUS-------- MODE MOUNTED LATCHES
ZFS 26 ACTIVE RDWR 02/02/2011 L=55
 NAME=PLEX.JMS.AGGR008.LARGE08 14.37.44 Q=0
 PATH=/zfsmnt5
OWNER=SY1 AUTOMOVE=Y CLIENT=N
PATH=/zfsmnt5
```

Figure 18: `DOMVS,F` output after movement

This situation occurs because the zFS file system is sysplex-aware and file requests are not function shipped by z/OS UNIX. Rather, the file requests are handled by zFS and metadata updates are sent to the zFS owner. Each local catch-up mount causes zFS to open the file system data set for read/write, and each system is prepared to read and write the file system. Because the file system is opened on each system, each system prepares to take ownership of the file system if that becomes necessary.

**Tip:** You can use the `DISPLAY GRS` system command to determine the zFS owner of a zFS file system. Use the `RNAME` for either the read-only or read/write file system. For example, issue the following command to display the system name of the zFS owner as the exclusive owner of the resource name.

```plaintext
D GRS,RES=(SYSZIOEZ,IOEZLT.file_system_name)
```

For more information, see the serialization summary and list of ENQs in *z/OS MVS Diagnosis: Reference*.

**When is the z/OS UNIX owner important?**

The z/OS UNIX owner is important when a zFS read/write file system is non-sysplex aware. In this case, all file requests are handled through z/OS UNIX function shipping to the z/OS UNIX owning system. The z/OS UNIX owner and the zFS owner are always the same system.

When a zFS sysplex-aware file system is mounted, z/OS UNIX causes the file system to be locally mounted on each system (where zFS is running sysplex-aware). These are called `catch-up mounts`. If a local catch-up mount fails (for example, because the DASD is not accessible from that system), then z/OS UNIX treats that system (such as SY1) as a client and function ships requests to the z/OS UNIX owner (SY2). The system (SY1) might issue message BPXF221I. In this case, a `df -v` command issued from SY1 indicates `Client=Y` for that file system. In turn, zFS directly accesses the file system and function ships...
metadata updates to the zFS owner, if the zFS owner is a different system than the z/OS UNIX owner. In this case, it is not different (for example, see Figure 19 on page 54).

The zFS owner can be different than the z/OS UNIX owner. In this case, the request is function shipped by z/OS UNIX (from SY1) to the z/OS UNIX owner (SY2) and then is handled by direct access to the file system. Metadata updates will be function shipped by zFS to the zFS owner.

Similarly, if a local mount fails in the read-only mount case, z/OS UNIX treats that system as a client and function ships (the read) requests to the z/OS UNIX owning system. zFS does not typically function ship in the read-only case regardless of which system is the zFS owner.

Figure 19: File system ownership when mount fails

Dynamic movement of the zFS owner

For zFS read/write sysplex-aware file systems, an important aspect of performance is knowing which system is the zFS owner. The zFS owner is the system that handles metadata updates to the file system. zFS automatically moves the zFS owner among zFS systems, based on the amount of activity at the zFS owner from each system. The frequency of the dynamic ownership movement varies, depending on the zFS level. Ownership moves less often than on systems that are running previous levels of the z/OS system. File requests do not fail as a result of dynamic aggregate movement. New requests are suspended until the aggregate is moved and then requests are allowed to complete. The system produces the following messages, for example:

Source system
22.19.12 DCEIMGVM IOEZ00541I Requesting that DCEIMGVM takeover aggregate PLEX.JMS.AGGR006.LDS0006 LDS0006 (requests: local 2, new owner 1202 total 1204)

Target system
22.19.12 DCEIMGVM IOEZ00388I Aggregate takeover being attempted for aggregate PLEX.JMS.AGGR006.LDS0006
22.19.12 DCEIMGVM IOEZ00044I Aggregate PLEX.JMS.AGGR006.LDS0006 attached successfully.

In message IOEZ00548I, local requests is the number of requests on the source system during the measurement period. New owner requests is the number of requests from the target system during the measurement period. Total requests is the total number of requests from all systems during the measurement period. (Total requests can be greater than the sum of the local requests and the new owner requests). This information is provided to aid in problem determination.

For zFS sysplex-aware file systems, zFS aggregate movement is independent of z/OS UNIX ownership movement except for the cases discussed later in this section. When z/OS UNIX ownership movement occurs because of the mount AUTOMOVE specification (for example, AUTOMOVE or AUTOMOVE(INCLUDE,SY1,SY2) or AUTOMOVE(EXCLUDE,SY1,SY2)), the z/OS UNIX ownership movement is as expected. Because z/OS UNIX sends requests directly to the local zFS system, the z/OS UNIX ownership movement does not change the way that the zFS aggregate is accessed. z/OS UNIX ownership movement between zFS sysplex-aware file systems that have local mounts does not change how the file system is accessed.
There are several situations where certain z/OS UNIX automove settings will change file system access.

- If the NOAUTOMOVE setting is used, the file system is made unavailable. In other words, the file system becomes unowned. In that situation, z/OS UNIX denies requests for file access.
- If the UNMOUNT setting is used, the file system is unmounted across the sysplex. Any file access will occur on the underlying file system.

**Tip:** Mount system-specific zFS file systems with the UNMOUNT setting instead of the NOAUTOMOVE setting.

Remember the following facts about the relationship between z/OS UNIX ownership movement and zFS aggregate ownership movement:

- z/OS UNIX controls whether any access exists at all.
- zFS ownership controls which system updates the metadata.

If a zFS read/write file system is non-sysplex aware, then z/OS UNIX controls movement of zFS read/write mounted file systems as in prior releases for a shared file system environment and the z/OS UNIX owner and the zFS owner are always the same.

For zFS read/write sysplex-aware file systems, zFS ownership can be moved dynamically in three situations:

1. For performance reasons,
2. When zFS or z/OS UNIX is shut down, or
3. When a system outage exists that was caused by an abnormal shutdown or an internal restart of zFS.

   An abnormal shutdown occurs if, for example, zFS is canceled or if zFS abends.

For systems that are z/OS V2R3 or later, and any prior release system that has honor_syslist=on, zFS takes the z/OS UNIX automove options into consideration when determining whether to move zFS ownership. If zFS ownership is to be moved, the z/OS UNIX automove system lists are used to determine which systems are eligible to become the new zFS owner. For more information about the automove option, see z/OS UNIX System Services Planning.

**Tip:** In order for the z/OS UNIX automove options to be used consistently throughout the entire sysplex, each system in the sysplex is required to have honor_syslist=on or be at least at the V2R3 level.

When all systems in the sysplex are release z/OS V2R3 or later, or a prior release with honor_syslist=on, zFS will not move ownership of read/write sysplex-aware file systems that have z/OS UNIX automove options UNMOUNT or NOAUTOMOVE. It also will not move ownership to systems that are excluded by a z/OS UNIX automove system list. zFS ownership will move only to systems that are included by a z/OS UNIX automove system list. z/OS UNIX uses the list of included systems, as determined by the automove system list, as a priority ordered list. zFS considers the list as a list of eligible systems with no priority given to any system based on its order in the list. The automove INCLUDE system list can also have a wildcard (*) in it. In that situation, from the zFS viewpoint, any system with a local mount is eligible to become the new zFS owner. Again, from the zFS viewpoint, the absence of a z/OS UNIX automove system list also means that any system with a local mount is eligible to become the new zFS owner.

When all systems in the sysplex are at release z/OS V2R3 or later, or at a prior release with honor_syslist=on, you can create subgroups of systems that own specific zFS read/write sysplex-aware file systems by including the members of the subgroup of systems in a z/OS UNIX automove INCLUDE system list. You can also prevent systems from becoming the zFS owner of certain file systems by using a z/OS UNIX automove EXCLUDE system list. To keep zFS ownership of a specific file system on a specific system, use the z/OS UNIX automove option NOAUTOMOVE, UNMOUNT, or a system INCLUDE list with that one system name specified in it.

---

**Considerations when using zFS in a shared file system environment**

The following considerations apply when using zFS in a sysplex in shared file system mode:

---

Using zFS in a shared file system environment 55
The file system hierarchy appears different when viewed from systems with zFS mounted file systems than it does from those systems not running zFS. The path name traversal through zFS mount points have different results in such cases because the zFS file system is not mounted on those systems not running zFS.

zFS file systems that are owned by another system are accessible from a member of the sysplex that is running zFS.

zFS compatibility mode file systems can be automoved and automounted. A zFS compatibility mode file system can only be automoved to a system where zFS is running.

To share IOEFSPRM across a sysplex, configuration options that specify data set names should use system symbols in the names. This needs to be done for data sets that zFS writes into, such as the data sets specified by configuration options trace_dsn or msg_output_dsn. It is also allowed, but not necessary, to use system symbols in the names of data sets that zFS reads data from, such as the data set specified by the configuration option debug_settings_dsn. For more information, see Chapter 12, “The zFS configuration options file (IOEPRMxx or IOEFSPRM),” on page 227.

In this case, you should use the &SYSNAME system variable in the IOEZPRM DD of the ZFS PROC to specify a different IOEFSPRM for different systems.

If you are not specifying a msg_output_dsn or a trace_dsn (or you can use system symbols), and you use the same options for all ZFS PFSs on all systems, you can share the same IOEFSPRM across systems.

If you want to share IOEFSPRM and you want to specify data set names in IOEFSPRM, you might be able to use system symbols. For example, if you have sysplex member systems SY1 and SY2, and you have allocated trace data sets named USERA.SY1.ZFS.TRACE and USERA.SY2.ZFS.TRACE, you can specify trace_dsn=USERA.&SYSNAME.ZFS.TRACE in your shared IOEFSPRM.

As a preferred alternative to the IOEZPRM DDNAME specification, the IOEFSPRM member can be specified as a true PARMLIB member. In this case, the member has the name IOEPRMxx, where xx is specified in the parmlib member list. It is possible to have multiple IOEPRMxx members and it is also possible to have an IOEPRMxx member that contains options that are specific to a particular sysplex member. See “IOEFSPRM” on page 227 for more information about IOEPRMxx.

The following information describes z/OS UNIX considerations when some or all systems are running zFS:

All systems running zFS see zFS compatibility mode file systems. The file system hierarchy appears differently when viewed from systems with zFS mounted compatibility mode file systems than it does from those systems that are not running zFS. The path name traversal through zFS mount points have different results in such cases because the zFS compatibility mode file system is not mounted on those systems that are not running zFS.

If a system running zFS is brought down:

– zFS compatibility mode file systems owned by the system that can be automoved are automoved to another system running zFS. If this function fails to find another owner, the file system becomes unowned. IBM recommends mounting zFS file systems with UNMOUNT instead of NOAUTOMOVE.
– zFS compatibility mode file systems that are NOAUTOMOVE, become unowned.
– zFS compatibility mode file systems that are unowned are not visible in the file system hierarchy, but can be seen from a D OMVS,F command. To recover a zFS compatibility mode file system that is mounted and unowned, the zFS compatibility mode file system must be unmounted.
– The unowned zFS compatibility mode file systems can be recovered if the original owning system is brought back into the sysplex.

If zFS is brought down on one system in the sysplex:

– zFS compatibility mode file systems owned by the system that can be automoved are automoved to another system running zFS. If this function does not find another z/OS UNIX owner, the zFS compatibility mode file system, and all file systems mounted under it, are unmounted in the sysplex.
– zFS compatibility mode file systems that are NOAUTOMOVE and, all file systems mounted under them, are unmounted in the sysplex.
When zFS is down on one system (SY1) in the sysplex, z/OS UNIX does not function ship any zFS compatibility mode file system that is subsequently mounted on another system. That file system is not visible from SY1. zFS can be brought up again on that system by responding R to the BPXF032D prompt. When this occurs, mounted file system visibility is established by one of the following methods:

- If the zFS file system is non-sysplex aware, z/OS UNIX function shipping is established
- If zFS file system is sysplex-aware, the zFS file system is locally mounted

When a zFS is brought down after a compatibility mode file system is mounted, the file system either continues to be function shipped or becomes function shipped. When zFS is brought back up on that system, the file system either:

- Continues to be function shipped, when the zFS file system is non-sysplex aware
- Is locally mounted, when the zFS file system is sysplex-aware

zfsadm commands work across the shared file system environment. You can display and modify zFS compatibility mode aggregates and file systems using zfsadm from any member of the sysplex, regardless of which member owns the aggregate.
Chapter 6. Copying or performing a backup of a zFS

**CAUTION:** Do not perform any type of COPY or DUMP operation of DASD that contains a mounted zFS file system that is not quiesced, or that is mounted on a system that is not a member of the same GRS configuration as the system from which the COPY or DUMP operation is being done. Doing so might result in the copy being a corrupted (or unusable) zFS file system. For additional information about DFSMSdss logical DUMP and COPY utilities, see Dumping zFS data sets in z/OS DFSMSdss Storage Administration.

You can back up a zFS aggregate using a DFSMSdss logical dump. DFSMSdss automatically performs a quiesce of the mounted zFS aggregate before dumping the data set and an unquiesce when the dump ends. Before performing a backup, review the information in “Unmounting zFS file systems before copying or moving” on page 42 and the following guidelines.

Review the following guidelines before performing a backup of zFS:

1. Do not specify TOL(ENQF) when backing up zFS aggregates because it can cause corruption of the file system.

2. Full volume dumps of volumes that contain mounted zFS file systems will not quiesce the file systems. As a result, all file systems that reside on the volume must be unmounted before performing a full volume dump. For information about logical and full volume dumps, see z/OS DFSMSdfp Storage Administration.

3. The term *sysplex* as it applies to zFS means a sysplex that supports the z/OS UNIX shared file system environment. That is, a sysplex that has a BPXPRMxx specification of SYSPLEX(YES).

4. If a quiesce is not done before the backup of a mounted file system, corruption of the file system can result. If you are using a different program or different commands than shown in “Backing up a zFS aggregate” on page 60, verify that a quiesce is done (automatically by the backup program) while the backup is occurring. If it is not, then you need to unmount the file system before backing it up or supply a before and after job step to quiesce and then unquiesce the aggregate before and after the backup. The steps are similar to Figure 20 on page 59.

```plaintext
/*-----------------------------------------------------------------*/
/* THIS STEP QUIESCES THE AGGREGATE.                              */
/*-----------------------------------------------------------------*/
//QUIESCE EXEC PGM=IOEZADM,REGION=0M,
// PARM=('quiesce -aggregate hlq.ZFS.AGGR004')
//*
//SYSPRINT DD SYSOUT=H
//STDOUT DD SYSOUT=H
//STDERR DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP DD SYSOUT=H
//*
/*-----------------------------------------------------------------*/
/* THIS STEP UNQUIESCES THE AGGREGATE.                             */
/*-----------------------------------------------------------------*/
//UQUIESCE EXEC PGM=IOEZADM,REGION=0M,
// PARM=('unquiesce -aggregate hlq.ZFS.AGGR004')
//*
//SYSPRINT DD SYSOUT=H
//STDOUT DD SYSOUT=H
//STDERR DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP DD SYSOUT=H
//*
```

*Figure 20: Steps for quiesce and unquiesce*
Back up a zFS aggregate

Figure 21 on page 60 shows an example of a job for backing up a zFS aggregate (and all the file systems). Ensure that the size of the target sequential data set has sufficient space. For additional information about the DUMP command and its keywords, see DUMP command in z/OS DFSMSdfp Storage Administration.

**Important:** Do not specify TOL(ENQF) when backing up zFS aggregates.

```plaintext
//ZFSBKUP1 JOB (OS390), 'PROGRAMMER', CLASS=A, MSGCLASS=X, MSGLEVEL=(1,1)
// *-----------------------------------------------------------------
// * THIS JOB QUIESCES A ZFS AGGREGATE, DUMPS IT, THEN UNQUIESCES IT.
// *-----------------------------------------------------------------
//DUMP EXEC PGM=ADRDSSU,REGION=4096K
//SYSPRINT DD  SYSOUT=*  
//SYSABEND DD  SYSOUT=*  
//OUT DD  DSN=hlq.AGGR004.BACKUP, 
//   DISP=(NEW,CATLG,DELETE),SPACE=(CYL,(5,1),RLSE)  
//SYSIN  DD  *  
//DUMP_DATASET(INCLUDE(hlq.ZFS.AGGR004)) -  
//   RESET -  
//   OUTDD(OUT)  
// /*
```

Leading blanks are required before the control statements (DUMP, RESET, OUTDD).

**Figure 21: Job to back up a zFS aggregate**

---

Restoring an aggregate with DFSMSdss logical restore

Use DFSMSdss logical restore to restore a zFS aggregate. If the original aggregate (in the example, hlq.ZFS.AGGR004) still exists, the aggregate is restored into a new aggregate (in the example, OMVS.PRV.AGGR005.LDS0005). Figure 22 on page 60 is an example of a job to restore a zFS aggregate.

```plaintext
//ZFSREST1 JOB (OS390), 'PROGRAMMER', CLASS=A, MSGCLASS=X, MSGLEVEL=(1,1)
// *-----------------------------------------------------------------
// * THIS JOB RESTORES A ZFS AGGREGATE.  
// *-----------------------------------------------------------------
//ZFSREST EXEC PGM=ADRDSSU,REGION=0M
//SYSPRINT DD SYSOUT=*  
//SYSABEND DD SYSOUT=*  
//INDS DD DISP=SHR,DSN=hlq.AGGR004.BACKUP  
//SYSIN DD  *  
//RESTORE DATASET(INCLUDE(**)) -  
//   CATALOG -  
//   RENAMU(-  
//      hlq.ZFS.AGGR004, -  
//      OMVS.PRV.AGGR005.LDS0005) -  
// ) -  
//WRITECHECK -  
//INDD(INDS)  
// /*
```

Leading blanks are required before the control statements (RESTORE, CATALOG, RENAMU).

**Figure 22: Job to restore a zFS aggregate**

---

For a compatibility mode aggregate, perform the following steps after the aggregate is restored:

1. Unmount the original aggregate (in this case, hlq.ZFS.AGGR004) if it still exists (this also detaches it).
2. Mount the file system in the restored aggregate (in this case, OMVS.PRV.AGGR005.LDS0005).
Figure 23 on page 61 is an example of a job to perform a logical restore of a zFS aggregate using DFSMSdss by replacing the existing aggregate. The backup is restored into the original aggregate (in this case, hlq.ZFS.AGGR004). The aggregate cannot be mounted (or attached) during the restore operation.

```
//ZFSREST2 JOB (OS390), 'PROGRAMMER', CLASS=A,
// MSGCLASS=X, MSGLEVEL=(1,1)
// *---------------------------------------------------
// * THIS JOB RESTORES A ZFS AGGREGATE.
// *---------------------------------------------------
//ZFSREST EXEC PGM=ADRDSSU, REGION=0M
//SYSPRINT DD SYSOUT=* 
//SYSABEND DD SYSOUT=* 
//INDS DD DISP=SHR, DSN=hlq.AGGR004.BACKUP
//SYSIN DD *
RESTORE DATASET(INCLUDE(hlq.ZFS.AGGR004)) - 
CATALOG -
REPLACE -
WRITECHECK -
INDD(INDS)
/*
```

Figure 23: Job to restore a zFS aggregate with replace

Leading blanks are required before the control statements (RESTORE, CATALOG, RENAMU).

For more information about DFSMSdss logical restore, see z/OS DFSMSdss Storage Administration.

Beginning in z/OS V2R1, zFS enhanced its support for the backup change activity flag in the VTOC (D1DSCHA in the Format 1/8). This flag indicates to a program (like DFSMShsm) whether the backup of a file system is needed (that is, data in the file system has been modified since the last backup).

In releases before z/OS V2R1, zFS would set the change activity flag when a file system was mounted. This is no longer done. Essentially, zFS will cause the setting of the change activity bit in the following cases:

1. During the first write after a MOUNT
2. During the first write after a successful backup (that is, after a successful reset of the change activity flag)
3. During log recovery (that is, during the replay of an aggregate log during the next mount after a system failure)
4. During salvager operation if the log is replayed or a repair is made
5. During administrative operations such as grow, shrink, encrypt, decrypt, compress, decompress, and setauditfid.

The formatting of a new zFS aggregate will not cause the setting of the change activity flag. If an existing zFS aggregate is formatted using the -overwrite option, then the change activity flag is set.

Beginning in z/OS V2R1, zFS supplies an application programming interface that can be used to reset the change activity flag for a file system. This interface is intended to be used by DFSMSdss during a backup of a mounted zFS file system. For more information, see “Reset Backup Flag” on page 338.
Chapter 7. Migrating data from HFS or zFS to zFS

You can migrate data from HFS to zFS, or you might need to copy data efficiently from an existing zFS file system to a larger one, or to one that is created with different attributes (for example, if you want to have a secondary allocation to enable it to be dynamically grown). In all cases, the target file system can be version 1.4 as well as version 1.5. If all of the systems at your site are running at least version z/OS V2R1, then it is recommended that you use version 1.5 aggregates for your new file systems.

Guideline: Do not use the HFS to zFS migration tool BPXWH2Z if you are migrating your sysplex root. To migrate the sysplex root, consider using the MODIFY OMVS,NEWROOT operator command. For details, see the topic Steps for dynamically replacing the sysplex root file system in z/OS UNIX System Services Planning.

The bpwxmigf command can also be used to migrate in-use HFS file systems to zFS. See z/OS UNIX System Services Command Reference and z/OS UNIX System Services Planning for more information about bpwxmigf.

Using the z/OS HFS to zFS migration tool

Use the ISPF-based BPXWH2Z tool to migrate HFS file systems to zFS file systems. It has a panel interface that enables you to alter the space allocation, placement, SMS classes, and data set names. With this tool, you can:

- Migrate HFS file systems (both mounted and unmounted) to zFS file systems. If the HFS being migrated is mounted, the tool automatically unmounts it and then mounts the new zFS file system on its current mount point.
- Define zFS aggregates, using the default settings, to be approximately the same size as the HFS. The new allocation size can also be increased or decreased.
- Have the migration run in TSO foreground or z/OS UNIX background.

The number of storage blocks that are needed to store a zFS file system might not be exactly the same as the amount needed for HFS. For example, starting with z/OS V1R13, zFS uses 8 K blocks to contain small files; however, HFS uses 4 K blocks. In this case, some HFS file systems might need additional storage (possibly twice as much) when they are migrated to zFS. For more information about migrating data from HFS to zFS, see z/OS Migration.

Tip: When BPXWH2Z creates new zFS aggregates, you can control whether it creates version 1.4 aggregates or version 1.5 aggregates by using the IOEFSPRM configuration option format_aggrversion. The default is to create version 1.5 aggregates with the value 5, or you can create version 1.4 aggregates with the value 4.

Using the bpwxmigf command

The bpwxmigf command can also be used to migrate in-use HFS file systems to zFS. See z/OS UNIX System Services Command Reference and z/OS UNIX System Services Planning for more information about bpwxmigf.

Using the z/OS UNIX pax command

You can copy data from a z/OS UNIX file system (either HFS or zFS) to a zFS file system by using the z/OS UNIX pax command with or without using an intermediate archive file. For more information about the pax command, see z/OS UNIX System Services Command Reference. When the data is being copied, the file system being accessed must be mounted.
Note: If you are migrating a file system that contains additional file systems mounted under it, the default settings on the pax command also copies the files and directories that are contained in those file systems. To avoid this situation, you can either specify the pax -X option, or unmount the earlier file systems before you issue the pax command.

Using an intermediate archive file

Use the pax command to copy the source (HFS) file system into an intermediate archive file and then use the pax command to copy from the archive file into the target (zFS) file system. This archive file can be a z/OS UNIX file or it can be an MVS™ data set.

Suppose you have an HFS file system mounted at /etc/dfs. You want to copy this into an empty zFS file system mounted at /etc/dir1/testzfs1. You issue the following commands from z/OS UNIX:

1. Move to the source (HFS) file system mounted at /etc/dfs
   
   ```
   cd /etc/dfs
   ```

2. Create a z/OS UNIX archive file called /tmp/zfs1.pax that contains the HFS file system mounted at /etc/dfs
   
   ```
   pax -wvf -o saveext /tmp/zfs1.pax .
   ```

3. Move to the target (zFS) file system mounted at /etc/dir1/testzfs1
   
   ```
   cd /etc/dir1/testzfs1
   ```

4. Read the archive file into the zFS file system mounted at /etc/dir1/testzfs1
   
   ```
   pax -rv -p e -f /tmp/zfs1.pax
   ```

Without using an intermediate archive file

Use the pax command to copy the source (HFS) file system to the target (zFS) file system, without an intermediate archive file.

Suppose you have an HFS file system mounted at /etc/dfs. You want to copy this into an empty zFS file system mounted at /etc/dir1/testzfs1. You issue the following commands from OMVS:

1. Move to the source (HFS) file system mounted at /etc/dfs
   
   ```
   cd /etc/dfs
   ```

2. Copy the (HFS) file system mounted at /etc/dfs to the (zFS) file system mounted at /etc/dir1/testzfs1
   
   ```
   pax -zwvCMX -p eW -o saveext . /etc/dir1/testzfs1
   ```
Chapter 8. Performance and debugging

This section discusses performance tuning techniques and what should be done if a problem occurs that requires IBM service assistance. The examples are for illustrative purposes only.

In releases prior to z/OS V2R2, it was typical for the 4-byte counters used in the reports to wrap. Starting in z/OS V2R2, 8-byte counters are used, which allows for monitoring of much longer time periods. The numbers being output into the report fields still use the same field width sizes, with the addition of a letter to indicate the units of the number if it is too large to fit into the field.

<table>
<thead>
<tr>
<th>Letter</th>
<th>Unit of number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>The number should be multiplied by 1,000,000,000.</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>The number should be multiplied by 1,073,741,824.</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>The number should be multiplied by 1000.</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>The number should be multiplied by 1,099,511,627,776.</td>
<td></td>
</tr>
<tr>
<td>tr</td>
<td>The number should be multiplied by 1,000,000,000,000.</td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>The number should be multiplied by 1,000,000.</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>The number should be multiplied by 1024.</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>The number should be multiplied by 1,048,576.</td>
<td></td>
</tr>
</tbody>
</table>

Performance tuning

zFS performance depends on many factors. zFS provides performance information to help the administrator determine bottlenecks. The IOEFSPRM file contains many tuning options that can be adjusted. The output of the system modify zfs, query commands provide feedback about the operation of zFS. This section describes those IOEFSPRM options and the operator commands that relate to performance.

It is always better for performance in a shared file system environment if you can mount a file system read-only rather than read/write. For example, the sysplex root file system and the version file systems perform better if they are mounted read-only. For more information, see Sharing file systems in a sysplex in z/OS UNIX System Services Planning.

In addition, if a file system is mounted read/write, but accessed mainly from one system (for instance, SY1), it is better for performance if that file system is z/OS UNIX owned on that system (SY1). To keep z/OS UNIX ownership on SY1, you might want to mount it with the UNMOUNT option or the NOAUTOMOVE option. If you must use the AUTOMOVE option because you want the file system to remain available even when SY1 is down, move z/OS UNIX ownership of that file system back to SY1 when SY1 becomes available. This is not necessary for zFS read/write file systems that are sysplex-aware.

zFS performance can be optimized by tailoring the size of its caches to reduce I/O rates and pathlength. It is also important to monitor DASD performance to ensure that there are no volumes or channels that are pushed beyond their capacity. The following sections describe areas to consider when tuning zFS performance.
Total cache size

In releases prior to z/OS V2R2, the total storage size available for all the caches in the zFS address space had to be less than 2 GB. If the cache sizes specified in the IOEFSPRM file were too large, zFS would terminate. In addition to the zFS address space caches, storage is necessary for processing file requests and for the products zFS might use. As a result, the total address space cache storage was restricted to approximately 1.5 GB. Use modify zfs, query, storage to determine the total allocated zFS storage. See “STOR” on page 81 for more information about determining how much of the available zFS address space storage is being used by the zFS caches.

In z/OS V2R2, zFS uses 64-bit storage above the 2 GB line. Therefore, zFS cache sizes are no longer restricted by the 2 GB storage size. Caches start at the minimum size during zFS initialization, and are allowed to grow as needed to the size specified in the IOEFSPRM file. Carefully consider how large you want your zFS caches to be, taking into account such things as the amount of real and auxiliary storage in your system.

The modify zfs, query, all command also shows the total zFS storage that is allocated, but includes the storage that is allocated for all the caches and everything else zFS might need. The zFS address space caches include the following caches:

- “Metadata cache” on page 66
- “Vnode cache” on page 66
- “Log file cache” on page 67

The data in the user file cache is stored in data spaces, not zFS address space storage.

Metadata cache

The metadata cache is used to contain all file system metadata; this metadata includes all directory contents, file status information (such as, atime, mtime, size, and permission bits), and file system structures.

Generally, metadata is referred to and updated frequently for most zFS file operations; hence, achieving a good hit ratio is often essential to good performance for most workloads. A good hit ratio might be considered to be 90% or more, depending on your workload.

The metadata cache is stored in the primary address space. Because the metadata cache contains only metadata and small files, it typically does not need to be nearly as large as the user file cache. The operator modify zfs, query, all command output shows statistics for the metadata cache including the cache hit ratio.

Vnode cache

Every object in the zFS file system is represented by a data structure called a vnode in memory. zFS keeps a cache of these vnodes and recycles them in a least recently used (LRU) manner. Every operation in zFS requires a vnode and z/OS UNIX keeps pointers to zFS vnodes. Because z/OS UNIX keeps references to zFS vnodes, zFS might be forced to dynamically increase the size of this cache to meet the demands of z/OS UNIX. To create a zFS vnode for a newly referenced file or a newly created file for a user requires the pathlength to initialize the structure and obtain its status information from the metadata cache. If the status of the file is not in the metadata cache, then a disk I/O might also be required.

The vnode cache is stored in the zFS primary address space and the default number of vnodes is 32,768. As with any cache, a good hit ratio is desirable and the operator MODIFY ZFS,QUERY,ALL command shows the vnode cache hit ratio. Because the vnode cache is backed by the metadata cache, if the vnode hit ratio is low but the metadata cache hit ratio is high your performance might not suffer too much because a vnode cache miss requires only some pathlength to initialize the vnode structures.

User file cache

The user file cache is used to cache all "regular" files. It caches any file, no matter what its size, and performs write-behind and asynchronous read-ahead for files.
The user file cache is allocated in memory regions in the primary zFS address space. The default size of user_cache_size is calculated. For more information, see “IOEFSPRM” on page 227. However, you can tailor this size to meet your performance needs, based on your overall system memory. The maximum size for user_cache_size is 65,536 MB (64 GB). The general rule for any cache is to ensure a good hit ratio. Additionally, it is good to have a user file cache that is large enough for write-behind activity to occur. If the cache is too small, you need to recycle buffers more frequently and that might degrade write-behind performance. The MODIFY ZFS,QUERY,ALL command output shows the cache hit ratio, which is actually the "fault ratio". To get the hit ratio, subtract the fault ratio from 100%.

In general, you should have a hit ratio of at least 80% or more. A hit ratio over 90% will typically give good performance. However, the hit ratio is very much workload-dependent. For example, a zFS file system that is exported exclusively to SMB clients by using the SMB server will likely have a low hit ratio. The low hit ratio occurs because the SMB client and the SMB server cache data, which reduces the zFS cache hit ratio. This reduction is expected and is not considered a problem.

Log files

Every zFS aggregate contains a log file that is used to record transactions that describe changes to the file system structure. This log file is, by default, 1% of the aggregate size; but, you can tailor it on the ioefagt command. Typically, 1% is sufficient for most aggregates. However, larger aggregates might need less than 1%, while very small aggregates might need more than 1% if a high degree of parallel update activity occurs for the aggregate.

Log file cache

The log file cache is a pool of 4 KB buffers used to contain log file updates. You must not modify the log file cache size unless under the direction of IBM service. Log file buffers are always written asynchronously to disk and typically need to be waited upon only when the log is becoming full, or if a file is in file synchronization (fsync).

The log file cache is stored in the primary address space and its default size is 16 MB. The log file cache is grown dynamically by adding two 4 KB buffers for each attached aggregate. This growth ensures that each aggregate always has one log cache buffer to use to record its most recent changes to file system metadata. Because log files are written asynchronously, the cache essentially allows write-behind of log files and because the cache is shared among all aggregates. Aggregates that have a higher write rate use more buffers in the cache using a least-recently-used (LRU) algorithm.

Fixed storage

By default, zFS does not fix pages in any of the caches except when an I/O is pending to or from the cache buffers. The administrator can permanently page fix the user file cache, the metadata cache, and the log file cache by choosing the fixed option for the cache. This option ensures that the cache experiences no paging and avoids page fixing for each I/O. This option does come at the expense of using real storage for the cache, which means the real storage is not available for other applications.

If you are compressing a zFS aggregate, fixing the user file cache with the edcfixed option results in a significant CPU savings. If enough real memory is available to support fixing the user file cache and compression is used with zFS, then the edcfixed option will provide much benefit. If you are not compressing a zFS aggregate, then the fixed option of the user file cache can reduce CPU slightly. Fixing the log cache is generally not recommended and fixing the metadata cache by using the fixed option can also reduce CPU slightly.

I/O balancing

The performance of any file system is heavily dependent on DASD I/O performance. If any channels or DASD volumes are overloaded, then it is possible for excessive I/O waits to occur on that DASD. Performance products such as RMF show DASD performance.

zFS MODIFY ZFS,QUERY,ALL operator commands also provide reports that show I/O rates per aggregate, and file system request rates per aggregate and per file system. This information, along with DASD performance information from RMF or performance products similar to RMF can be used to balance I/O
among your DASD. For example, you can use the `query` command output to show the file systems that can be moved to different DASD to achieve a better balance among disks.

**Monitoring zFS performance**

You can monitor zFS performance using the `MODIFY` command. The output from the `MODIFY ZFS,QUERY` command is written to the system log. The syntax of this command and an explanation of the report and their option values, if any, are shown as follows.

```
modify zfs,query,<report>,<option>
```

If zFS is running in the OMVS address space, the syntax of the modify command is as follows:

```
modify omvs,pfs=zfs,query,<report>,<option>
```

- **ALL**
  
  Shows all of the reports. However, for the STOR report, the DETAILS option is off and the FILE report indicates only active file systems.

- **CTKC**
  
  Displays the client token manager statistics. CTKC is only present when the system is a sysplex client of another system and the zFS CTKC component on this system sent a message to another system. See “CTKC” on page 69 for details of the report.

- **DATASET**
  
  Displays zFS statistics about file systems.

- **FILE**
  
  Provides a detailed breakdown of requests per zFS file system and aggregate. By default, this report lists only file systems and aggregates that had active requests since the last statistics reset. If you use the ALL option, you get all file system and aggregates regardless of whether they were active or not. See “FILE” on page 71 for details of the report.

- **IOBYDASD**
  
  Displays the I/O statistics by currently attached DASD volumes including the total number of waits for I/O and the average wait time per I/O. See “IOBYDASD” on page 72 for details of the report.

- **KN**
  
  Provides counts of calls that are made to zFS from z/OS UNIX and the average response time of each call. This information is the basic measure of zFS performance. See “KN” on page 72 for details of the report.

- **LFS**
  
  Provides detailed file system statistics including the performance of the zFS metadata cache, the vnode cache, and the aggregate I/O statistics. See “LFS” on page 74 for details of the report.

- **LOCK**
  
  Provides a measure of lock contention and how often z/OS UNIX threads wait for certain events such as user file cache reclaim. See “LOCK” on page 79 for details of the report.

- **LOG**
  
  Provides performance information for the log file cache. See “LOG” on page 79 for details of the report.

- **STKM**
  
  Displays the current server token manager (STKM) statistics. See “STKM” on page 80 for details of the report.

- **STOR**
  
  Provides a detailed breakdown of zFS allocated storage by component. By default, this report lists only storage usage by zFS component. If you use the DETAILS option, you get more detailed information for each zFS component. See “STOR” on page 81 for details of the report.
SVI
Displays the calls from other systems to this server through the server vnode interface (SVI) component. Output is only displayed when the zFS SVI component on the local system has received a message from a client system.

VM
Provides performance information for the user file cache including cache hit ratios, I/O rates, and storage usage. See “VM” on page 86 for details of the report.

Resetting performance monitoring data
You can reset the performance monitoring statistics for any given zFS report or reset all of the internal zFS statistics. The syntax of this command is as follows, where report is KN, VM, LFS, LOG, LOCK, STOR, FILE, STKM, CTKC, IOBYDASD, DATASET, SVI, or ALL.

```
modify zfs,reset,<report>
```

Note: If zFS is running in the OMVS address space, the syntax of the modify command is:

```
modify omvs,pfs=zfs,reset,<report>
```

Resetting the statistics is useful if you want to view zFS performance for a given time of day, such as during peak usage. For example, if you want performance of zFS between 1 PM and 3 PM, you enter MODIFY ZFS,RESET,ALL at 1 PM and enter MODIFY ZFS,QUERY,ALL at 3 PM.

To start the monitoring period at 1 PM, enter MODIFY ZFS,RESET,ALL.
To end the monitoring period at 3 PM, enter MODIFY ZFS,QUERY,ALL.

Sample zFS QUERY reports
The following sections show sample output from zFS QUERY reports and describe the relevant fields of each report. Some fields are used mainly by IBM service, but are included here for completeness.

- “CTKC” on page 69
- “DATASET” on page 70
- “FILE” on page 71
- “IOBYDASD” on page 72
- “KN” on page 72
- “LFS” on page 74
- “LOCK” on page 79
- “STKM” on page 80
- “STOR” on page 81
- “SVI” on page 85
- “VM” on page 86

CTKC
The CTKC report displays the statistics relating to calls made to other systems that were caused by operations on the local system (called client operations). The output is displayed only when the system is a sysplex client of another system and the zFS CTKC component on this system has sent a message to another system. The following report shows an example of the total number of call counts and the average response time in milliseconds of the call to the system indicated (in this case NP1).
Note: Output is only displayed when the zFS CTKC component on this system has sent a message to another system.

<table>
<thead>
<tr>
<th>SVI Call</th>
<th>Count</th>
<th>Avg. Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>GetToken</td>
<td>211324</td>
<td>15.996</td>
</tr>
<tr>
<td>GetMultTokens</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>ReturnTokens</td>
<td>31</td>
<td>0.621</td>
</tr>
<tr>
<td>ReturnFileTokens</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FetchData</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>StoreData</td>
<td>27005</td>
<td>3.354</td>
</tr>
<tr>
<td>Setattr</td>
<td>184762</td>
<td>4.486</td>
</tr>
<tr>
<td>FetchDir</td>
<td>25</td>
<td>20.464</td>
</tr>
<tr>
<td>Lookup</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>GetTokensDirSearch</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Create</td>
<td>3</td>
<td>17.921</td>
</tr>
<tr>
<td>Remove</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Rename</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Link</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>ReadLink</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>SetACL</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Statfs</td>
<td>42</td>
<td>2.006</td>
</tr>
<tr>
<td>TSR</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FilesysSyncTable</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FileSyncMeta</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>BitmapReserve</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>BitmapUnreserve</td>
<td>2</td>
<td>0.000</td>
</tr>
<tr>
<td>BitmapReclaim</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FileUpdateIB</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FileCreateIB</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FwdReaddir</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>LkupInvalidate</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FileDebug</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FetchPage</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>ServerIO</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>BulkFetchStatus</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Convert</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>ConvertFID</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td><em>TOTALS</em></td>
<td>423222</td>
<td>10.162</td>
</tr>
</tbody>
</table>

DATASET

The DATASET report lists zFS data set statistics. Table 2 on page 70 describes the contents of the report.

<table>
<thead>
<tr>
<th>Printing Dataset Allocation Stats</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocates</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Allocates failed</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Unallocates</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Unallocates failed</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Opens</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Open failures</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Closes</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: DATASET report fields

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocates</td>
<td>Number of allocations issued by zFS for zFS data sets.</td>
</tr>
<tr>
<td>Allocates failed</td>
<td>Number of allocations issued by zFS for zFS data sets that were unsuccessful.</td>
</tr>
<tr>
<td>Unallocates</td>
<td>Number of unallocations issued by zFS for zFS data sets.</td>
</tr>
<tr>
<td>Unallocates failed</td>
<td>Number of unallocations issued by zFS for zFS data sets that were unsuccessful.</td>
</tr>
<tr>
<td>Opens</td>
<td>Number of opens issued by zFS for zFS data sets.</td>
</tr>
<tr>
<td>Opens failed</td>
<td>Number of opens issued by zFS for zFS data sets that were unsuccessful.</td>
</tr>
<tr>
<td>Closes</td>
<td>Number of closes issued by zFS for zFS data sets.</td>
</tr>
</tbody>
</table>
The FILE report lists every file system that was active since the last reset by default. If you use the ALL option, it lists all file systems. The file systems are listed in the report with the most active file systems listed first. Table 3 on page 71 describes the contents of the report.

<table>
<thead>
<tr>
<th>FILE:</th>
<th>File System Name</th>
<th>Aggr #</th>
<th>Flg</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OMVS.ZFS.DFBLD.DFSSRC</td>
<td>8</td>
<td>AM</td>
<td>274472</td>
</tr>
<tr>
<td></td>
<td>OMVS.ZFS.LOCAL</td>
<td>9</td>
<td>AM</td>
<td>111722</td>
</tr>
<tr>
<td></td>
<td>OMVS.ZFS.DCEDFBLD.DCES390.ETC.DCE</td>
<td>10</td>
<td>AMQ</td>
<td>81632</td>
</tr>
<tr>
<td></td>
<td>OMVS.ZFS.DCEDFBLD.DFSLOCAL</td>
<td>12</td>
<td>AM</td>
<td>52154</td>
</tr>
<tr>
<td></td>
<td>OMVS.ZFS.DCEDFBLD.OS390R10.ETC</td>
<td>4</td>
<td>AM</td>
<td>44108</td>
</tr>
<tr>
<td></td>
<td>OMVS.ZFS.GPLTOOLS</td>
<td>6</td>
<td>AM</td>
<td>8458</td>
</tr>
<tr>
<td></td>
<td>OMVS.ZFS.BLDTOOLS</td>
<td>7</td>
<td>AM</td>
<td>8120</td>
</tr>
<tr>
<td></td>
<td>OMVS.ZFS.DCEDFBLD.VAR</td>
<td>5</td>
<td>AM</td>
<td>314</td>
</tr>
<tr>
<td></td>
<td>OMVS.ZFS.USR.LOCAL</td>
<td>11</td>
<td>AM</td>
<td>54</td>
</tr>
</tbody>
</table>

Table 3: FILE report fields.

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggr #</td>
<td>The aggregate ID that can be seen in the zfsadm lsfs -long command.</td>
</tr>
<tr>
<td>Flg</td>
<td>Indicates the aggregate status, as follows:</td>
</tr>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>G</td>
</tr>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Q</td>
</tr>
<tr>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Operations</td>
<td>Indicates the count of z/OS UNIX vnode calls to that particular file system; it is not an I/O rate. You can use the RMF DASD reports, the LFS Aggregate I/O report, and the FILE report to balance your file systems among disks to provide a more even I/O spread.</td>
</tr>
</tbody>
</table>
IOBYDASD

The IOBYDASD report lists the currently attached DASD by volume. This report is important for viewing the average wait time per I/O (in milliseconds).

<table>
<thead>
<tr>
<th>DASD VOLSER</th>
<th>PAV IOs</th>
<th>Reads</th>
<th>bytes</th>
<th>Writes</th>
<th>bytes</th>
<th>Waits</th>
<th>Average Wait</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFC002</td>
<td>1</td>
<td>5m</td>
<td>40M</td>
<td>2m</td>
<td>52M</td>
<td>5m</td>
<td>5.964</td>
</tr>
<tr>
<td>SMBD80</td>
<td>1</td>
<td>5136</td>
<td>21784</td>
<td>197t</td>
<td>1M</td>
<td>138t</td>
<td>3.377</td>
</tr>
<tr>
<td>ZFSD50</td>
<td>1</td>
<td>3m</td>
<td>27M</td>
<td>1m</td>
<td>32M</td>
<td>4m</td>
<td>7.629</td>
</tr>
<tr>
<td>ZFSD32</td>
<td>1</td>
<td>5697</td>
<td>21626</td>
<td>57227</td>
<td>1M</td>
<td>13173</td>
<td>4.372</td>
</tr>
<tr>
<td>ZFSD33</td>
<td>1</td>
<td>4m</td>
<td>33M</td>
<td>2m</td>
<td>37M</td>
<td>5m</td>
<td>8.316</td>
</tr>
<tr>
<td>ZFS183</td>
<td>1</td>
<td>663t</td>
<td>4M</td>
<td>262t</td>
<td>4M</td>
<td>669t</td>
<td>8.506</td>
</tr>
</tbody>
</table>

Total number of waits for I/O: 1611355
Average wait time per I/O: 7.228

Table 4 on page 72 describes the contents of the report.

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASD VOLSER</td>
<td>The DASD volumes that contain the zFS aggregates.</td>
</tr>
<tr>
<td>PAV IOs</td>
<td>The maximum number of concurrent I/O requests to volume.</td>
</tr>
<tr>
<td>Reads</td>
<td>The number of read I/O requests.</td>
</tr>
<tr>
<td>K bytes</td>
<td>The number of bytes read or written in K units.</td>
</tr>
<tr>
<td>Writes</td>
<td>The number of write I/O requests.</td>
</tr>
<tr>
<td>Waits</td>
<td>The number of waits for I/O completion.</td>
</tr>
<tr>
<td>Average Wait</td>
<td>The average wait time for I/O requests in milliseconds.</td>
</tr>
<tr>
<td>Total number of waits for I/O</td>
<td>Total of Waits column</td>
</tr>
<tr>
<td>Average wait time per I/O</td>
<td>The average of the Average Wait times, in milliseconds.</td>
</tr>
</tbody>
</table>

KN

The QUERY,KN report shows basic zFS performance for both the PFS file system owner and the PFS client. It shows all calls made to zFS by z/OS UNIX since the last statistics reset or since zFS was first initialized if no explicit reset has been done, and the average response time in milliseconds for each request. These requests are the official interface between z/OS UNIX and zFS; this is the most fundamental measure of zFS performance because it includes any CPU, I/O wait time, or lock wait time.

The times here represent only the zFS portion of the overall command response time. For example, entering a mkdir command from z/OS UNIX will actually result in many zFS calls, and the zfs_mkdir time is only the portion of time it took zFS to perform the actual mkdir. Hence, application time and time spent processing in z/OS UNIX is not included here.

If you see abnormally long times that are listed for zfs_lookup, zfs_creates, or zfs_removes and you are using v4 directories, you might have a zFS large directory problem. For information about the zFS large directory performance problem, see “Minimum and maximum file system sizes” on page 46.

In the following sample KN report, the Operation column is the z/OS UNIX operation being performed, the Count column is the number of operations, the XCF.Reqn column is the number of XCF messages that were sent during the processing of the operation and Avg. Time is the average response time for the operations. The server could send XCF messages to revoke tokens and the client might send XCF messages to obtain needed tokens and security information from a server or to write metadata changes to
the server. If XCF messages need to be sent, then you should expect average response times to be longer than if messages were not sent.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Count</th>
<th>XCF req.</th>
<th>Avg Time</th>
<th>Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>zfs_opens</td>
<td>65972</td>
<td>4</td>
<td>0.182</td>
<td></td>
</tr>
<tr>
<td>zfs_closes</td>
<td>66015</td>
<td>0</td>
<td>0.014</td>
<td></td>
</tr>
<tr>
<td>zfs_reads</td>
<td>62522</td>
<td>3</td>
<td>8.668</td>
<td>231.024M</td>
</tr>
<tr>
<td>zfs_write</td>
<td>1320</td>
<td>3</td>
<td>0.324</td>
<td>9.995M</td>
</tr>
<tr>
<td>zfs_ioctl</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_fileinfo</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_convert</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_getattr</td>
<td>182493</td>
<td>1</td>
<td>0.039</td>
<td></td>
</tr>
<tr>
<td>zfs_setattr</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_access</td>
<td>65926</td>
<td>0</td>
<td>0.056</td>
<td></td>
</tr>
<tr>
<td>zfs_lookup</td>
<td>627118</td>
<td>935</td>
<td>0.987</td>
<td></td>
</tr>
<tr>
<td>zfs_create</td>
<td>1</td>
<td>0</td>
<td>0.183</td>
<td></td>
</tr>
<tr>
<td>zfs_remove</td>
<td>4</td>
<td>2</td>
<td>267.854</td>
<td></td>
</tr>
<tr>
<td>zfs_link</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_rename</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_mkdir</td>
<td>1</td>
<td>1</td>
<td>308.082</td>
<td></td>
</tr>
<tr>
<td>zfs_rmdir</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_readdir</td>
<td>71717</td>
<td>0</td>
<td>3.322</td>
<td>7573.907K</td>
</tr>
<tr>
<td>zfs_linkdir</td>
<td>2</td>
<td>1</td>
<td>92.339</td>
<td></td>
</tr>
<tr>
<td>zfs_fsync</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_setattr</td>
<td>47298</td>
<td>105</td>
<td>18.012</td>
<td></td>
</tr>
<tr>
<td>zfs_getattr</td>
<td>6</td>
<td>5</td>
<td>263.333</td>
<td></td>
</tr>
<tr>
<td>zfs_access</td>
<td>8</td>
<td>8</td>
<td>415.752</td>
<td></td>
</tr>
<tr>
<td>zfs_lookup</td>
<td>213659</td>
<td>23083</td>
<td>33.436</td>
<td></td>
</tr>
<tr>
<td>zfs_create</td>
<td>51</td>
<td>51</td>
<td>243.079</td>
<td></td>
</tr>
<tr>
<td>zfs_remove</td>
<td>37</td>
<td>37</td>
<td>535.925</td>
<td></td>
</tr>
<tr>
<td>zfs_link</td>
<td>1</td>
<td>1</td>
<td>140.882</td>
<td></td>
</tr>
<tr>
<td>zfs_rename</td>
<td>4</td>
<td>3</td>
<td>1593.482</td>
<td></td>
</tr>
<tr>
<td>zfs_mkdir</td>
<td>8</td>
<td>8</td>
<td>415.752</td>
<td></td>
</tr>
<tr>
<td>zfs_rmdir</td>
<td>9</td>
<td>9</td>
<td>736.476</td>
<td></td>
</tr>
<tr>
<td>zfs_readdir</td>
<td>31417</td>
<td>2370</td>
<td>36.865</td>
<td>12.724M</td>
</tr>
<tr>
<td>zfs_linkdir</td>
<td>4018</td>
<td>7</td>
<td>968.494</td>
<td></td>
</tr>
<tr>
<td>zfs_fsync</td>
<td>8</td>
<td>8</td>
<td>12041.074</td>
<td></td>
</tr>
<tr>
<td>zfs_inactive</td>
<td>56196</td>
<td>0</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>zfs_setattr</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_getattr</td>
<td>32</td>
<td>12</td>
<td>1364.853</td>
<td></td>
</tr>
<tr>
<td>zfs_access</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>zfs_lookup</td>
<td>51</td>
<td>0</td>
<td>0.042</td>
<td></td>
</tr>
</tbody>
</table>
zfs_pfsctls    0       0       0.000
zfs_statfss    25      25      95.533
zfs_vgets       0       0       0.000
zfs_mounts     6       0      981.206
zfsUnmounts    0       0       0.000
zfs_vinacts    0       0       0.000
zfs_sync       0       0       0.000
zfs_backups    0       0       0.000

*TOTALS*    971372   29884   12.593

IOEZ00025I zFS kernel: MODIFY command - QUERY,KNPFS completed successfully.

LFS

The LFS report provides detailed file system statistics; the following sample shows an example of the content. Each part of the report is described.
<table>
<thead>
<tr>
<th>Vnodes</th>
<th>Requests</th>
<th>Hits</th>
<th>Hits Ratio</th>
<th>Allocates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deletes</td>
<td>---------</td>
<td>---------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>29295</td>
<td>766173</td>
<td>716967</td>
<td>93.578%</td>
<td></td>
</tr>
<tr>
<td>34171</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

zFS Vnode structure size: 240 bytes
zFS extended vnodes: 13830, extension size 864 bytes (minimum)
Held zFS vnodes: 8 (high 11293)
Open zFS vnodes: 0 (high 5)
Reusable: 29286

Total osi_getvnode Calls: 13495 (high resp 0)
Avg. Call Time: 0.008 (msecs)
Total SAF Calls: 87013 (high resp 0)
Avg. Call Time: 0.001 (msecs)

Remote Vnode Extension Cleans: 0
zFS Fast Lookup

Buffers Lookups Hits Ratio Neg. Hits
------------ --------- --------- ------ ----------
1000 4660 2452 52.618% 1357
2271
YSID EIMG DATE 07/05/2017 2017.186 LINE 4,584 PAGE 2

Metadata Caching

Buffers PartialWrt Requests Hits Ratio Updates
---------- --------- ---------- ---------- ----- ----------
83484 23848 981046 967961 98.6% 476870
1813

I/O Summary By Type

<table>
<thead>
<tr>
<th>Count Type</th>
<th>Waits</th>
<th>Cancels</th>
<th>Merges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metadata</td>
<td>44579</td>
<td>27968</td>
<td>0</td>
</tr>
<tr>
<td>File</td>
<td>422</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>Data</td>
<td>121373</td>
<td>60255</td>
<td>0</td>
</tr>
</tbody>
</table>
## I/O Summary By Circumstance

<table>
<thead>
<tr>
<th>Circumstance</th>
<th>Count</th>
<th>Waits</th>
<th>Cancels</th>
<th>Merges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metadata cache</td>
<td>40251</td>
<td>23846</td>
<td>0</td>
<td>1968</td>
</tr>
<tr>
<td>User file cache</td>
<td>52102</td>
<td>52101</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Log file</td>
<td>34</td>
<td>34</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>159</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>983</td>
<td>983</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>68257</td>
<td>7140</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>19</td>
<td>19</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>51</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>53</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>4034</td>
<td>4034</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>388</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metadata cache</td>
<td>31</td>
<td>31</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

---

## zFS I/O by Currently Attached Aggregate

<table>
<thead>
<tr>
<th>VOLSER</th>
<th>I/Os Mode</th>
<th>Reads</th>
<th>K bytes</th>
<th>Writes</th>
<th>K bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMMMN0</td>
<td>R/O</td>
<td>8007</td>
<td>35880</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>POSIX6</td>
<td>R/W</td>
<td>338</td>
<td>2688</td>
<td>7094</td>
<td>0</td>
</tr>
<tr>
<td>SMBRS1</td>
<td>R/W</td>
<td>21</td>
<td>488</td>
<td>7342</td>
<td>0</td>
</tr>
<tr>
<td>POSIX5</td>
<td>R/O</td>
<td>7014</td>
<td>28636</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

---

z/OS: Distributed File Service zFS Administration
**Table 5: LFS report fields.**

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>zFS Vnode Op Counts:</strong></td>
<td>Shows the number of calls to the lower layer zFS components. One request from z/OS UNIX typically requires more than one lower-layer call. Note that the output of this report wraps.</td>
</tr>
</tbody>
</table>
| **zFS Vnode Cache Statistics:** | zFS Fast Lookup Statistics:  
  Shows the basic performance characteristics of the zFS fast lookup cache. The fast lookup cache is used on the owning system for a zFS sysplex-aware file system to improve the performance of the lookup operation. There are no externals for this cache (other than this display). The statistics show the total number of buffers (each are 8K in size), the total number of lookups, the cache hits for lookups and the hit ratio. The higher the hit ratio, the better the performance. |
| **Metadata Caching Statistics:** | Shows the basic performance characteristics of the metadata cache. The metadata cache contains a cache of all disk blocks that contain metadata and any file data for files less than 7 K in size. For files smaller than 7 K, zFS places multiple files in one disk block (for zFS a disk block is 8 K bytes). Only the lower metadata management layers have the block fragmentation information, so the user file I/O for small files is performed directly through this cache rather than the user file cache. The statistics show the total number of buffers (each buffer is 8 K in size), the total bytes, the request rates, hit ratio of the cache, Updates (the number of times an update was made to a metadata block), and Partial writes (the number of times that only half of an 8-K metadata block needed to be written). The higher the hit ratio the better the performance. Metadata is accessed frequently in zFS and all metadata is contained only (for the most part) in the metadata cache therefore, a hit ratio of 80% or more is typically sufficient. |
Table 5: LFS report fields. (continued)

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
</table>
| zFS I/O by Currently Attached Aggregate: | The zFS I/O driver is essentially an I/O queue manager (one I/O queue per DASD). It uses Media Manager to issue I/O to VSAM data sets. It generally sends no more than one I/O per DASD volume to disk at one time. The exception is parallel access volume (PAV) DASD. These DASD often have multiple paths and can perform multiple I/O in parallel. In this case, zFS will divide the number of access paths by two and round any fraction up. (For example, for a PAV DASD with five paths, zFS will issue, at the most, three I/Os at one time to Media Manager).

zFS limits the I/O because it uses a dynamic reordering and prioritization scheme to improve performance by reordering the I/O queue on demand. Thus, high priority I/Os (I/Os that are currently being waited on, for example) are placed up front. An I/O can be made high priority at any time during its life. This reordering has been proven to provide the best performance, and for PAV DASD, performance tests have shown that not sending quite as many I/Os as available paths allows zFS to reorder I/Os and leave paths available for I/Os that become high priority.

Another feature of the zFS I/O driver is that by queuing I/Os, it allows I/Os to be canceled. For example, this is done in cases where a file was written, and then immediately deleted. Finally, the zFS I/O driver merges adjacent I/Os into one larger I/O to reduce I/O scheduling resource, this is often done with log file I/Os because often times multiple log file I/Os are in the queue at one time and the log file blocks are contiguous on disk. This allows log file pages to be written aggressively (making it less likely that users lose data in a failure) and yet batched together for performance if the disk has a high load.

This section contains the following information:

- PAV IO, which shows how many I/Os are sent in parallel to Media Manager by zFS, non PAV DASD always shows the value 1.
- DASD VOLSER for the primary extent of each aggregate and the total number of I/Os and bytes read/written.
- Number of times a thread processing a request must wait on I/O and the average wait time in milliseconds is shown.
- For each zFS aggregate, the name of the aggregate is listed, followed by a line of its statistics.

By using this information with the KN report, you can break down zFS response time into what percentage of the response time is for I/O wait. To reduce I/O waits, you can run with larger cache sizes. Small log files (small aggregates) that are heavily updated might result in I/Os to sync metadata to reclaim log file pages resulting in additional I/O waits. Note that this number is not DASD response time. It is affected by it, but it is not the same. If a thread does not have to wait for an I/O then it has no I/O wait; if a thread has to wait for an I/O but there are other I/Os being processed, it might actually wait for more than one I/O (the time in queue plus the time for the I/O).

This report, along with RMF DASD reports and the zFS FILE report, can be also used to balance zFS aggregates among DASD volumes to ensure an even I/O spread.

Table 6: COMPRESS report fields.

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression calls</td>
<td>The number of compression calls.</td>
</tr>
<tr>
<td>Decompression calls</td>
<td>The number of decompression calls.</td>
</tr>
<tr>
<td>Average call time</td>
<td>The average number of milliseconds per compression or decompression call.</td>
</tr>
<tr>
<td>KB input</td>
<td>The number of kilobytes sent to zEDC cards for compression or decompression calls.</td>
</tr>
<tr>
<td>KB output</td>
<td>The number of kilobytes returned from zEDC cards for compression or decompression calls.</td>
</tr>
</tbody>
</table>
**LOCK**

The LOCK report is mainly for IBM service to use when diagnosing performance problems relating to lock contention. This report shows a detailed breakdown of how often zFS waits for locks. It also shows which locks cause the most contention. Additionally, the report monitors how often a thread sleeps while waiting for an event.

**LOCK:**

<table>
<thead>
<tr>
<th>Untimed sleeps:</th>
<th>22</th>
<th>Timed Sleeps:</th>
<th>0</th>
<th>Wakeups:</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average lock wait time:</td>
<td>8.261 (msecs)</td>
<td>3698</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average monitored sleep time:</td>
<td>0.792 (msecs)</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total monitored sleeps:</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total starved waiters:</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total task priority boosts:</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Top 15 Most Highly Contended Locks**

<table>
<thead>
<tr>
<th>Thread Wait</th>
<th>Async Disp.</th>
<th>Spin Resol.</th>
<th>Pct.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>877</td>
<td>0</td>
<td>899</td>
<td>35.763%</td>
<td>Log system map lock</td>
</tr>
<tr>
<td>1464</td>
<td>0</td>
<td>40</td>
<td>30.285%</td>
<td>Anode bitmap allocation handle</td>
</tr>
<tr>
<td>481</td>
<td>0</td>
<td>28</td>
<td>10.249%</td>
<td>Anode fileset quota lock</td>
</tr>
<tr>
<td>291</td>
<td>0</td>
<td>42</td>
<td>6.705%</td>
<td>Transaction lock</td>
</tr>
<tr>
<td>205</td>
<td>0</td>
<td>62</td>
<td>5.376%</td>
<td>Metadata-cache buffer lock</td>
</tr>
<tr>
<td>210</td>
<td>0</td>
<td>4</td>
<td>4.309%</td>
<td>Anode fileset handle lock</td>
</tr>
<tr>
<td>84</td>
<td>68</td>
<td>7</td>
<td>3.201%</td>
<td>User file cache main segment lock</td>
</tr>
<tr>
<td>38</td>
<td>0</td>
<td>0</td>
<td>0.765%</td>
<td>Vnode-cache access lock</td>
</tr>
<tr>
<td>19</td>
<td>0</td>
<td>3</td>
<td>0.422%</td>
<td>Transaction-cache equivalence c</td>
</tr>
<tr>
<td>21</td>
<td>0</td>
<td>14</td>
<td>0.281%</td>
<td>Cache Services association main</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>5</td>
<td>0.100%</td>
<td>Transaction-cache complete list</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.080%</td>
<td>Cache Services hashtable resize</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.000%</td>
<td>Transaction-cache complete list</td>
</tr>
</tbody>
</table>

**Log File Caching Statistics**

- **Logs**
  - 7 : Log files cached
  - 0 : Log file recoveries performed
  - 1494 : Log file syncs (filesys quiesce)

- **Policies**
  - 16 : Reclaim pct. (amount reclaimed at log-full time)
  - 16 : Maximum log pages per IO
In the image, the content is divided into sections under the title "STKM". The STKM report lists the server token manager statistics. LOCALUSR is the local system (the server). ZEROLINK is a "special client" used to handle zero link count files and vnode inactivations.

### Server Token Manager (STKM) Statistics

<table>
<thead>
<tr>
<th>System</th>
<th>Tokens</th>
<th>Obtains</th>
<th>Returns</th>
<th>Revokes</th>
<th>Async Grt</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1</td>
<td>3781</td>
<td>897812</td>
<td>894887</td>
<td>582842</td>
<td>0</td>
</tr>
<tr>
<td>NP2</td>
<td>15147</td>
<td>1233561</td>
<td>1188354</td>
<td>415917</td>
<td>0</td>
</tr>
<tr>
<td>NP3</td>
<td>719</td>
<td>912</td>
<td>909</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NP4</td>
<td>8756</td>
<td>1410737</td>
<td>1402062</td>
<td>504757</td>
<td>0</td>
</tr>
<tr>
<td>ZEROLINK</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LOCALUSR</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Thrashing Objects:

<table>
<thead>
<tr>
<th>Inode</th>
<th>Uniquifier</th>
<th>File system</th>
</tr>
</thead>
<tbody>
<tr>
<td>19365</td>
<td>181790</td>
<td>PLEX.ZFS.SMALL2</td>
</tr>
<tr>
<td>711</td>
<td>184733</td>
<td>PLEX.ZFS.SMALL2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>ZFSAGGR.BIGZFS.DHH.FS4.EXTATTR</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>ZFSAGGR.BIGZFS.DHH.FS14.EXTATTR</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>ZFSAGGR.BIGZFS.DHH.FS1.EXTATTR</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>ZFSAGGR.BIGZFS.DHH.FS4.EXTATTR</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>ZFSAGGR.BIGZFS.DHH.FS14.EXTATTR</td>
</tr>
<tr>
<td>21761</td>
<td>8528</td>
<td>ZFSAGGR.BIGZFS.DHH.FS6.EXTATTR</td>
</tr>
</tbody>
</table>
Table 7 on page 81 describes the contents of the report.

<table>
<thead>
<tr>
<th>Field</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum tokens</td>
<td>Lists the token limit at the server which is defined by the IOEFSPRM configuration option token_cache_size. The server runs garbage collection to ensure that token maximum is not exceeded. In some cases, the system workload might cause the token maximum to be exceeded, such as when there are many open files.</td>
</tr>
<tr>
<td>Allocated tokens</td>
<td>Number of tokens allocated in server memory. Tokens are allocated as needed, up to maximum tokens.</td>
</tr>
<tr>
<td>File structures</td>
<td>Number of file structures.</td>
</tr>
<tr>
<td>Tokens In Use</td>
<td>Number of tokens currently held by all clients and the local system. If this number approaches maximum tokens, then consider increasing the token_cache_size setting.</td>
</tr>
<tr>
<td>Token obtains</td>
<td>Total number of token obtains by all clients and local system.</td>
</tr>
<tr>
<td>Token revokes</td>
<td>Total number of token revokes by all clients and local system.</td>
</tr>
<tr>
<td>Token returns</td>
<td>Total number of token returns by all clients and local system.</td>
</tr>
<tr>
<td>Async grants</td>
<td>Number of asynchronously granted tokens to all clients and local system. Asynchronous grant is used during file deletion processing when the file is still opened by some process in the sysplex, and in support of NFS V4 share modes.</td>
</tr>
<tr>
<td>Garbage collects</td>
<td>Number of garbage collections of tokens. Garbage collection is used to keep the total number of client/local system tokens below the maximum whenever possible. If this number gets high, consider increasing the token_cache_size setting.</td>
</tr>
<tr>
<td>Thrashing files</td>
<td>Number of files or directories that are thrashing.</td>
</tr>
<tr>
<td>Thrashing resolutions</td>
<td>Number of thrashing situations that were resolved.</td>
</tr>
</tbody>
</table>

The report indicates how many tokens each system currently has, how many token obtains and token returns each system has done, and how many times each system has had some tokens revoked.

The report also contains a list of objects that are undergoing thrashing. Thrashing means that the system that owns the file system containing the object needed to keep revoking tokens for the object because multiple systems were repeatedly writing to it. The list contains the inode and uniquifier of the object and the file system that contains it.

**STOR**

The STOR report shows the storage that zFS has allocated below the 2 G addressing line, and the storage that is allocated above the 2 G address line. The STOR report also provides a breakdown of zFS storage usage. This report can be used to determine how much storage zFS uses, based on a configuration change (such as increasing or decreasing a zFS cache through the zfsadm config command). Figure 24 on page 83 shows a sample report and Table 8 on page 85 explains the contents of each field. (Not shown here is the output of QUERY,STOR,DETAILS, which breaks down each component and shows how much storage is used for each data structure class; this report is intended primarily for IBM service.)

You can check zFS storage usage by issuing the operator command MODIFY ZFS,QUERY,STORAGE. If you compare the third line of data (USS/External Storage Access Limit) to the fourth line (Total Storage Below 2G Bar Allocated), you can determine how close zFS is to using its maximum storage below the 2 G addressing line. The vast majority of the storage that is used by zFS should be above the 2 G addressing line. The storage that is allocated below the 2 G Bar should be far less than the USS/External Performance and debugging 81
Storage Access Limit. For example, in the following figure, the storage that is allocated below the 2 G bar (approximately 231 M) is much less than the USS/External storage access limit (1793 M).

If the Total Storage Below 2G Bar Allocated becomes greater than or equal to the USS/External Storage Access Limit, zFS issues message IOEZ00662I. If the Total Storage Below 2G Bar Allocated approaches the value of the USS/External Storage Access Limit, you can attempt to dynamically decrease the caches using the `zfsadm config` command. (Also make the corresponding changes in your IOEFSPRM file for the next zFS restart.) Alternatively, you can stop and restart zFS after you make the cache size changes to your IOEFSPRM file.

If zFS failed to initialize and is not active, decrease some of your zFS IOEFSPRM settings, especially if they are significantly larger than the default values, and restart zFS. The settings to review include:

- `meta_cache_size`
- `recovery_max_storage`
- `token_cache_size`
- `vnode_cache_size`

If zFS is active but message IOEZ00662I was issued, you can issue the `zfsadm config` command to attempt to decrease the cache sizes dynamically. Also make the corresponding changes in your IOEFSPRM file for the next zFS restart. Alternatively, you can stop and restart zFS after you make the cache size changes to your IOEFSPRM file.

You can also use the `MODIFY ZFS,QUERY,STORAGE` command to see Total Storage Above 2G Bar Allocated. If the amount of storage allocated becomes more than you want, overall system performance can be impacted. If this occurs, you can attempt to use the `zfsadm config` command to decrease the size of a zFS cache that is using too much storage dynamically.

In the report, Discarded (or unbacked) storage is storage that is allocated to zFS, but is currently not in use. So, it is not occupying real storage frames, which reduce the need for paging by the system. If the storage is needed later, then it will again be used.
IOEZ00438I Starting Query Command STORAGE.
  zFS Primary Address Space <2G Stge Usage

Total Storage Below 2G Bar Available: 1943011328
Non-critical Storage Limit: 1922039808
USSS/External Storage Access Limit: 1880967668
Total Storage Below 2G Bar Allocated: 242671616

IOEFSCM Heap Bytes Allocated: 26560184
IOEFSCM Heap Pieces Allocated: 1671
IOEFSCM Heap Allocation Requests: 1680
IOEFSCM Heap Free Requests: 9

IOEFSKN Heap Bytes Allocated: 3610517
IOEFSKN Heap Pieces Allocated: 54383
IOEFSKN Heap Allocation Requests: 242678
IOEFSKN Heap Free Requests: 188295

<table>
<thead>
<tr>
<th>Storage Usage By Sub-component</th>
<th>Bytes Allocated</th>
<th>No. of Pieces</th>
<th>No. of Allocs</th>
<th>No. of Frees</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>2375</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>Interface</td>
<td></td>
</tr>
<tr>
<td>14544</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>Media Manager I/O driver</td>
<td></td>
</tr>
<tr>
<td>1888</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>Trace Facility</td>
<td></td>
</tr>
<tr>
<td>434088</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>Message Service</td>
<td></td>
</tr>
<tr>
<td>546428</td>
<td>164</td>
<td>164</td>
<td>0</td>
<td>Miscellaneous</td>
<td></td>
</tr>
<tr>
<td>33168</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Aggregate Management</td>
<td></td>
</tr>
<tr>
<td>200384</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>Filesystem Management</td>
<td></td>
</tr>
<tr>
<td>32160</td>
<td>27</td>
<td>36</td>
<td>9</td>
<td>Administration Command Handling</td>
<td></td>
</tr>
<tr>
<td>1264</td>
<td>5</td>
<td>138652</td>
<td>130647</td>
<td>Vnode Management</td>
<td></td>
</tr>
<tr>
<td>50632</td>
<td>14</td>
<td>57614</td>
<td>57600</td>
<td>Anode Management</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Directory Management</td>
<td></td>
</tr>
<tr>
<td>1904</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>Log File Management</td>
<td></td>
</tr>
<tr>
<td>272</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Metadata Cache</td>
<td></td>
</tr>
<tr>
<td>2192</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Transaction Management</td>
<td></td>
</tr>
<tr>
<td>119436</td>
<td>1909</td>
<td>1909</td>
<td>0</td>
<td>Lock Facility</td>
<td></td>
</tr>
<tr>
<td>10440</td>
<td>348</td>
<td>348</td>
<td>0</td>
<td>Threading Services</td>
<td></td>
</tr>
<tr>
<td>1768592</td>
<td>51561</td>
<td>51597</td>
<td>36</td>
<td>Cache Services</td>
<td></td>
</tr>
<tr>
<td>49366</td>
<td>8</td>
<td>9</td>
<td>1</td>
<td>Config. parameters processing</td>
<td></td>
</tr>
<tr>
<td>8496</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>User File Cache</td>
<td></td>
</tr>
</tbody>
</table>

Figure 24: Sample STOR report (part 1 of 2)


```
313784   182   182   0  Storage Management
12456    126   128   2  XCF Services
      0    0    0    0  Cross system attach validation
5464    4    4    0  Server Token Manager (STKM)
224      1    1    0  Server Token Cache (STKC)
 936     1    1    0  Client Token Cache (CTKC)
      0    0    0  Server Vnode Interface (SVI)
      0    0    0  Name Space (NS)
     24    1    1    0  Directory storage
      0    0    0  Salvage storage
IOEZ00438I Starting Query Command STORAGE.

Total Bytes Allocated by IOEFSCM (Stack+Heap):  22020096
IOEFSCM Heap Bytes Allocated:  22020096
IOEFSCM Heap Allocation Requests:  462
IOEFSCM Heap Free Requests:  0
Total Bytes Allocated by IOEFSKN (Stack+Heap):  648019968
Total Bytes Discarded (unbacked) by IOEFSKN:  55504896
IOEFSKN Heap Bytes Allocated:  546676397
IOEFSKN Heap Allocation Requests:  1122125
IOEFSKN Heap Free Requests:  6739163
IOEFSKN Heap Free Requests:  5617038

Storage Usage by Sub-component

<table>
<thead>
<tr>
<th>Bytes Allocated</th>
<th>Pieces</th>
<th>Allocs</th>
<th>Frees</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>459628</td>
<td>16</td>
<td>16</td>
<td>0</td>
<td>Interface</td>
</tr>
<tr>
<td>675080</td>
<td>193</td>
<td>213</td>
<td>20</td>
<td>Media Manager I/O driver</td>
</tr>
<tr>
<td>73400320</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>Trace Facility</td>
</tr>
<tr>
<td>8399961</td>
<td>284</td>
<td>315</td>
<td>31</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>77216</td>
<td>117</td>
<td>126</td>
<td>9</td>
<td>Aggregate Management</td>
</tr>
<tr>
<td>21376</td>
<td>14</td>
<td>14</td>
<td>0</td>
<td>Filesystem Management</td>
</tr>
<tr>
<td>1464</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>Administration Command Handling</td>
</tr>
<tr>
<td>15028992</td>
<td>56535</td>
<td>453053</td>
<td>396518</td>
<td>Vnode Management</td>
</tr>
<tr>
<td>43586724</td>
<td>329845</td>
<td>387711</td>
<td>57866</td>
<td>Anode Management</td>
</tr>
<tr>
<td>45070848</td>
<td>44098</td>
<td>267949</td>
<td>223851</td>
<td>Log File Management</td>
</tr>
<tr>
<td>164305040</td>
<td>38354</td>
<td>38366</td>
<td>12</td>
<td>Metadata Cache</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Transaction Management</td>
</tr>
<tr>
<td>5874464</td>
<td>68159</td>
<td>69176</td>
<td>1017</td>
<td>Asynchronous I/O Component</td>
</tr>
<tr>
<td>1048576</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>Lock Facility</td>
</tr>
<tr>
<td>1048576</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Threading Services</td>
</tr>
<tr>
<td>87901988</td>
<td>490273</td>
<td>1214627</td>
<td>724354</td>
<td>Cache Services</td>
</tr>
<tr>
<td>164305040</td>
<td>38354</td>
<td>38366</td>
<td>12</td>
<td>Metadata Cache</td>
</tr>
<tr>
<td>4696016</td>
<td>16004</td>
<td>16022</td>
<td>18</td>
<td>User File Cache</td>
</tr>
<tr>
<td>69472800</td>
<td>4322</td>
<td>4687</td>
<td>285</td>
<td>Storage Management</td>
</tr>
<tr>
<td>656688048</td>
<td>1678</td>
<td>1678</td>
<td>0</td>
<td>XCF Services</td>
</tr>
<tr>
<td>17680</td>
<td>13</td>
<td>22</td>
<td>9</td>
<td>Cross system attach validation</td>
</tr>
<tr>
<td>1167992</td>
<td>6050</td>
<td>4117454</td>
<td>4111404</td>
<td>Server Token Manager (STKM)</td>
</tr>
<tr>
<td>263528</td>
<td>3058</td>
<td>3058</td>
<td>0</td>
<td>Server Token Cache (STKC)</td>
</tr>
<tr>
<td>26930824</td>
<td>63097</td>
<td>63097</td>
<td>0</td>
<td>Client Token Cache (CTKC)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>101623</td>
<td>101623</td>
<td>Server Vnode Interface (SVI)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>9</td>
<td>9</td>
<td>Name Space (NS)</td>
</tr>
<tr>
<td>1048576</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Directory storage</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Salvage storage</td>
</tr>
</tbody>
</table>

Figure 25: Sample STOR report (part 2 of 2)
```
### Table 8: STOR report fields

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total storage below 2G bar available</td>
<td>Total virtual storage in the zFS address space that is available for usage (such as caches, control blocks, and stacks).</td>
</tr>
<tr>
<td>Total storage above 2G bar available</td>
<td></td>
</tr>
<tr>
<td>Non-critical Storage Limit</td>
<td>The value that, when exceeded, will cause zFS to issue message IOEZ00663I ZFS is critically low on storage.</td>
</tr>
<tr>
<td>USS/External Storage Access Limit</td>
<td>The value that, when exceeded, will cause zFS to issue message IOEZ00662I ZFS is low on storage.</td>
</tr>
<tr>
<td>Total storage below 2G bar allocated</td>
<td>The current usage of virtual storage in the zFS address space (requested by zFS and other components that are running in the zFS address space).</td>
</tr>
<tr>
<td>Total storage above 2G bar allocated</td>
<td></td>
</tr>
<tr>
<td>IOEFSCM Heap Bytes Allocated</td>
<td>The current amount of storage that is allocated to the zFS heaps.</td>
</tr>
<tr>
<td>IOEFSCM Heap Pieces Allocated</td>
<td></td>
</tr>
<tr>
<td>IOEFSCM Heap Allocation Requests</td>
<td>Number of requests that zFS made to obtain heap storage since the last zFS storage statistics reset.</td>
</tr>
<tr>
<td>IOEFSCM Heap Free Allocated</td>
<td>Number of requests that zFS made to free heap storage since the last zFS storage statistics reset.</td>
</tr>
<tr>
<td>Total Bytes Allocated by IOEFSCM (Stack + Heap)</td>
<td>The total bytes of storage that is allocated by the zFS IOEFSCM and IOEFSCN components.</td>
</tr>
<tr>
<td>Total Bytes Allocated by IOEFSCN (Stack + Heap)</td>
<td></td>
</tr>
<tr>
<td>Storage Usage by Sub-component</td>
<td>Storage usage for each zFS component.</td>
</tr>
<tr>
<td>Total Bytes Discarded (unbacked) by IOEFSCN</td>
<td>Total number of bytes that IOEFSCN has discarded (made unbacked) from allocated storage.</td>
</tr>
</tbody>
</table>

#### SVI

The server vnode interface component handles this call. The following example report displays the total number of calls that the server received from the specific client and the average server response time in milliseconds, including the XCF transmit and CPU time of the reply. XCF Req is the count of XCF messages that had to be sent to other systems (most likely for token revokes) to process the client request. Qwait counts the number of times a wait was done for an available zFS thread to process the client request.

**Note:** The output is displayed only when the zFS svi component on this system has received a message from another system.

```
<table>
<thead>
<tr>
<th>SVI Call</th>
<th>Count</th>
<th>Qwait</th>
<th>XCF Req.</th>
<th>Avg. Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>GetToken</td>
<td>663624</td>
<td>2</td>
<td>180593</td>
<td>4.246</td>
</tr>
<tr>
<td>GetMultTokens</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>ReturnTokens</td>
<td>814</td>
<td>0</td>
<td>0</td>
<td>8.139</td>
</tr>
<tr>
<td>ReturnFileTokens</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>FetchData</td>
<td>132962</td>
<td>0</td>
<td>13222</td>
<td>1.016</td>
</tr>
<tr>
<td>StoreData</td>
<td>1461717</td>
<td>9</td>
<td>0</td>
<td>0.229</td>
</tr>
<tr>
<td>Setattr</td>
<td>228600</td>
<td>0</td>
<td>0</td>
<td>0.527</td>
</tr>
<tr>
<td>FetchDir</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0.188</td>
</tr>
<tr>
<td>Lookup</td>
<td>93113</td>
<td>1</td>
<td>1934</td>
<td>2.875</td>
</tr>
<tr>
<td>GetTokensDirSearch</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Create</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>5.056</td>
</tr>
<tr>
<td>Remove</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>9.040</td>
</tr>
<tr>
<td>Rename</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
</tr>
</tbody>
</table>
```
VM

The VM report shows the statistics that relate to the performance of the zFS user file caching system. The size of this cache is controlled by the IOEFSRM user_cache_size configuration option or the zfsadm config command.

Prior to V2R3, the user data was kept in data spaces. In V2R3, the data is now kept in chunks of memory called cache spaces.

The zFS user file cache is stored in a collection of cache spaces. zFS prefers to use multiple cache spaces rather than one large cache space when possible in order to reduce lock contention (as shown in this example). zFS has a structure for each file that is cached. The user cache breaks the cached file into 64 K segments. Each segment is broken into 4 K pages. A segment is assigned to a cache space, hence the pages for any given segment belong only to one cache space. A file's pages can be scattered throughout multiple segments.

At any given time, a file need not (and for large files often might not) have all of its segments in the cache. Furthermore, any segment need not (and often might not) have all of its pages in the cache. Reuse of pages and segments is done in a least-recently used (LRU) fashion.

The cache provides asynchronous read-ahead and write-behind of large files when access is considered sequential. Read-ahead and write-behind for a file is performed by reading/writing segments (up to 64 K).

Following is a sample VM report.

```
User File (VM) Caching System Statistics
----------------------------------------
External Requests:
-------------------
Reads   20868497
Writes  20839431
Asy Reads 20714262
Fsyncs 0
Setattrs 4006
Getattrs 178114

File System Reads:
-------------------
Reads Faulted 0 (Fault Ratio 0.000%)
Writes Faulted 0 (Fault Ratio 0.000%)
Read Waits 0 (Wait Ratio 0.000%)
Total Reads 0

File System Writes:
--------------------
Scheduled Writes 384576
Error Writes 0
Scheduled deletes 0
Page Reclaim Writes 0
Write Waits 3 (Wait Ratio 0.000%)
```

The following report describes the fields of the User File (VM) Caching System Statistics report.

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Requests:</td>
<td>Describes the requests that are made to the user file cache to perform operations as requested by applications.</td>
</tr>
<tr>
<td></td>
<td><strong>Reads, Writes</strong></td>
</tr>
<tr>
<td></td>
<td>How often the cache was called to read or write files.</td>
</tr>
<tr>
<td></td>
<td><strong>Asy Reads</strong></td>
</tr>
<tr>
<td></td>
<td>How often read-ahead is performed.</td>
</tr>
<tr>
<td></td>
<td><strong>Fsync</strong></td>
</tr>
<tr>
<td></td>
<td>How often applications requested that zFS sync a file's data to disk.</td>
</tr>
<tr>
<td></td>
<td><strong>Unmaps</strong></td>
</tr>
<tr>
<td></td>
<td>The count of file deletions.</td>
</tr>
</tbody>
</table>

![Table 9: User File (VM) Caching System Statistics report fields](image)
<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File System Reads:</strong></td>
<td>Shows how often the cache reads data from disk for a file. Cache misses and read I/Os degrade application response time and the goal is for these numbers to be as low as possible. Increasing the cache size is the typical method for lowering these numbers.</td>
</tr>
<tr>
<td><em>Reads Faulted</em></td>
<td>Count of read requests that needed to perform at least one I/O to read the requested portion of the file from disk.</td>
</tr>
<tr>
<td><em>Writes Faulted</em></td>
<td>Count of how often a write to a file needed to perform a read from disk. If a write only updates a portion of a page of a file on disk and that page is not in memory, then the page must be read in (the zFS I/O driver can only perform I/O in whole pages) before the new data is written to the in-memory page.</td>
</tr>
<tr>
<td><em>Read Waits</em></td>
<td>How often a read had to wait for a pending I/O. For example, how often a read of a file found that the range of the file is pending read (probably because of asynchronous read ahead).</td>
</tr>
<tr>
<td><em>Total Reads</em></td>
<td>Total number of file system reads made for any reason.</td>
</tr>
<tr>
<td><strong>File System Writes:</strong></td>
<td>Shows how often the cache wrote the data to disk. In general, it is desirable to minimize the Page Reclaim Writes and Reclaim Waits. If these occur often, relative to the external zFS request rate (shown in the KN report), then the cache might be too small.</td>
</tr>
<tr>
<td><em>Scheduled Writes</em></td>
<td>Count of how often the cache wrote out dirty segments for a file. Segments are written as soon as every page becomes dirty (segments are said to be dirty if they contain live blocks). When a file is closed all of its dirty segments are scheduled asynchronously and segments are also written asynchronously during file system syncs through the zFS sync daemon (which by default runs every 30 seconds).</td>
</tr>
<tr>
<td><em>Sync Waits</em></td>
<td>Count of how often a fsync request that is needed to wait on pending I/O for dirty segments.</td>
</tr>
<tr>
<td><em>Error Writes and Error Waits</em></td>
<td>Count of the error handling paths and should almost always be 0 unless a disk hardware error occurs. Whenever an unexpected error occurs for a file, all of its dirty segments are written and synced to disk. (A file system that is running out of space is not an error condition that causes the cache to sync a file, the cache reserves storage for files as they are written which ensures no unexpected out of space conditions arise).</td>
</tr>
<tr>
<td><em>Scheduled Deletes</em></td>
<td>Count of times a pending I/O was canceled because a file was being deleted. In this case, the data is not appropriate to be on disk (because the file is 0 link count). Therefore, canceling the I/O is done to avoid an I/O wait. This is a performance optimization for file remove.</td>
</tr>
<tr>
<td><em>Page Reclaim Writes</em></td>
<td>Count of times that a segment had to be written to DASD to reclaim space in the cache.</td>
</tr>
<tr>
<td><em>Page Reclaim Waits</em></td>
<td>Count of times that the reclaim function waited on pending I/O to reclaim segment pages.</td>
</tr>
<tr>
<td><em>Write Waits</em></td>
<td>Count of times a write occurred to a page that was already pending I/O. In this case, the I/O must be waited upon before the page is updated with the new data.</td>
</tr>
</tbody>
</table>
Table 9: User File (VM) Caching System Statistics report fields (continued)

<table>
<thead>
<tr>
<th>Field name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Page Management:</strong></td>
<td>Shows how storage in the user file cache is used. It is generally desirable to minimize the number of steal invocations (reclaims). To minimize the number of steal invocations, increase the size of the cache. Performance is increased as more data spaces are used.</td>
</tr>
<tr>
<td><strong>Total pages</strong></td>
<td>The number of 4 K pages in the cache. That is, (user_cache_size / 4K).</td>
</tr>
<tr>
<td><strong>Free</strong></td>
<td>The number of available 4 K pages in the cache.</td>
</tr>
<tr>
<td><strong>Segments</strong></td>
<td>The number of 64 K sections that was referenced in a file. The number of segments starts out as half of vnode_cache_size and is allocated as needed, similar to vnodes.</td>
</tr>
<tr>
<td><strong>Steal Invocations</strong></td>
<td>The number of times 4 K pages were reclaimed from the cache.</td>
</tr>
<tr>
<td><strong>Waits for Reclaim</strong></td>
<td>The number of times a task waited for space to be reclaimed from the cache.</td>
</tr>
<tr>
<td><strong>Number of cache spaces</strong></td>
<td>The number of cache spaces that are used to hold the 4 K pages in the cache. The pages are spread evenly across the cache spaces to allow for better performance of the cache. The number of data spaces that are used is approximately one per 16384 4 K pages, up to a maximum of 32.</td>
</tr>
<tr>
<td><strong>Pages per cache space</strong></td>
<td>The number of 4 K pages that is assigned to each cache space.</td>
</tr>
</tbody>
</table>

**Using SMF records to report on activities**

System Management Facilities (SMF) provides a means to record data that can be used for various purposes. zFS can use this facility to record information that describes events that are related to the file system. zFS can also record statistics that are generally available from existing zFS queries so that administrators can get a better sense of system performance over an extended period of time.

To have zFS record this information, use the IOEFSPRM configuration option smf_recording. For a full description of this option and its values, see “IOEFSPRM” on page 227. The values of smf_recording can also be dynamically modified with the zfsadm config -smf_recording command. See “zfsadm config” on page 160. Also, see z/OS MVS System Management Facilities (SMF) for information about defining what information that zFS is to collect in SMF and how often it should be collected.

The information to be collected can be defined only in parmlib member SMFPRMxx. The time interval that defines how often zFS is to record data in SMF can be specified in the parmlib member or by using the zFS IOEFSPRM configuration option smf_recording.

- The default value, smf_recording=OFF, indicates that zFS is not to record any SMF records, regardless of the values specified in parmlib member SMFPRMxx.
- smf_recording=ON means that zFS will create SMF records for the record types that are specified in the parmlib member SMFPRMxx, but it will use the time interval that was specified in the parmlib member.
- smf_recording=ON,intvl means that zFS will create SMF records for the record types that are specified in the parmlib member and it will also use the time interval intvl that is specified in smf_recording.

See z/OS MVS System Management Facilities (SMF) for information about the contents of the SMF records provided by zFS, and for information about how to obtain the records from SMF.

**SMF record type 92**

zFS records file system-related data in type 92 records with subtypes of 50 through 59.
• Subtype 50 is used when administrative actions or other significant events occur to a file system. Subtype 50 records are recorded when the event occurs, regardless of the SMF time interval setting. See Table 10 on page 90 for a complete list of file system events.

• Records in subtypes 51-59 provide reports that contain performance-related statistics. These statistics are the same information that is displayed when the zFS modify command is used to print reports. See Chapter 8, “Performance and debugging,” on page 65 for examples of the reports that are displayed with the zFS modify command. These statistics are gathered for each subtype that is being recorded when the time interval expires.

The statistics contained in a record will represent a delta from the last time the subtype record was created. This allows for monitoring of performance changes over a long period of time. The data in the SMF records is not affected by a reset of the statistics by a zFS modify command or a zfsadm query –reset command. Similarly, the creation of SMF records also does not cause a reset of statistics that might affect the results from the zFS modify command or zfsadm query command. See Table 10 on page 90 for a complete list of the performance statistics available in SMF records.

<table>
<thead>
<tr>
<th>Subtype</th>
<th>Record contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>This record represents one of the following events that has occurred:</td>
</tr>
<tr>
<td></td>
<td>• Log file recovery performed during mount or during aggregate recovery of a system that is internally restarting.</td>
</tr>
<tr>
<td></td>
<td>• Successful grow or dynamic grow of a file system.</td>
</tr>
<tr>
<td></td>
<td>• Failed grow or dynamic grow of a file system.</td>
</tr>
<tr>
<td></td>
<td>• Aggregate data set is different after a file system mount.</td>
</tr>
<tr>
<td></td>
<td>• File system ownership change in a sysplex.</td>
</tr>
<tr>
<td></td>
<td>• File system is disabled when zFS detects an internal error or when metadata I/O fails.</td>
</tr>
<tr>
<td></td>
<td>• File system is salvaged.</td>
</tr>
<tr>
<td></td>
<td>• File system is successfully shrunk.</td>
</tr>
<tr>
<td></td>
<td>• The result of an encryption operation.</td>
</tr>
<tr>
<td></td>
<td>• The result of a decryption operation.</td>
</tr>
<tr>
<td></td>
<td>• The result of a compression operation.</td>
</tr>
<tr>
<td></td>
<td>• The result of a decompression operation.</td>
</tr>
<tr>
<td>51</td>
<td>Shows the accumulated counts and response times for vnode operations.</td>
</tr>
<tr>
<td>52</td>
<td>Contains the statistics for the zFS user file cache.</td>
</tr>
<tr>
<td>53</td>
<td>Contains statistics for the zFS metadata cache.</td>
</tr>
<tr>
<td>54</td>
<td>Contains zFS locking and sleep statistics, including most highly contended locks.</td>
</tr>
<tr>
<td>55</td>
<td>Contains general zFS disk I/O statistics.</td>
</tr>
<tr>
<td>56</td>
<td>Provides statistics for the token manager.</td>
</tr>
<tr>
<td>57</td>
<td>Details zFS use of memory, with total bytes allocated to each zFS subcomponent.</td>
</tr>
<tr>
<td>58</td>
<td>Contains records that indicate how many XCF messages were sent between zFS members in the sysplex, and the average time for these messages.</td>
</tr>
</tbody>
</table>
Table 10: Subtypes for SMF record type 92. This table lists the subtypes for SMF record type 92 and explains when they are produced. (continued)

<table>
<thead>
<tr>
<th>Subtype</th>
<th>Record contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>Contains per-file system usage. There is data for each file system that is mounted at the time the records are created. Although zFS will bundle data for multiple file systems into a record, the more file systems you have, the more records zFS will write to SMF. If you select records of this subtype, you should ensure that the SMF data sets are large enough to prevent these records from flooding it.</td>
</tr>
</tbody>
</table>

**Debugging aids for zFS**

If a problem occurs in zFS that requires the attention of IBM support, it is important to obtain the appropriate problem determination information to help resolve the problem quickly. This section covers topics to help you gather this information.

**Overview of trace options for zFS**

One of the most important aspects of zFS problem determination is its tracing capability. zFS has an internal (wrap around) trace table that is always tracing certain events. The size of this trace table is controlled by the IOEFSRPM trace_table_size option.

**Steps for tracing on zFS**

If you are re-creating a problem and need to collect a zFS trace, use the following steps:

1. Allocate the trace output data set as a PDSE, RECFM=VB, LRECL=133 with a primary allocation of at least 50 cylinders and a secondary allocation of 30 cylinders.
2. Define the zFS trace output data set to zFS by either using the IOEFSRPM trace_dsn option, or dynamically by using the `zfsadm config -trace_dsn` command.
   - If you use the IOEFSRPM option, zFS must be stopped and then restarted to pick up the change, unless you also dynamically activate the trace output data set with the `zfsadm config -trace_dsn` command.
3. When you are ready to re-create the problem, reset the zFS trace table using the `MODIFY ZFS,TRACE,RESET` command.
4. Re-create the problem.
5. Enter the `MODIFY ZFS,TRACE,PRINT` command. This formats and prints the trace table to the PDSE defined on the `trace_dsn` option.
6. Capture the ZFSKNTnn member from the trace output data set, (for example, copy it to a sequential data set) so that it can be sent to IBM service.

A separate trace output data set is required for each member of a sysplex.

1. Ensure that you set up the trace data sets so that each system in the sysplex can write to its own trace output data set concurrently. This requires separate IOEFSRPM files or the use of system symbols in the trace_dsn name or the use of an IOEPRMxx parmlib member. For more information, see Chapter 5, “Using zFS in a shared file system environment,” on page 49.
2. Allocate the data set as a PDSE, RECFM=VB, LRECL=133 with a primary allocation of at least 50 cylinders and a secondary allocation of 30 cylinders. Each trace output is created as a new member with a name of ZFSKNTnn, where nn starts at 01 and increments for each trace output until zFS is restarted. After restart, when the next trace output is sent to the trace output data set, ZFSKNT01 is overlaid. You should not be accessing the trace output data set while a trace is being sent to the trace output data set. The space that is used by a particular trace depends on how large the trace_table_size is and how recently the trace was reset. For example, a 32-MB trace_table_size can generate a trace output member of 100 cylinders of 3390. It is important that the trace output data set be large enough...
to hold the trace output. If it runs out of room while sending the trace to the trace output data set, the complete trace will not be captured.

**Note:** You can have a trace_table_size up to 65535 MB, but to print the trace to a PDSE you must limit its size to 750 MB.

IBM service might require you to trace more events. Additional trace information can be obtained using the following methods:

- Add events to trace by specifying the ioedebug statements in a data set that is read when zFS is started (or restarted). The data set name is specified in the IOESPROM debug_settings_dsn option. It is a PDS member with an LRECL of at least 80. IBM specifies the exact statements needed in the data set.
- Dynamically add the events to trace by entering the MODIFY ZFS,IOEDEBUG command. IBM specifies the exact statements needed.
- If you were not able to capture the trace, but you have a zFS dump, IBM service can obtain the trace from the dump. To obtain a dump, you can issue a MODIFY ZFS command. See “Understanding zFS dumps” on page 93 for additional information.

The zFS trace table is above the 2-GB bar to avoid consuming space in the zFS address space, which is below the bar.

**Understanding the salvager utility**

The salvager (ioeagslv or ioefsutl salvage) utility is a zFS-supplied program that runs as a batch job. It examines a zFS aggregate to determine if there are any inconsistencies in the structure of the aggregate. In many cases, it can also fix a corrupted aggregate. Before you run the salvager utility against an aggregate, the aggregate must be unmounted (detached). If unmounting the aggregate is not possible or not convenient, it can still be salvaged while it is mounted by using the zfsadm salvage command. For more information about salvaging online, see “zfsadm salvage” on page 220.

When a zFS aggregate is not cleanly unmounted (for example, system is re-IPLed without a shutdown, system goes down, zFS abends and goes down, zFS is canceled, and so on), the next time the aggregate is mounted, zFS will play the aggregate log to bring the aggregate back to a consistent state. Message IOEZ00397I (among others) is issued to indicate zFS is playing the log. Usually, running the log is successful and does not require any other action. However, even though the aggregate is consistent, you can still have some data loss if information was being written shortly before or at the time the failure occurred.

There are times, listed in the following list, when it might be appropriate to run the salvager utility against a zFS aggregate. Depending on how the file system is used at your installation, you might want to run the salvager to ensure that there is no corruption or to attempt to correct a corruption. For example, if the file system has not yet been mounted or you can take it offline without impacting many users or applications, you might want to run the salvager soon after the problem occurs. Conversely, if the file system is used extensively, you might decide not to run the salvager or wait for a more convenient time to do so.

- An internal error has occurred during zFS processing for the aggregate.

  In this situation, zFS issues abend 2C3 and message IOEZ00422E. zFS detected a problem and disabled the aggregate so that no reads or writes can occur for this aggregate until it is remounted. This action attempts to avoid writing incorrect data that might corrupt the aggregate. If you want to run the salvage utility, you must first unmount the aggregate.

- An I/O error has occurred while accessing the aggregate. zFS detected a physical I/O error on the device.

  In this case, zFS issues messages IOEZ00001E or IOEZ00550E and the message IOEZ00422E. zFS detected the I/O error and disabled the aggregate. This is most likely a hardware problem. Follow your local procedures for analyzing I/O problems to determine if you want to run the salvage utility. If you run the utility, you must first unmount the aggregate.

- A zFS problem occurs during a mount of a zFS aggregate.
zFS detected a problem while mounting a zFS aggregate. The mount might receive a return code of EMVSERR (decimal 157). zFS might issue a non-terminating abend during the mount. In this case, you might choose to run the salvager because the aggregate was not yet mounted.

If an aggregate cannot be repaired successfully, the salvager marks it as damaged. If it is then mounted, an IOEZ00783E message is issued indicating that a damaged aggregate was mounted.

If you decide to run the salvager utility, specify the -verifyonly option to examine the aggregate structures. If there are no error messages, the aggregate is not corrupted. If you run the salvager utility with no options, it attempts to fix any corruptions that it finds.

In the following situations, the salvager utility might not always be able to fix a corrupted aggregate:

- If a fundamental aggregate structure is corrupted, the salvager will not be able to recover the aggregate.
- If the aggregate is large or has many objects, the salvager might not be able to complete successfully. Even when the salvager is successful, an aggregate with many objects will take a long time to examine and attempt to repair. It might take less time to restore a backup copy of the aggregate than to salvage it.

The salvager is designed to make all repairs in one pass, but due to the nature of the program's inputs (a corrupted, possibly vastly corrupted file system) IBM recommends a second running of the salvage program to verify that the aggregate is truly repaired. If verifying the aggregate shows that it is not repaired, then you should try running the salvager again to repair the aggregate. If this does not repair the aggregate, you can create a copy of the aggregate and run the salvager more times to try to repair it. If the salvager cannot repair the aggregate after several repair attempts, the copy of the aggregate and salvager job logs will allow IBM service to determine why.

It is important to maintain backups of zFS aggregates to restore in case of a corrupted aggregate. It is also very important to maintain a regular backup regimen (for example, daily, weekly, monthly) so that if a recent backup is corrupted, you can use an older backup. However, if a quiesce is not done before backup, corruption of the file system can result. See Chapter 6, “Copying or performing a backup of a zFS,” on page 59 for recommendations for backing up zFS aggregates.

Understanding zFS dumps

Another important source of information is a zFS dump. Any time a zFS failure occurs, you should check the system log to see if zFS has performed a dump. In a sysplex, zFS typically requests a dump on the other sysplex members; check to see if other members have zFS dumps. Typically, these will have the following message:

```
IOEZ00337E zFS kernel: non-terminating exception 2C3 occurred, reason EA2F0385
```

The abend reason of EAxx0385 indicates that the dump was requested by zFS from another sysplex member. If zFS does not automatically request a dump from the other sysplex members, you should enter the MODIFY ZFS,DUMP command on these other systems.

zFS also sends the trace to the trace output data set when a zFS dump occurs. When a zFS abend occurs, other application failures might occur. For problem determination, these failures are not as important as the original zFS failure and dump.

Typically, zFS does not stop as a result of a zFS failure. An aggregate might become disabled (see “Diagnosing disabled aggregates” on page 101). If zFS does stop, zFS attempts to perform an internal restart after the terminating exception occurs. If the internal restart is unsuccessful, zFS attempts a stop and restart sequence. If the restart is successful, you might need to remount any zFS file systems. You might need to remount zFS file systems. The SETOMVS command can be used to remount file systems that were mounted from a BPXPRMxx parmlib member statement.

If a failure of a zFS operation occurs (other than a user error), but zFS does not dump, you should get a trace of the failure, if possible. Perform the steps outlined in “Steps for tracing on zFS” on page 91.

You can also obtain a dump of the zFS address space by entering the MODIFY ZFS,DUMP command. The dump should contain the zFS trace table. You must ensure that the dump is complete. Partial dumps are of little use.
Alternatively, you can enter the MODIFY ZFS,ABORT command to cause zFS to send the trace to the trace output data set and to perform a dump. This also causes zFS to attempt an internal restart.

**Determining the XCF protocol interface level**

Beginning with z/OS V2R3, zFS uses the long-running command support protocol and runs with sysplex=filesys. This change requires toleration support on V2R1 and V2R2. For more information, see [z/OS Migration](#) and “Applying required APARs for z/OS V2R3” on page 14.

Message IOEZ00617I is issued during zFS initialization to indicate whether zFS is running sysplex-aware on a file system basis (referred to as sysplex filesys), sysplex-aware for all read/write file systems (referred to as sysplex file-support), or neither (referred to as sysplex admin-only). It also indicates the zFS interface level that is being used:

4
  One of the following:
  • The z/OS V2R3 level (with XCF protocol long-running command support).
  • The z/OS V2R2 level (with XCF protocol enhance log and enhanced status APIs).
  • The z/OS V2R1 level (with XCF protocol extended directory).
  • The z/OS V1R13 level (with XCF enhanced connect protocol).

3
  The z/OS V1R12 level.

2
  The V1R12-compatible level that is used by z/OS V1R9 and z/OS V1R10.

**Saving initialization messages in a data set**

The IOEFSPRM msg_output_dsn option specifies the name of a data set that contains output messages that come from the zFS PFS during zFS initialization. This option might be helpful for debugging because the data set can be sent to IBM service if needed. The msg_output_dsn option is optional. If it is not specified, zFS PFS messages go only to the system log. If it is specified, the data set should be preallocated as a sequential data set with a RECFM=VB and LRECL=248 and should be large enough to contain all zFS PFS initialization messages between restarts. The space used depends on how many zFS initialization messages are issued. A suggested primary allocation is two cylinders with a secondary allocation of two cylinders. If the data set fills up, no more messages are written to the data set. (They still go to the system log.) After zFS restarts, the message output data set is overwritten.

**Determining service levels**

You can determine the service level of the zFS physical file system by examining the messages that occur on the operator’s console when zFS initializes.

Alternatively, you can issue the MODIFY ZFS,QUERY,LEVEL operator command and look for the following message:

In a z/OS V1R13 or later shared file system environment, the sysplex level is (filesys,norwshare) or (filesys,rwshare), depending on the sysplex_filesys_sharemode. The interface is (4).
In addition, you can determine the service level of the `zfsadm` command by issuing the `-level` option of the `zfsadm` command. For example:

```
IOEZ00020I zfsadm: z/OS    zFS
Version 02.03.00 Service Level 0000000 - HZFS430.
Created on Tue Mar 14 12:06:59 EDT 2017.
```

### Understanding namespace validation and correction

zFS provides namespace validation and correction in a shared file system environment. First, it is important to understand the concept of a namespace. zFS communicates between sysplex members using XCF protocols. The zFS XCF protocol exchanges information among members about zFS ownership and other attributes of zFS mounted file systems. This information, which is kept in the memory of each zFS member, is called the zFS namespace. If zFS members do not agree on the zFS owner of each file system, there might be problems that require a zFS restart or an IPL to recover.

zFS namespace validation is invoked in one of four ways:

- When an administration command experiences an XCF message timeout.
- Automatically at zFS initialization.
- Automatically when zFS detects a problem that might be because of a namespace inconsistency.
- Explicitly using the `MODIFY ZFS,NSVALIDATE` operator command.

zFS namespace validation compares the information that is stored in each zFS member. If zFS validation detects an inconsistency, one or more messages can occur (for example, IOEZ00612I) and zFS attempts to correct the inconsistency, using one of the following actions:

- Updating the inconsistent information.
- Automatically remounting a file system.
- Internally restarting zFS on one or more members.

The corrective action is disruptive and might cause one or more applications to receive I/O errors and display messages IOEZ00618E through IOEZ00637E. In addition, zFS might take SVC dumps when it detects a name inconsistency; therefore, do not issue the `MODIFY ZFS,DUMP,ALL` command.

Each zFS only keeps track of file systems that are locally mounted. z/OS UNIX locally mounts file systems on systems where the mount was issued (or directed to through the SYSNAME parameter), and for sysplex-aware file systems, on other systems. z/OS UNIX keeps mount information that is hardened in the couple data set. In addition, zFS keeps track of zFS ownership by using cross system ENQ. The zFS owner of an aggregate always has an exclusive ENQ with a qname of SYSZIOEZ and an rname of IOEZLT.aggregatename. In this way, zFS hardens zFS ownership information in an independent repository. When an inconsistency is detected in the zFS namespace information between zFS members, this hardened information can be queried to determine how to automatically correct the inconsistency.

**Tip:** Use the `DISPLAY GRS,RES=(SYSZIOEZ,*)` operator command to display zFS ENQs. For RNAME explanations and use, see Serialization summary in *z/OS MVS Diagnosis: Reference*.

### Understanding delays and hangs in zFS using the zFS hang detector

The zFS hang detector automatically monitors the current location of the various tasks processing in zFS. At a set interval, the hang detector thread wakes up and scans the current user requests that have been called into zFS. The hang detector processes this list of tasks and notes various pieces of information to determine the location of the task. When the hang detector determines that a task has remained in the same location for a predefined period of time, it attempts to determine why it is not making progress. This might cause zFS messages or dumps. Certain zFS messages can remain on the screen while the delay continues. If subsequently, the hang detector recognizes that this task has finally progressed, it removes zFS message from the console. If the zFS message is removed, it means that the delay has cleared and was just a slowdown because of a stressful workload or some other issue. In this case, you can discard any zFS dumps that occur because of this delay.
Several zFS messages warn of potential problems in the zFS address space that have to do with delays. If zFS determines there is a true deadlock, zFS initiates dumps of all systems. The system that detected the deadlock stops and restarts zFS to clear the deadlock. Some delays involve only a single system; other delays in a shared file system environment can involve other systems and XCF communications.

IOEZ00xxxI zFS messages are issued by the zFS hang detector and generally remain on the console until the situation is resolved. Resolution occurs when:

- The delayed task completes without any external correction. This is a slowdown and not a hang. Discard any zFS system dumps.
- The delayed task is cancelled or the request is timed out. In these cases, you should supply any system dump taken by zFS to IBM service for diagnosis.

For delays, zFS issues several messages to attempt to diagnose what might be involved in the delay. A delay might occur when:

- zFS invokes another component (such as allocation, open/close, or global resource serialization). In this case, zFS issues message IOEZ00604I or IOEZ00660I to recommend that you use the other component's diagnosis material to determine the cause of the delay. zFS does not produce a dump.
- There is heavy system activity with higher priority tasks delaying lower priority tasks or a delay in another system service that is not covered by message IOEZ00604I. In this case, zFS issues message IOEZ00605I, but does not produce a dump.

**Hangs and delays in shared file system environment**

When there is an XCF communication delay, the zFS hang detector sends you a message. For example:

- If the other system never received the XCF message, zFS issues message IOEZ00591I.
- If the other system received the XCF message, but it is not making any progress on the other system or zFS cannot determine its status, zFS issues message IOEZ00547I.
- If the other system received the XCF message but the progress is very slow or long running, zFS issues message IOEZ00661I.
- If the other system processed the XCF message and sent a response back, but zFS did not receive the response, zFS issues message IOEZ00592I.

In these cases, zFS does not issue a system dump. Use the message information that refers to the systems that are not responding and determine the status of those systems. There might also be messages on the other systems that indicate the real problem. (Typically, each system issues its own messages when there is a problem.) There are timeouts on each XCF message. Wait to see whether a request timing out resolves the hang. If a request times out, the request will fail.

zFS also determines how long remote requests can take by supplying a timeout value to XCF (approximately 10 to 15 minutes). XCF monitors the request and if it takes longer than the timeout value, XCF indicates to zFS that the request timed out. In this case, zFS issues message IOEZ00658E or IOEZ00659E and fails the request. The message indicates an aggregate name if the timeout can be associated with an aggregate. The administrator should use the information in the message that refers to the system that is not responding and determine the status of that system. You might see zFS hang detector messages and the operation might not have run on the target system.

**Steps for diagnosing and resolving a zFS hang**

**About this task**

Perform the following steps when a hang condition is suspected.

**Procedure**

1. Continually monitor for the following messages:
**IOEZ00524I**

zFS has a potentially hanging thread that is caused by: UserList, where: UserList is a list of address space IDs and TCB addresses causing the hang.

**IOEZ00547I**

zFS has a potentially hanging XCF request on systems: Systemnames, where: Systemnames is the list of system names.

To start investigating, if in a sysplex file sharing environment check for message IOEZ00547I (hanging XCF request), which can indicate an XCF issue. If you see this message:

a. Check the status of XCF on each system in the sysplex.

b. Check for any outstanding message that might need a response to determine whether a system is leaving the sysplex or not (for example, IXC402D). The wait for a response to the message might appear to be a zFS hang.

If there is no apparent problem with XCF, continue diagnosis and resolution of the hang by looking for the following messages in syslog or on the operator console. Check each system in the sysplex if applicable.

**IOEZ00604I or IOEZ00660I**

The delay is outside of zFS. zFS called the identified system service and is waiting for a response. Investigate the identified system service. The problem is likely not with zFS.

**IOEZ00605I**

The delay is either in zFS or in a system service that zFS did not specifically identify in message IOEZ00604I. zFS cannot determine whether there is a hang, a slowdown, or some other system problem. To take action, look for other symptoms. For example, if you see messages about components that are using a significant amount of auxiliary storage, resolve the auxiliary storage shortage. If the message persists, continue to the next step.

2. Enter the MODIFY ZFS,QUERY,THREADS command to determine whether any zFS threads are hanging and why.

   The type and amount of information that is displayed as a result of this command is for internal use and can vary between releases or service levels. For an example, see Figure 26 on page 98.

3. Enter the DISPLAY A,ZFS command to determine the zFS ASID.

4. Enter MODIFY ZFS,QUERY,THREADS at one to two-minute intervals for six minutes.

5. Check the output for any user tasks (tasks that do not show the zFS ASID) that are repeatedly in the same state during the time you requested MODIFY ZFS,QUERY,THREADS. If there is a hang, the task that is hanging persists unchanged over the course of this time span. If the information is different each time, there is no hang.

6. If message IOEZ00581E is highlighted in white on the console, there are or recently were quiesced zFS aggregates. Verify that no zFS aggregates are in the QUIESCED state by checking their status using the zfsadm lsaggr, zfsadm aggrinfo -long, or zfsadm fsinfo command. For example, quiesced aggregates are displayed as follows:

   ```
   DCESVPI:/home/susvpi/> zfsadm lsaggr
   IOEZ00106I A total of 1 aggregates are attached
   SUSVPI.HIGHRISK.TEST                                      DCESVPI   R/W QUIESCED
   DCESVPI:/home/susvpi/> zfsadm aggrinfo
   IOEZ00370I A total of 1 aggregates are attached.
   SUSVPI.HIGHRISK.TEST (R/W COMP QUIESCED): 35582 K free out of total 36000
   DCESVPI:/home/susvpi/>
   or
   ```
This example shows how to determine which aggregates are quiesced with the owner information.

If the hang condition prevents you from issuing shell commands, you can also issue the MODIFY ZFS,QUERY,FILE,ALL command to determine whether any file systems are quiesced. As indicated in Table 3 on page 71, a quiesced file system is identified by a "Q" in the flg column.

Resolve the QUIESCED state before continuing to the next step. The hang condition message can remain on the console for up to a minute after the aggregate is unquiesced.

Message IOEZ00581E appears on the zFS owning systems that contain at least one zFS aggregate that is quiesced. There is a delay between the time that the aggregate is quiesced and the time that the message appears. Typically, this time delay is about 30 seconds. You can control this time delay by using the IOEFSPRM QUIESE_CHAR_MESSAGE_DELAY option. This option allows you to specify that the delay should be longer than 30 seconds before the IOEZ00581E message is first displayed. When there are no quiesced zFS aggregates on the system, this message is removed from the console.

There is also a delay between the time that the last aggregate is unquiesced and the time that the message is removed from the console. This message is handled by a thread that wakes up every 30 seconds and checks for any quiesced aggregates that are owned by this system. It is possible for an aggregate to be quiesced and unquiesced in the 30-second sleep window of the thread and not produce a quiesce message. This message remains if one aggregate is unquiesced and another is quiesced within the 30-second sleep window.

7. Check whether any user tasks are hung, focusing on the tasks that are identified by message IOEZ00524I or message IOEZ00660I. User tasks do not have the same address space identifier (ASID) as the zFS address space. One or more threads consistently at the same location might indicate a hang (for example, Recov, TCB, ASID Stack, Routine, State). The threads in the zFS address space with the zFS ASID (for example, xcf_server) are typically waiting for work. It is typical for the routine these threads are waiting in to have the same name as the entry routine. For an example, see Figure 26 on page 98.

If successive iterations of the MODIFY ZFS,QUERY,THREADS command show that the STK/Recov, TCB, ASID, Routine, and State for a thread are constant, it is probable that this thread is hung.

Figure 26: Example of how to check whether user tasks are hung
since  Oct 14 04:15:57 2014  Current DSA: 48338EB5C8
wait code location offset=3D74 rtn=epit4_Allocate
lock=48263E30F0 state=80000048000D6AA1 owner=(48000D6AA0)
lock description=ANODETB status area lock
ReadLock held for 4833F0DE50 state=A 0
lock description=Vnode-cache access lock
ReadLock held for 4833F0DEA0 state=8 0
lock description=Vnode lock
ReadLock held for 482660CC20 state=7 7A94FEF0
lock description=Vnode lock
ReadLock held for 482660BA00 state=4 0
lock description=Anode filesset handle lock
ReadLock held for 48263E30B0 state=4 0
lock description=ANODETB main update lock
Resource 4833F0DE40 1A held
resource description=STKC held token by local user task
Resource 4826661800 17 held
resource description=ANODE maximum transactions started for a
Resource 4830685800 2F held
resource description=Transaction in progress
Operation counted for OEVFS=7AB8DA00 VOLP=4826661A00
fs=ZFSAGGR.BIGZFS.DHH.FS1.EXATTR

48338E0000 005C12F8 0084 48338E9700 ZFSDWR WAITLOCK
since  Oct 14 04:15:57 2014  Current DSA: 48338E23C8
wait code location offset=4940 rtn=stkc_getTokenLocked
lock=4823F8CFD0 state=5 owner=(2 read holders)
lock description=Vnode-cache access lock
Operation counted for OEVFS=7AB8DE00 VOLP=4826663200
fs=ZFSAGGR.BIGZFS.DHH.FS6.EXATTR

48338D8000 005CAD80 0079 48338D8700 ZFSCREAT RUNNING
since  Oct 14 04:15:57 2014  Current DSA: 48338D8000
wait code location offset=4940 rtn=allocate_pages
wait for resource=7BC66330 0
resource description=VNOPS user file cache page reclaim wait
ReadLock held for 4823F49F10 state=A 0
lock description=Vnode-cache access lock
Operation counted for OEVFS=7AB8DE00 VOLP=4826663200
fs=ZFSAGGR.BIGZFS.DHH.FS6.EXATTR

48338C8000 005CABE8 00A6 48338C8700 ZFSDWR OSIWAIT
since  Oct 14 04:15:57 2014  Current DSA: 48338CDA38
wait code location offset=4940 rtn=allocate_pages
wait for resource=7BC66330 0
resource description=VNOPS user file cache page reclaim wait
ReadLock held for 4833B49F10 state=A 0
lock description=Vnode-cache access lock
Operation counted for OEVFS=7AB8DE00 VOLP=4826663200
fs=ZFSAGGR.BIGZFS.DHH.FS6.EXATTR

7F37B000 005D5528 0044 7F37C000 openclose_task RUNNING
since  Oct 14 03:43:35 2014

7F3B4000 005F8100 0044 7F3B5000 CNMAIN WAITING
since  Oct 14 02:58:01 2014

7BC45000 005C19C0 0044 7BC46000 comm_daemon RUNNING
since  Oct 14 04:15:57 2014
8. IBM Support must have dumps of zFS, OMVS and the OMVS data spaces and also possibly the user address space identified on any preceding IOEZ00605 for problem resolution. Obtain and save SYSLOG and dumps of zFS, OMVS and the OMVS data spaces, and the user ASID using JOBNAME=(OMVS,ZFS, user_jobname), DSPNAME=('OMVS' . *) in your reply to the DUMP command. If you are running in a sysplex and zFS is running on other systems in the sysplex, dump all the systems in the sysplex where zFS is running, dumping zFS, OMVS and OMVS data spaces. The following is an example of the DUMP command:

```
DUMP COMM=(zfs hang)
R x, JOBNAME=(OMVS,ZFS), SDATA=(RGN, LPA, SQA, LSQA, PSA, CSA, GRSQ, TRT, SUM, COUPLE),
JOBNAME=(OMVS,ZFS, user_jobname)
DSPNAME=('OMVS' . *), END
```

Do not specify the job name ZFS if zFS is running inside the OMVS address space.

You must capture dumps for IBM Support before taking any recovery actions (HANGBREAK, CANCEL, ABORT).

9. If you know which user task is hung (for example, returned in IOEZ00524I or determined to be hung after review of the output from repeated MODIFY ZFS,QUERY,THREADS,OLDEST commands), consider entering the CANCEL or STOP command to clear that task from the system.

10. Finally, if the previous steps do not clear the hang, issue the MODIFY ZFS,ABORT command to initiate a zFS internal restart.

An internal restart causes the zFS kernel (IOEFSKN) to end and then restart, under control of the zFS controller task (IOEFSCM). The zFS address space does not end and the z/OS UNIX mount tree is preserved. During the internal restart, requests that are already in the zFS address space fail and new requests are suspended. File systems owned by zFS on the system that is doing the internal restart become temporarily unowned. These file systems are taken over by other zFS systems (or by the zFS system doing the internal restart when it completes the internal restart). When the internal restart is complete, the suspended new requests resume.

If you question the hang condition or if the MODIFY ZFS,ABORT command does not resolve the situation, contact IBM Support and provide all the dumps and SYSLOG information.

### Identifying storage shortages in zFS

When zFS can no longer obtain sufficient storage to complete a request, it issues message IOEZ00188A, possibly creates a dump, and restarts. If you see message IOEZ00188A before zFS initialization is complete (before message IOEZ00055I), either increase the REGION size in the ZFS PROC or decrease some cache sizes in the IOEFSPRM configuration file.

In addition, the zFS hang detector periodically checks a warning limit and a critical limit. When it reaches the warning limit, message IOEZ00662I displays and remains on the console until the situation is resolved, or until the critical limit is reached. If the critical limit is reached, message IOEZ00663I displays and remains on the console until storage usage goes below the critical limit to the warning limit, and then message IOEZ00662I displays again. See “STOR” on page 81 for more information about how to determine the amount of storage being used in the zFS address space.

A zFS storage shortage can be caused by the number of active vnodes in use in zFS. You can query the number of held vnodes using either the MODIFY ZFS,QUERY,LFS system command, or the zfsadm query -vnodecache command. You can also query the current sizes of the zFS caches in the zFS address space using the zfsadm configquery command with its cache size parameters, such as -meta_cache_size or -vnode_cache_size. For example, zfsadm configquery -meta_cache_size returns the metadata cache size. When zFS is running in a shared file system environment, you can query the client reply storage using zfsadm configquery -client_reply_storage. You can also determine cache sizes by using the MODIFY ZFS,QUERY,STORAGE command. Decreasing one or more cache sizes might relieve the zFS storage shortage.

### Tips:

- Changing the size of a cache can cause delays. Try to change the size during low activity periods.
• In general, if you see a return code of 132 (ENOMEM), zFS is short on storage; take steps to reduce zFS storage usage. When storage shortages become critical, you can also see 157 (EMVSERR) and mounts might begin to fail.

• Started subtasks, such as the zFS colony address space, fall under SUBSYS STC. These address spaces might be subject to IEFUSI limitations if IEFUSI exits are allowed for SUBSYS STC. IBM strongly recommends that you always set REGION=0M and MEMLIMIT=NOLIMIT for the zFS colony address space.

**Diagnosing disabled aggregates**

If zFS detects a problem on an aggregate that is mounted read/write, zFS attempts to isolate the failure. As a result, zFS might mark an aggregate unavailable and issue message IOEZ00422E, as shown in the following example.

```
IOEZ00422E Aggregate PLEX.JMS.AGGR001.LDS0001 disabled
```

In addition, a dump and possibly zFS trace information might be generated. You can contact IBM service and provide the dump and the trace and any other information that is useful for diagnosing the problem (for example, what was running on the system when the problem occurred).

When an aggregate is disabled, applications cannot read from, or write to, the aggregate. Other aggregates that are not involved in the failure remain available. However, the disabled aggregate is not available for reading and writing until it is automatically re-enabled by zFS, or it is unmounted and mounted.

• zFS attempts an internal remount samemode on the zFS-owning system in the following situations:
  – It is in a non-shared file system environment.
  – The file system is non-sysplex aware.
  – The file system is sysplex-aware, but no other system in the shared file system environment can take it over.

• Alternatively, in a shared file system environment where the file system is sysplex-aware, the zFS owning system requests that another system take over the aggregate.

The preceding re-enablement actions (aggregate movement or internal remount samemode) are taken only if the file system became disabled due to an internal zFS error or a corruption.

Even though the aggregate is disabled, z/OS UNIX System Services continues to display the aggregate mounted as R/W. To determine whether the aggregate has been marked as disabled, use the zfsadm fsinfo command, zfsadm lsaggr command or the zfsadm aggrinfo command.

An aggregate that was disabled might be corrupted, even if it was disabled and remounted. To be sure that the aggregate is internally consistent, run the ioefsutl salvage batch utility against the aggregate that was disabled, to repair any corruption, and prevent loss of data. See “ioefsutl” on page 127 for more information.

**Handling disabled aggregates**

An aggregate can become disabled for many reasons, such as:

• An I/O error or failure of a DASD device.
• Loss of connectivity to a DASD device.
• An internal zFS error.
• Permanent corruption of the aggregate.

If a compatibility mode aggregate becomes disabled, zFS attempts to automatically re-enable the disabled aggregate. It either requests that another system in the shared file system environment take over the aggregate (if it is sysplex-aware) or it attempts an internal remount samemode. This action should recover the aggregate and it will no longer be disabled.
Generally, an aggregate that has become disabled (unless it was due to a planned activity, such as a vary offline of a device) should be salvaged by using the `ioefsutl salvage` utility as soon as possible. Because zFS has detected a problem, there is a chance that the file system is corrupted, even if it has been successfully re-enabled.

- If the file system can be taken offline (unmounted) immediately or at a regularly scheduled time, take it offline and run salvager.
- If the file system is a critical production file system that cannot be easily unmounted, you can run the online salvage utility if the file system is zFS-owned on a system that is running release V2R3 or later.

Otherwise, you will have to use your best judgment when considering the inconvenience of unmounting the file system against the risk of continuing to use a file system that might possibly be corrupted. When the file system is backed up according to your installation's regular schedule, you might be backing up a corrupted file system. If this continues, you might lose any previous backed-up versions of the file system that were not corrupted. In this case, you might want to arrange to salvage the first backup copy of the file system after it was disabled and re-enabled.

**Running the `ioefsutl salvage` utility**

To run the `ioefsutl salvage` utility, you must first unmount the aggregate. The z/OS UNIX shell unmount command (/usr/sbin/unmount) may query the status of the file system before unmounting it. Because the file system is disabled, this query will fail which, in turn, might cause the entire unmount to fail. Therefore, you might need to use the TSO/E UNMOUNT command or the operator MODIFY BPXOINIT,FILESYS=UNMOUNT,FILESYSTEM=filesysname command to unmount the disabled file system.

If you do not unmount before running `ioefsutl salvage`, the system issues messages such as the following one:

IKJ5622SI DATA SET PLEX.JMS.AGGR001.LDS0001 ALREADY IN USE, TRY LATER+
IKJ5622SI DATA SET IS ALLOCATED TO ANOTHER JOB OR USER
IOEZ00003E While opening minor device 1, could not open dataset
PLEX.JMS.AGGR001.LDS0001.

After you run the `ioefsutl salvage` utility and are satisfied that the aggregate is in a consistent state, mount the aggregate again.

To run the online salvage utility on a z/OS V2R3 or later system, issue the `zfsadm salvage` command. For more information about running the online salvage utility, see “zfsadm salvage” on page 220. If automatic re-enablement of the disabled aggregate fails three times, zFS will automatically run the online salvage utility. If the salvage is successful, the aggregate can continue to be used without needing to unmount and mount it again.
Chapter 9. Overview of the zFS audit identifier

An auditid is a 16-byte value that is associated with each z/OS UNIX file or directory. The auditid identifies a z/OS UNIX file or directory in an SMF audit record or in certain authorization failure messages (for example, RACF message ICH408I). An auditid appears in Type 80 SMF records and in the output of certain z/OS UNIX APIs (for example, stat). zFS allows the administrator to specify whether zFS uses a more unique auditid for a zFS file or directory, or uses the non-unique, standard auditid.

Figure 27 on page 103 shows the format of the unique zFS auditid, the standard zFS auditid, and the HFS auditid.

Figure 27: zFS auditid examples

Together, the i-node and unique identifier identify the file or directory within a file system. The remainder of the auditid identifies the file system. The i-node is a slot number that identifies an existing file or directory, but it is reused when a file or directory is deleted. When that same i-node slot is used for a different file or directory, the uniquifier is incremented so that the combination of the i-node and uniquifier is unique. When the uniquifier is two bytes, they are the low-order bytes (the bytes that change most often) of the four-byte uniquifier. In the unique zFS auditid, the file system part of the auditid is known as the auditfid. The VOLSER is the volume serial of the volume that contains the first extent of the zFS aggregate data set. The CCHH is the CCHH of the first extent of the zFS aggregate data set.

The auditfid in the zFS aggregate controls the type of auditid zFS uses: unique auditid or less unique auditid (auditfid of binary zeros). Typically, a zFS aggregate contains a zero auditfid, but you can take steps to store a unique zFS auditfid, which subsequently causes zFS to generate a unique format auditid for each file or directory in the aggregate.

There are three ways to control the zFS auditfid that is stored in the aggregate, which thereby controls the format of the zFS auditid for files and directories that are contained in the aggregate:

• When formatting an aggregate, you get a unique auditfid by default (that is, if you do not specify -nonewauditfid). This is true for the IOEAGFMT batch utility and the zfsadm format command. If you specify -nonewauditfid, the aggregate has the standard auditfid (binary zeros). The IOEFSUTL format always provides a unique auditfid.
• You can optionally specify a zFS configuration option (convert_auditfid=on) in the IOEFSPRM file to control whether the aggregate’s auditfid is converted from a standard format auditfid to a unique auditfid when a zFS file system is mounted. If you specify on, zFS converts the standard auditfid to the unique auditfid on the read/write mount (attach) of the aggregate. You can also specify the convert_auditfid configuration option by using the zfsadm config -convert_auditfid option and query by using the zfsadm configquery -convert_auditfid option. The default for convert_auditfid is ON.
• You can explicitly set an aggregate’s auditfid to a unique auditfid by using the zfsadm setauditfid command.
Enabling the zFS auditid

To enable the unique auditid, start by following scenario “2” on page 104 with some new aggregates to verify that it does not cause problems for your installation. Then, use scenario “3” on page 104 to convert the rest of the aggregates. The next time the aggregates are mounted, they have a unique auditfid.

Scenarios:

1. You want all your aggregates to have the unique auditfid (and therefore, all auditids) use the new method:
   a. Do nothing. The default is convert_auditfid=on in your IOEPRMxx configuration file and new aggregates get unique auditfids by default.

   Any existing aggregates are converted to the unique auditfid the next time they are mounted (attached). Newly formatted aggregates using IOEAGFMT, or zfsadm format get unique auditfids by default. IOEFSUTL format always creates unique auditfids.

2. You want your new aggregates to have the unique auditfid and your existing aggregates to remain with the standard auditfid:
   a. Specify convert_auditfid=off in your IOEPRMxx configuration file.

   b. Specify (or default to) -newauditfid when you format new aggregates using IOEAGFMT or zfsadm format. Use IOEFSUTL to format new aggregates.

   Result: Old aggregates are not converted to unique auditfids when you mount (attach), but new aggregates have the unique auditfids.

3. You want all your aggregates to remain with the standard auditfid (and therefore all auditids have the standard format):
   a. Specify convert_auditfid=off in your IOEPRMxx configuration file and specify -nonewauditfid when you use IOEAGFMT or zfsadm format to format new aggregates. Do not use IOEFSUTL format to format new aggregates.

   Any existing aggregates are converted to the unique auditfid the next time they are mounted (attached). When you format new aggregates and specify the -newauditfid option, the aggregates have the unique auditfid.

Tip: New aggregates formatted with ISHELL, automount allocany, allocuser, or the BPXWH2Z utility will not have unique auditfids after they are formatted. However, they will be converted to unique auditfids by default the first time they are mounted unless you specify convert_auditfid=off in your IOEPRMxx configuration file or specify zfsadm config -convert_auditfid off.

If a zFS aggregate is moved to another DASD location, the auditfid remains the same, unless you change it using the zfsadm setauditfid -force command. This is a trade-off between changing the auditfid, which causes auditfids for the same file to be generated differently, versus not changing the auditfid, which causes auditfids to remain the same but with the possibility that another zFS aggregate might get allocated with the first extent exactly in the place (and on the same volume) as the moved aggregate was located. This means that two different zFS files/directories might have the same auditid.

Even though the zFS auditid format is described, the internal contents of an auditid might not match exactly as stated. The VOLSER might not match the VOLSER of the volume containing the first extent because of moving the aggregate. The main use should be as an opaque number (that is, you should only use it to compare for equality of the whole auditid against another auditid).

Use the following algorithm to help distinguish between the unique auditfid, the standard zFS auditfid, and HFS auditid (which does not depend on the internal contents of the new zFS auditid):

| If the last eight bytes of the auditid are binary zero, the auditid is zFS standard format |
| Else, if the first byte of the auditid is X'01', the auditid is an HFS format |
| Else, the auditid is the unique zFS format |
Part 2. zFS administration reference

This part of the document contains reference information for zFS.

- Chapter 10, “z/OS system commands,” on page 107
- Chapter 11, “zFS commands,” on page 117
- Chapter 12, “The zFS configuration options file (IOEPRMxx or IOEFSPRM),” on page 227
- Chapter 13, “zFS application programming interface information,” on page 239.
Several z/OS system commands are available.

- **MODIFY ZFS PROCESS** queries internal counters and values. Use it to initiate or gather debugging information.
- **SETOMVS RESET** starts the zFS Physical File System (PFS) if it has not been started at IPL, or if the PFS was stopped and the BPXF032D message was responded to with a reply of i.

Run these commands from the console or from System Display and Search Facility (SDSF).
**MODIFY ZFS PROCESS**

**Purpose**

The MODIFY ZFS PROCESS command enables you to query internal zFS counters and values. They are displayed on the system log. It also allows you to initiate or gather debugging information. To use this command, the zFS PFS must be running.

Prior to z/OS V2R2, zFS always ran as a colony address space. The syntax of that command was `modify zfs,<cmd>`. Beginning in z/OS V2R2, zFS can be run as a colony address space or in the OMVS address space. In both cases, the syntax of the modify command can be `modify omvs,pfs=zfs,<cmd>`. This form of the modify command should also be used if you have any zFS modify commands issued through an automated process or system automation.

When zFS modify commands in this documentation are mentioned, they are shown in the historical `modify zfs,<cmd>` form, as they always have been, rather than always mentioning both forms.

**Format**

You can use any of the following formats for this command.

```
modify procname,query,[{level|settings|threads},[allwait|oldest]];[status| [{kn|vm|lfs|lock|storage|file|stkm|ctkc|svliobysd|dataset|all}]
modify procname,reset,[{kn|vm|lfs|lock|storage|file|stkm|ctkc|svliobysd |dataset| all}]
modify procname,trace,[{reset | print}]
modify procname,abort
modify procname,dump
modify procname,hangbreak
modify procname,unquiesce,aggregate_name
modify procname,nsvalidate[,print]
modify procname,fsinfo,[[aggrname | all] [,full | basic | owner | reset} [,{|select=criteria | exceptions} [,sort=sort_name]]]
```

**Parameters**

- `procname`
  The name of the zFS PFS PROC. The default `procname` is ZFS.

  If zFS is running in the OMVS address space (the address space that is used by z/OS UNIX), `procname` must direct the command to zFS through OMVS. For example:

  ```
  modify omvs,pfs=zfs,command
  ```

- `command`
  The action that is performed on the zFS PFS. This parameter can have one of the following values:

  - `abort`
    Causes zFS to dump and then perform an internal restart. The internal trace table is also printed to the data set specified in the IOEFSPRM file `trace_dsn` entry.

  - `dump`
    Causes the zFS PFS to dump and to print the internal trace table to the data set specified in the IOEFSPRM file `trace_dsn` entry.
**fsinfo**

Displays detailed information about a zFS file system, which is also known as a zFS aggregate.

**aggrname**

Specifies the name of the aggregate that the detailed zFS information is for. The aggregate name is not case-sensitive and is translated to uppercase. To specify multiple aggregates with similar names, use an asterisk (*) at the beginning, at the end, or both at the beginning and the end of `aggrname` as a wildcard. If `aggrname` is specified with wildcards, the default display is basic. Otherwise, the default display is owner. For more information, see “Usage notes for displaying file system information” on page 112 and “Examples of displaying file system information” on page 114.

**all**

Displays information for all aggregates in the sysplex. It is the default when `aggrname` is not specified. The default information display will be as if basic were specified.

**basic**

Displays a line of basic file system information for each specified file system. This option is the default in the following situations:

- The all option is specified but full, owner, and reset are not specified.
- If `aggrname` and all are not specified.
- `aggrname` is specified with wildcards.

For more information about what is displayed when the basic option is used, see Table 15 on page 198.

**exceptions**

Displays information about any specified aggregate that is quiesced, disabled, had grow failures, is low on space, failed to convert a directory to version5, or is damaged. Any specified aggregate is also displayed if it has had XCF communication failures or an error because it ran out of space or when doing I/O. This option cannot be specified with reset, select, and `aggrname` with no wildcard.

**full**

Displays information that is maintained by the system owning each specified file system. It also displays information that is locally maintained by each system in the sysplex that has each specified file system locally mounted.

**Tip:** If a large number of file systems are to be displayed, a large amount of output will be displayed. For that case, consider using either the basic output option or the `zfsadm fsinfo` command so that the output can be redirected to a file.

**owner**

Displays only information that is maintained by the system owning each file system specified. This option is the default when `aggrname` with no wildcards is specified. For more information about what is displayed when the owner option is used, see Table 15 on page 198 and Table 16 on page 199.

**Tip:** If a large number of file systems are to be displayed, a large amount of output will be displayed. For that case, consider using either the basic output option or the `zfsadm fsinfo` command so that the output can be redirected to a file.

**reset**

Resets zFS statistics that relate to each specified file system. reset cannot be specified with basic, full, owner, exceptions, select, or sort.

**select=**criteria

Displays each specified file system that matches the criteria.

This option cannot be specified with exceptions, reset, and `aggrname` with no wildcard.

To use this option, specify a selection criteria from Table 14 on page 197. Multiple criteria are separated by spaces.
sort=sort_option
Sorts the displayed information using the value of sort_option. The default is to sort by Name. This option cannot be specified with reset. For a list of the sorting options, see Table 17 on page 200.

hangbreak
Causes a zFS internal restart; this produces the same result as issuing a modify zfs,abort command.

nsvalidate
Initiates the zFS namespace validation on the system where the command is entered. The modify nsvalidate command should only be used in a shared file system environment; typically, it is only used as a part of a recovery procedure when a problem with zFS is suspected. If the command finds an inconsistency, it might cause zFS to abort and internally restart the zFS address space on one or more systems to correct the zFS namespace inconsistency. The modify nsvalidate command consists of the following option:

print
The optional print parameter displays additional name space information that is obtained after validation.

query
Displays zFS counters or values.

level
Displays the zFS level for the zFS physical file system kernel. When running in a shared file system environment, level also displays the zFS sysplex level and the zFS XCF communication interface level (1, 2, 3 or 4). The zFS sysplex level is controlled by the IOEFSPRM sysplex configuration option. When the sysplex level is filesys, the default mount PARM (NORWSHARE or RWSHARE) is also displayed. (As of z/OS V1R13, zFS always runs with sysplex=filesys.) For an example and more information, see “Determining service levels” on page 94.

settings
Displays the zFS configuration settings, which are based on the IOEFSPRM file and defaults.

status
Displays zFS internal restart information.

threads[,allwait | oldest]]
Displays the threads that are monitored by the zFS hang detector. To display all zFS threads, use the modify zfs,query,threads,allwait command. The time of day values are shown in Greenwich mean time (GMT). To display the oldest thread of each system, use the modify zfs,query,threads,oldest command.

<report>
One of the following report options. These parameters all produce reports; for details about these reports, see “Monitoring zFS performance” on page 68.

all
Displays all the zFS counters.

c tkc
Displays the client calls to other systems. Output is only displayed when the zFS ctkc component on this system has sent a message to another system.

dataset
Displays zFS statistics about file systems.

file
Displays the requests per zFS file system and aggregate.

iobydasd
Displays the DASD that is attached by volume.

kn
Displays the calls that were made to zFS from z/OS UNIX.
lfs
Displays the file system statistics, including the performance of the zFS metadata caches, the vnode cache, and the aggregate I/O statistics.

lock
Displays the lock contention values.

log
Displays the log statistics.

stkm
Displays the current server token manager (STKM) statistics.

storage
Displays the zFS storage values.

svi
Displays the calls from other systems to this server through the server vnode interface (SVI) component. Output is only displayed when the zFS svi component on this system has received a message from another system.

vm
Displays the user file cache, including cache hit ratios, I/O rates, and storage usage.

reset
Resets zFS counters and consists of the following options:

all
Resets all the zFS counters to zero.

ctkc
Resets the client call statistics.

dataset
Reset the zFS statistics about file systems.

file
Resets the requests for zFS file system and aggregate.

iobydasd
Resets the count of the DASD that is attached by volume.

kn
Resets the calls that were made to zFS from z/OS UNIX.

lfs
Resets the file system statistics, including the performance of the zFS metadata caches, the vnode cache, and the aggregate I/O statistics.

lock
Resets the lock contention values.

log
Resets the log statistics.

stkm
Resets the server token manager (STKM) statistics.

storage
Resets the zFS storage counters.

svi
Resets the received calls from other systems statistics.

vm
Resets the user file cache, including cache hit ratios, I/O rates, and storage usage.

No other options are allowed after reset.

trace
Resets or prints the internal zFS trace table.
print
Formats and sends the current trace table to the data set specified in the IOEFSPRM file trace_dsn entry. This data set must be preallocated as a PDSE with RECFM VB and LRECL 133. It must be large enough to hold the formatted trace table. See Chapter 8, “Performance and debugging,” on page 65 for more information about the trace output data set.

reset
Resets the internal (wrap around) trace table to empty.

unquiesce
Causes a quiesced aggregate to become unquiesced. Only locally attached aggregates can be unquiesced using the modify unquiesce command. You must issue this command on the system that is the zFS owner of the aggregate. Use the z/OS UNIX zfsadm lsaggr command to determine which system is the zFS owner of the aggregate.

Usage notes for MODIFY ZFS PROCESS
The modify zfs command is used to display zFS counters or values and to initiate or gather debugging information. You cannot issue modify zfs commands during a zFS internal restart.

Usage notes for displaying file system information
Use the MODIFY FSINFO command to display detailed information about zFS file systems, which are also known as zFS aggregates. Normally, file systems must be attached before this command can be used to display their information. However, when specifying a specific aggregate name (with no wildcards), the file system does not need to be attached. You can use several methods to specify aggregates, based on their names, as follows:

- **aggrname** with an exact aggregate name. The aggregate can either be mounted or not mounted.
- **aggrname** using a wildcard (*) at the beginning of the name value to select aggregates with a common suffix.
- **aggrname** using a wildcard (*) at the end of the name value to select aggregates with a common prefix.
- **aggrname** using a wildcard (*) at the beginning and the end of the name value to select aggregates with both a common prefix and a common suffix.
- **all** can be specified or defaulted to mean all file systems that are currently mounted in the sysplex.

The MODIFY FSINFO command options are positional. Each option must be separated by a comma. Only the options at the end of the line can be omitted. If options are omitted, the default values are used instead. Examples of supported syntax are as follows:

<table>
<thead>
<tr>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F ZFS,FSINFO</td>
<td>Displays all available information for each specified file system from the zFS-owning system. The information is obtained via XCF communication with the owning system if the owning system is not the local system. It also displays the statistics that are shown in Table 16 on page 199.</td>
</tr>
<tr>
<td>F ZFS,FSINFO,ALL</td>
<td>Displays statistics for each specified file system from the zFS owning system and from each system in the sysplex that has it locally mounted. This will be obtained via XCF communication with each system in the sysplex. The statistics are described in Table 18 on page 201.</td>
</tr>
<tr>
<td>F ZFS,FSINFO,ALL,BASIC,SELECT=RW Q,SORT=REQUESTS</td>
<td>Aggregates can also be selected using the exceptions option. This option can be useful for identifying file systems which have encountered unexpected conditions, and might need attention. Unexpected conditions include I/O errors, XCF communication failures or being low on space. An aggregate can also be damaged, quiesced, or disabled.</td>
</tr>
</tbody>
</table>

The owner option displays all available information for each specified file system from the zFS-owning system. The information is obtained via XCF communication with the owning system if the owning system is not the local system. It also displays the statistics that are shown in Table 16 on page 199.

The full option displays statistics for each specified file system from the zFS owning system and from each system in the sysplex that has it locally mounted. This will be obtained via XCF communication with each system in the sysplex. The statistics are described in Table 18 on page 201.

Aggregates can also be selected using the exceptions option. This option can be useful for identifying file systems which have encountered unexpected conditions, and might need attention. Unexpected conditions include I/O errors, XCF communication failures or being low on space. An aggregate can also be damaged, quiesced, or disabled.
Aggregates can also be selected by use of the `select` option. To use this option, specify a criteria from the list in Table 14 on page 197. You can specify more than one criteria by using a space to separate them.

The displayed information has the file system status as part of the output. The status field contains abbreviated values. For quick reference, these values are defined in a Legend string at the end of the output. The full definitions of these abbreviations are listed in Table 15 on page 198.

All times are in milliseconds. To display large numbers, use the following suffixes:

<table>
<thead>
<tr>
<th>Letter</th>
<th>Unit of number</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>The number should be multiplied by 1,000,000,000.</td>
</tr>
<tr>
<td>G</td>
<td>The number should be multiplied by 1,073,741,824.</td>
</tr>
<tr>
<td>t</td>
<td>The number should be multiplied by 1000.</td>
</tr>
<tr>
<td>T</td>
<td>The number should be multiplied by 1,099,511,627,776.</td>
</tr>
<tr>
<td>tr</td>
<td>The number should be multiplied by 1,000,000,000,000.</td>
</tr>
<tr>
<td>m</td>
<td>The number should be multiplied by 1,000,000.</td>
</tr>
<tr>
<td>K</td>
<td>The number should be multiplied by 1024.</td>
</tr>
<tr>
<td>M</td>
<td>The number should be multiplied by 1,048,576.</td>
</tr>
</tbody>
</table>

**Privilege required**

This command is a z/OS system command.

**Examples for MODIFY ZFS PROCESS**

The following example queries all the zFS counters:

```
modify zfs,query,all
```

The following example resets the zFS storage counters:

```
modify zfs,reset,storage
```

The following example formats and sends the trace table to the data set specified in the IOEFSIAP file `trace_dsn` entry:

```
modify zfs,abort
```

The following example causes the zFS PFS to execute an internal restart:

```
modify omvs,pfs=zfs,query,all
```

`z/OS system commands 113`
Examples of displaying file system information

1. To display basic file system information for zFS aggregate PLEX.DCEIMGNK.FSINFO:
   modify zfs,fsinfo,aggr,PLEX.DCEIMGNK.FSINFO,basic

2. To display file system owner status using a wildcard:
   modify zfs,fsinfo,aggr,PLEX.DCEIMGNK.*,owner

3. To display full file system status for all zFS aggregates that are quiesced, damaged or disabled:
   modify zfs,fsinfo,all,full,select=Q DA DI

4. To display basic file system status for all zFS aggregates that are quiesced, damaged, or disabled and also to sort aggregate names by response time:
   modify zfs,fsinfo,all,basic,select=Q DA DI,sort=response

Related information

Files:
- IOEFSRPM
- zfsadm fsinfo

For details about stopping zFS, see the topic on Recycling z/OS UNIX System Services in z/OS MVS System Commands.
SETOMVS RESET

Purpose
Can be used to start the zFS PFS if it has not been started at IPL. It can also be used to redefine it if it has been terminated by replying i to the BPXF032D operator message (after stopping the zFS PFS).

Format
setomvs reset=(xx)

Parameters
xx
The suffix of a BPXPRMxx member of PARMLIB that contains the FILESYSTYPE statement for the zFS PFS.

Usage
The SETOMVS RESET command can be used to start the zFS PFS.

Privilege required
This command is a z/OS system command.

Examples
The following command starts the zFS Physical File System if the BPXPRMSS member of the PARMLIB contains the zFS FILESYSTYPE statement:
setomvs reset=(ss)

Related information
File: IOEFSprm
The SETOMVS command also processes zFS FILESYSTYPE statements. For more information, see the SETOMVS command in z/OS MVS System Commands.
SETOMVS RESET
Chapter 11. zFS commands

This section provides a description of zFS commands and batch utilities. In the options section for each command, options are described in alphabetic order to make them easier to locate; this does not reflect the format of the command. The formats are presented the same as on your system.

In addition to displaying z/OS UNIX reason codes, the z/OS UNIX shell command, bpxmtext, also displays the text and action of zFS reason codes (EFxxnnnn) returned from the kernel. zFS does not use the xx part of the reason code to display a module name. It always displays zFS. If you only know the nnnn part of the zFS reason code, you can use EF00nnnn as the reason code. The date and time returned with the zFS reason code matches the date and time returned from the zFS kernel (displayed with operator command MODIFY ZFS,QUERY,LEVEL).

Restriction: The bpxmtext command is not valid for zFS abend reason codes (EAXxnnnn).

You can use the man command to view the descriptions of zFS command manual pages. To use man pages, enter man followed by the command information you want to display. You must enter the zfsadm command suite entries as one word. Table 11 on page 117 shows examples of the zFS man commands.

<table>
<thead>
<tr>
<th>zFS command</th>
<th>man command</th>
</tr>
</thead>
<tbody>
<tr>
<td>ioefsutl salvage</td>
<td>man ioefsutlsalvage</td>
</tr>
<tr>
<td>ioeagfmt</td>
<td>man ioeagfmt</td>
</tr>
<tr>
<td>mount</td>
<td>man zfsmount</td>
</tr>
<tr>
<td>zfsadm aggrinfo</td>
<td>man zfsadmaggrinfo</td>
</tr>
<tr>
<td>zfsadm query</td>
<td>man zfsadmquery</td>
</tr>
</tbody>
</table>

For more information about the man command, see

- man - Display sections of the online reference manual in z/OS UNIX System Services Command Reference.
- Enabling the man pages in z/OS UNIX System Services Planning.
**Purpose**

ioeagfmt is a batch utility that formats a VSAM linear data set to become a zFS compatibility mode aggregate.

**Format**

```
ioeagfmt -aggregate name
    [-encrypt|-noencrypt][-compress|-nocompress]
    [-logsize blocks] [-overwrite] [-compat]
    [-owner {uid|name}][-group {gid|name}]
    [-perms {number}] [-grow blocks]
    [{-newauditfid|-nonewauditfid}][-version4|-version5]
    [-level][-help]
```

**Options**

- `-aggregate name` Specifies the name of the data set to format. This is also the aggregate name. The aggregate name is always converted to uppercase and cannot be longer than 44 characters. The following characters can be included in the name of an aggregate:
  - All uppercase and lowercase alphabetic characters (a to z, A to Z)
  - All numerals (0 to 9)
  - The . (period)
  - The - (dash)
  - The @ (at sign)
  - The # (number sign)
  - The $ (dollar)

- `-compat` Indicates that a compatibility mode aggregate should be created. This means that in addition to formatting the VSAM linear data set as a zFS aggregate, a zFS file system is created with the same name as the aggregate and its free space is set to the size of the available blocks on the aggregate. Beginning with z/OS V2R1, only HFS compatibility mode aggregates can be created. This option is being allowed for compatibility with earlier versions and is not needed.

- `-compress` Specifies that the aggregate will be compressed. See “Usage notes for ioeagfmt” on page 120 for the default value that is used.

- `-encrypt` Specifies that the aggregate will be encrypted. See “Usage notes for ioeagfmt” on page 120 for the default value that is used.

- `-group gid | name` Specifies the group owner for the root directory of the file system. It can be specified as a z/OS group name or as a GID. The default is the GID of the issuer of ioeagfmt. If only -owner name is specified, the group is that owner’s default group. If only -owner uid is specified, the group is the issuer’s group.

- `-grow blocks` Specifies the number of 8-KB blocks that zFS will use as the increment for extension when the -size option specifies a size greater than the primary allocation.
-help
Prints the online help for this command. All other valid options that are specified with this option are ignored.

-initialempty blocks
This option is being allowed for compatibility with earlier versions and is ignored. One 8-KB block at the beginning of the aggregate is reserved for IBM use.

-level
Prints the level of the ioeagfmt command. This is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

-logsize blocks
Specifies the size in 8-KB blocks of the log. The valid range is from 13 to 16384 blocks (128 megabytes). The default is 1% of the aggregate size. This default logsize will never be smaller than 14 blocks and it will never be larger than 4096 blocks (32 megabytes). This size is normally sufficient. However, a small aggregate that is grown to be very large will still have a small log. You might want to specify a larger log if you expect the aggregate to grow very large.

-newauditfid
Specifies that the aggregate should be formatted with the zFS auditfid and stored in the aggregate. Beginning with z/OS V2R1, -newauditfid is the default.

-nocompress
Specifies that the aggregate will not be compressed. See “Usage notes for ioeagfmt” on page 120 for the default value that is used.

-noencrypt
Specifies that the aggregate will not be encrypted. See “Usage notes for ioeagfmt” on page 120 for the default value that is used.

-nonewauditfid
Specifies that the aggregate should not be formatted with a zFS auditfid that is stored in it. Before z/OS V2R1, this was the default.

-overwrite
Required if you are reformatting an existing aggregate. Use this option with caution because it deletes any existing data. This option is not typically specified.

-owner uid | userid
Specifies the owner for the root directory of the file system. It can be specified as a z/OS user ID or as a UID. The default is the UID of the issuer of ioeagfmt.

-perms number
Specifies the permissions for the root directory of the file system. The number can be specified as octal (for example, o755), as hexadecimal (for example, x1ED), or as decimal (for example, 493). See “Usage notes for ioeagfmt” on page 120 for the default value that is used.

-size blocks
Specifies the number of 8-KB blocks that should be formatted to form the zFS aggregate. The default is the number of blocks that will fit in the primary allocation of the VSAM linear data set. If a number less than the default is specified, it is rounded up to the default. If a number greater than the default is specified, a single extend of the VSAM linear data set is attempted after the primary allocation is formatted unless the -grow option is specified. In that case, multiple extensions of the amount that is specified in the -grow option will be attempted until the -size is satisfied. The size can be rounded up to a control area (CA) boundary by DFSMS. It is not necessary to specify a secondary allocation size on the DEFINE of the VSAM linear data set for this extension to occur. Space must be available on the volume.

-version4
Specifies that the aggregate should be a version 1.4 aggregate. Because you can no longer format a version 1.4 aggregate, a version 1.5 aggregate is formatted instead if -version4 is specified.

-version5
Specifies that the aggregate should be a version 1.5 aggregate. See “Usage notes for ioeagfmt” on page 120 for the default value that is used.
Usage notes for ioeagfmt

1. Beginning in z/OS V2R1, ioeagfmt fails if the zFS PFS is not active on the system.
2. The ioeagfmt utility formats an existing VSAM linear data set as a zFS aggregate.
3. The aggregate version of the compatibility mode aggregate that was created can be specified by using the -version4 or the -version5 option. Because you can no longer format a version 1.4 aggregate, if -version4 is specified, -version5 is used instead. If you do not use either option, the setting of the zFS PFS format_aggrversion IOEFSPRM option is used. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_aggrversion option.
4. The encryption status of the compatibility mode aggregate that was created can be specified by using the -encrypt or the -noencrypt option. If you do not use either option, then the setting of the zFS PFS format_encrypt IOEFSPRM option is used. The -encrypt option can only be used if the VSAM linear data set was defined with a key label. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_encrypt option.
5. The compression status of the compatibility mode aggregate that was created can be specified by using the -compress or the -nocompress option. If you do not use either option, then the setting of the zFS PFS format_compress IOEFSPRM option is used. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_compress option.
6. The permissions on the file system root directory can be specified by using the -perms option. If the -perms option is not used, then the setting of the zFS PFS format_perms IOEFSPRM option is used. See "Processing options for IOEFSPRM and IOEPRMxx" on page 229 for a description of the format_perms option.
7. The size of the aggregate is as many 8-KB blocks as fits in the primary allocation of the VSAM linear data set or as specified in the -size option. The -size option can cause one additional extension to occur during formatting. To extend it further, use the zfsadm grow command. If -overwrite is specified, all existing primary and secondary allocations are formatted and the size includes all of that space. If the VSAM linear data set has a SHAREOPTIONS value of other than 3, ioeagfmt changes it to SHAREOPTIONS 3 during format. -overwrite will also cause the backup change activity flag to be set.
8. For a batch job, the ioeagfmt options are specified in the EXEC PARM as a single subparameter (a single character string enclosed in apostrophes with no commas separating the options). You cannot put the ending apostrophe in column 72. If it needs to go to the next line, use a continuation character in column 72 (continuing in column 16 with the ending apostrophe on the second line). Remember that a JCL EXEC PARM is limited to 100 characters. See the topic on EXEC PARM in z/OS MVS JCL Reference.

Privilege required

Before you can issue ioeagfmt, you must have UPDATE authority to the VSAM linear data set.

If you specified -owner, -group, or -perms with values that differ from the defaults, you must also be UID 0 or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIX UNIXPRIV class. The defaults for -owner and -group are determined from the credentials of the issuer. The default for -perms is the value of the IOEFSPRM FORMAT_PERMS option.

Examples
Figure 28 on page 121 shows an example of a job that creates a compatibility mode aggregate and file system.

```plaintext
//USERIDA  JOB ,'Compatibility Mode',
//         CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//DEFINE   EXEC   PGM=IDCAMS
//SYSPRINT DD     SYSOUT=H
//SYSUDUMP DD     SYSOUT=H
//AMSDUMP  DD     SYSOUT=H
//DASD0    DD     DISP=OLD,UNIT=3390,VOL=SER=PRV000
//SYSIN DD     *
//DEFINE CLUSTER (NAME(OMVS.PRV.COMPAT.AGGR001) -
//                VOLUMES(PRV000) -
//                ZFS CYL(25 0) SHAREOPTIONS(3))
/
//CREATE   EXEC   PGM=IOEAGFMT,REGION=0M,
//           PARM=('-aggregate OMVS.PRV.COMPAT.AGGR001')
//SYSPRINT DD     SYSOUT=H
//STDOUT   DD     SYSOUT=H
//STDERR   DD     SYSOUT=H
//SYSUDUMP DD     SYSOUT=H
//CEEDUMP  DD     SYSOUT=H
//*
```

**Figure 28: Sample job to create a compatibility mode aggregate and file system**

In the PARM=(' -aggregate OMVS.PRV.COMPAT.AGGR001') statement, the -aggregate option must be in lowercase.
ioeagslv

Purpose
ioeagslv is a batch utility that scans an aggregate and reports inconsistencies. Aggregates can be verified, recovered (that is, the log is replayed), or salvaged (that is, the aggregate is repaired). This utility is known as the salvager.

This utility is not normally needed. If a system failure occurs, the aggregate log is replayed automatically the next time the aggregate is attached or mounted. This action typically brings the aggregate back to a consistent state. The aggregate must not be mounted or attached when ioeagslv is run. If the aggregate cannot be unmounted, you can consider using the zfsadm salvage command to salvage the aggregate.

Format
ioeagslv -aggregate name

[[{-recoveronly|-verifyonly|-salvageonly}]
[-verbose][-level][-help]

Options
-aggregate name
Specifies the name of the aggregate to be verified, recovered, or salvaged. The aggregate name is not case-sensitive. It is translated to uppercase.

-help
Prints the online help for this command. All other valid options that are specified with this option are ignored.

-level
Prints the level of the ioeagslv command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

-recoveronly
Directs the salvager to recover the specified aggregate. The salvager replays the log of metadata changes that resides on the aggregate. See "Usage notes for the ioeagslv utility" on page 123 for information about using and combining the command's options.

-salvageonly
Directs the salvager to salvage the specified aggregate. The salvager attempts to repair any inconsistencies it finds on the aggregate. See "Usage notes for the ioeagslv utility" on page 123 for information about using and combining the command's options.

-verbose
This option is ignored.

-verifyonly
Directs the salvager to verify the specified aggregate. The salvager examines the structure of the aggregate to determine if it contains any inconsistencies, reporting any that it finds. See "Usage notes for the ioeagslv utility" on page 123 for information about using and combining the command's options.

Results
The salvager returns the following return codes for -verifyonly:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Success. The aggregate is correct and no repair is needed.</td>
</tr>
</tbody>
</table>
Table 12: Return codes for -verifyonly that are returned by the salvager. (continued)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>The aggregate has some inconsistencies that need repair.</td>
</tr>
<tr>
<td>08</td>
<td>An error occurred during verification; the report might be incomplete.</td>
</tr>
<tr>
<td>12</td>
<td>A severe error occurred during verification. Verify that processing was halted. The aggregate is not repairable.</td>
</tr>
<tr>
<td>16</td>
<td>Terminating error.</td>
</tr>
<tr>
<td>EIO</td>
<td>The salvager could not read or write the DASD.</td>
</tr>
<tr>
<td>EBUSY</td>
<td>The aggregate was mounted or attached.</td>
</tr>
<tr>
<td>EMVSERR</td>
<td>The salvager had an internal error. This return code is preceded by a dump for an abend 2C3 and reason code EA660701.</td>
</tr>
<tr>
<td>ENOMEM</td>
<td>The salvager ran out of storage.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The salvager arguments were incorrect.</td>
</tr>
<tr>
<td>ENOSPC</td>
<td>Dynamic grow failed because the salvager ran out of disk space.</td>
</tr>
</tbody>
</table>

For no options specified (or the -recoveronly and -salvageonly options specified) the salvager returns the following return codes:

Table 13: Return codes for -recoveronly that are returned by the salvager.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Success. The aggregate is correct and no repair is needed.</td>
</tr>
<tr>
<td>04</td>
<td>The aggregate had some inconsistencies that were repaired.</td>
</tr>
<tr>
<td>08</td>
<td>An error occurred during verification; the report might be incomplete; the aggregate could not be repaired.</td>
</tr>
<tr>
<td>12</td>
<td>A severe error occurred during verification and the aggregate could not be repaired. Verification processing was stopped..</td>
</tr>
<tr>
<td>16</td>
<td>Terminating error.</td>
</tr>
<tr>
<td>EIO</td>
<td>The salvager could not read or write the DASD.</td>
</tr>
<tr>
<td>EBUSY</td>
<td>The aggregate was mounted or attached.</td>
</tr>
<tr>
<td>EMVSERR</td>
<td>The salvager had an internal error. This return code is preceded by a dump for an abend 2C3 and reason code EA660701.</td>
</tr>
<tr>
<td>ENOMEM</td>
<td>The salvager ran out of storage.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The salvager arguments were incorrect.</td>
</tr>
</tbody>
</table>

Usage notes for the ioeagslv utility

1. You can run ioeagslv even if the zFS PFS is not active on the system. The ioeagslv utility invokes the salvager on the zFS aggregate that is specified with the -aggregate option. After a system restart, the salvager employs the zFS file system log mechanism to return consistency to a file system by running recovery on the aggregate on which the file system resides. Recovery is the replaying of the log on the aggregate; the log records all changes that are made to metadata as a result of operations such as file creation and deletion. If problems are detected in the basic structure of the aggregate, if
the log mechanism is damaged, or if the storage medium of the aggregate is suspect, the `ioeagslv`
utility must be used to verify or repair the structure of the aggregate.

2. Use the utility's `-recoveronly`, `-verifyonly`, and `-salvageonly` options to indicate the operations the
   salvager is to perform on the specified aggregate, as follows:

   - Specify the `-recoveronly` option
     To run recovery on the aggregate without attempting to find or repair any inconsistencies found on
     it. Recovery is the replaying of the log on the aggregate. Use this option to quickly return
     consistency to an aggregate that does not need to be salvaged; this represents the normal
     production use of the salvager. Unless the contents of the log or the physical structure of the
     aggregate is damaged, replaying the log is an effective guarantee of a file system's integrity.

   - Specify the `-verifyonly` option
     To determine whether the structure of the aggregate contains any inconsistencies. Use this option
     to assess the extent of the damage to an aggregate. The salvager runs log recovery and then
     determines whether there are any inconsistencies. No repair is attempted other than running log
     recovery.

   - Specify the `-salvageonly` option
     To attempt to repair any inconsistencies that are found in the structure of the aggregate without
     first running recovery on it. Use this option if you believe the log is damaged or replaying the log
     does not return consistency to the aggregate and might in fact further damage it. In most cases,
     you do not salvage an aggregate without first recovering it.

   - Omit the `-recoveronly`, `-verifyonly`, and `-salvageonly` options
     To run recovery on the aggregate and then attempt to repair any inconsistencies that are found in
     the structure of the aggregate. Because recovery eliminates inconsistencies in an undamaged file
     system, an aggregate is typically recovered before it is salvaged. In general, it is good first to
     recover and then to salvage an aggregate if a system goes down or experiences a hardware failure.

     Omit these three options if you believe the log should be replayed before attempts are made to
     repair any inconsistencies that are found on the aggregate. (Omitting the three options is equivalent
     to specifying the `-recoveronly` and `-salvageonly` options.)

3. The salvager utility can set or clear the aggregate damaged bit:

   - The `-verifyonly` option can set the bit if a true corruption is found or clear it if no corruption is found.
   - Repair (with no option) can clear the bit if a successful repair is done.

4. The following rule summarizes the interaction of the `-recoveronly`, `-verifyonly`, and `-salvageonly`
   options: The salvage command runs recovery on an aggregate and attempts to repair it unless one of
   the three salvage options is specified; after one of these options is specified, you must explicitly
   request any operation that you want the salvager to perform on the aggregate.

5. The basic function of the salvager is similar to that of the `fsck` program in many UNIX systems. The
   salvager recovers a zFS aggregate and repairs problems it detects in the structure of the aggregate. It
   does not verify or repair the format of user data that is contained in files on the aggregate.

6. The salvager verifies the structure of an aggregate by examining all of the anodes, directories, and
   other metadata in each file system on the aggregate. An anode is an area on the disk that provides
   information that is used to locate data such as files, directories, ACLs, and other types of file system
   objects. Each file system contains an arbitrary number of anodes, all of which must reside on the
   same aggregate. By following the links between the various types of anodes, the salvager can
   determine whether the organization of an aggregate and the file system it contains is correct and
   make repairs if necessary.

7. The salvager is designed to make all repairs in one pass, but due to the nature of the program's inputs
   (a corrupted, possibly vastly corrupted file system) IBM recommends a second running of the salvage
   program to verify that the aggregate is truly repaired. If verifying the aggregate shows that it is not
   repaired, then you should try running the salvager again to repair the aggregate. If this does not repair
   the aggregate, you can create a copy of the aggregate and run the salvager more times to try to repair
it. If the salvager cannot repair the aggregate after several repair attempts, the copy of the aggregate and salvager job logs will allow IBM service to determine why.

8. Not all aggregates can be salvaged. In cases of extensive damage to the structure of the metadata on an aggregate or damage to the physical disk that houses an aggregate, the salvager cannot repair inconsistencies. Also, the salvager cannot verify or repair damage to user data on an aggregate. The salvager cannot detect problems that modified the contents of a file but did not damage the structure of an aggregate or change the metadata of the aggregate.

9. Like the fsck command, the salvager analyzes the consistency of an aggregate by making successive passes through the aggregate. With each successive pass, the salvager examines and extracts a different type of information from the blocks and anodes on the aggregate. Later passes of the salvager use information that is found in earlier passes to help in the analysis.

10. It is possible for the salvager to attempt a dynamic grow of an aggregate. One possible reason for this is if an extended (v5) directory is found to be inconsistent (or broken). The salvager will try to repair it by converting it to a new extended (v5) directory. To do this might require more disk space. If the disk space is not available, the directory is marked read-only. The rest of the file system has already been made consistent, so you should still be able to mount the file system and read from the directory.

11. In general, if the salvager is invoked for a VSAM linear data set that it is sure is not a zFS aggregate, it exits with an error code of at least 16 without analyzing the VSAM linear data set. It exits with an error code of EBUSY (114) if a file system on the aggregate to be recovered or salvaged is mounted or attached. (If necessary, you can use the UNMOUNT command to unmount the aggregate.)

12. Beginning in z/OS V2R1, the salvager no longer supports salvaging aggregates that contain more than one file system or clones (.bak file systems). For additional details about running the salvage utility, see "Understanding the salvager utility" on page 92.

13. As the salvager runs, it maintains a list of sorted error records that need repair. Each record includes details for the salvager to quickly repair the aggregate. The salvager displays corruption messages if verification found any inconsistency. It also displays progress messages (IOEZ00782I) during verification to indicate how many objects have been processed. Depending on the aggregate size and system usage, the salvager batch job might take hours or even longer to complete.

14. For a batch job, the ioeagslv options are specified in the EXEC PARM as a single subparameter (a single character string enclosed in apostrophes with no commas separating the options). You cannot put the ending apostrophe in column 72. If it needs to go to the next line, use a continuation character in column 72 (continuing in column 16 with the ending apostrophe on the second line). Remember that a JCL EXEC PARM is limited to 100 characters. See the topic on the EXEC PARM in z/OS MVS JCL Reference. For an example of the EXEC PARM for ioeagslv, see Figure 29 on page 126.

15. The zFS configuration file can include debugging parameters for the salvager utility. The debugging parameters are described in "IOEFSPRM" on page 227. There are two ways that you can implement the configuration file:

   • As a single file that is defined by a IOEZPRM DD card.
   • As one or more parameter file members, named IOEPRMxx.

16. You can provide an optional IOEZPRM DD statement in the JCL for the batch job to specify the location of the IOEFSPRM file. Or, you can omit the IOEZPRM DD statement and specify the -PRM option on the EXEC PARM to use IOEPRMxx parameter file members. If you do not specify the IOEZPRM DD statement, the utility searches the logical parmlib concatenation to find the IOEPRMxx members that contain the debugging parameters, in the same way that the zFS PFS does if you do not specify the IOEZPRM DD statement in the ZFS PROC. For more information about specifying the configuration file, see “IOEFSPRM” on page 227.

17. ioeagslv causes the backup change activity flag to be set if the log is replayed or a repair is done.

18. ioeagslv can be used to salvage aggregate versions 1.4 and 1.5.

19. ioefsutl salvage can also be used to salvage aggregates that contain data that is compressed, encrypted, or both compressed and encrypted.
Privilege required

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Examples

The following figures show examples of jobs that invoke the ioeagslv utility.

```
//USERIDA  JOB 'Salvage',
  CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//SALVAGE  EXEC PGM=IOEAGSLV,REGION=0M,
  // PARM=('aggregate OMVS.PRV.COMPAT.AGGR001 -verifyonly')
//IOEZPRM DD  DSN=SYS4.PVT.SYL.PARMLIB(IOEFSPRM),DISP=SHR
//SYSPRINT DD  SYSOUT=H
//STDOUT   DD     SYSOUT=H
//STDERR   DD     SYSOUT=H
//SYSUDUMP DD     SYSOUT=H
//CEEDUMP  DD     SYSOUT=H
/*

Figure 29: Job to verify a zFS aggregate that uses debug parameters specified in IOEFSPRM
```

```
//USERIDA  JOB 'Salvage',
  CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//SALVAGE  EXEC PGM=IOEAGSLV,REGION=0M,
  // PARM=('aggregate OMVS.PRV.COMPAT.AGGR001 -verifyonly -PRM=(03)')
//SYSPRINT DD  SYSOUT=H
//STDOUT   DD     SYSOUT=H
//STDERR   DD     SYSOUT=H
//SYSUDUMP DD     SYSOUT=H
//CEEDUMP  DD     SYSOUT=H
/*

Figure 30: Job to verify a zFS aggregate that uses debug parameters specified in parmlib member IOEPRM03
```
**ioefsutl**

**Purpose**

This section introduces the `ioefsutl` batch utility suite. It is run as a batch job. A zFS aggregate must be unmounted (and not attached) before `ioefsutl` can process it.

`ioefsutl` is a batch utility that supports the following functions:

- **format** of a new aggregate in the specified version.
- **salvage** to verify and repair a damaged aggregate.
- **converttov5** to change a version 1.4 aggregate to a version 1.5 aggregate and convert all the existing directories to extended (v5) directories.
- **converttov4** to convert all extended (v5) directories to v4 directories and then change the version 1.5 aggregate to a version 1.4 aggregate.

If you are using the IOEFSPRM file, you can provide an optional IOEZPRM DD statement in the JCL for a batch job to specify the location of the IOEFSPRM file. If you are using the IOEPRMxx parmlib member, omit the IOEZPRM DD statement and specify the -PRM option on the EXEC PARM; for example -PRM=(03) if your configuration file is in the parmlib member IOEPRM03. If you do not specify the IOEZPRM DD statement, the utility searches the logical parmlib concatenation to find the IOEPRMxx members that contain the debugging parameters, in the same way that the zFS PFS does if you do not specify the IOEZPRM DD statement in the ZFS PROC. For more information about specifying the configuration file, see “IOEFSPRM” on page 227.
ioefsutl converttov4

Purpose
ioefsutl converttov4 is a batch utility that converts a version 1.5 aggregate to a version 1.4 aggregate.

Format
ioefsutl converttov4 -aggregate name [-verbose][-level][-help]

Options
-aggregate name
   Specifies the name of the aggregate to be converted. The aggregate name is not case-sensitive. It is translated to uppercase.
-help
   Prints the online help for this command. All other valid options specified with this option are ignored.
-level
   Prints the level of the ioefsutl command. This information is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.
-verbose
   Displays starting and ending messages of each directory being converted.

Usage notes for ioefsutl converttov4
1. ioefsutl converttov4 cannot convert an aggregate that has been migrated from HFS to zFS with the bpxwmigf command.
2. ioefsutl converttov4 cannot convert an aggregate that contains data that is encrypted or compress (or both). In this case, you first need to run zfsadm decrypt or zfsadm decompress.
3. The ioefsutl converttov4 command is used when you need to convert a zFS version 1.5 aggregate to a version 1.4 aggregate. All extended (v5) directories are converted to v4 directories. You might use this if you need to run z/OS releases prior to z/OS V2R1.
4. ioefsutl converttov4 cannot convert the version 1.5 aggregate if it has grown larger than approximately 4 TB. In this case, you must copy subsets of the data one at a time into other version 1.4 aggregates using the z/OS UNIX shell command pax. Each subset must be copied into a separate version 1.4 aggregate that is less than 4 TB.
5. ioefsutl converttov4 cannot convert a directory that contains more than 64K-1 subdirectories. In this case, you must copy subsets of the directory into separate directories contained in a version 1.4 aggregate.
6. Converting a directory from an extended (v5) directory to a version 4 directory requires both versions of the directory to be on the disk at the same time, temporarily. If the aggregate becomes full during the allocation of the new directory, a dynamic grow is attempted. See "Dynamically growing a compatibility mode aggregate" on page 26 for information about controlling the dynamic growth of an aggregate. If there is not enough space to complete the conversion, the new directory is deleted and the conversion operation fails.
7. The old directory is deleted when the conversion is completed. The resulting new directory can possibly require more space than the old directory, and could also possibly require less space than the old directory. Results will vary based on the actual directory contents.
8. If a system outage occurs during a directory conversion, the directory is made consistent during log recovery processing. That is, either the old directory will exist or the new directory will exist, but both will not exist.
9. The conversion will cause the backup change activity flag to be set.
10. If the aggregate damaged bit is set, conversion does not start and an error is issued. You can still
    mount the aggregate. The IOEZ00783E console message is displayed:

```
IOEZ00783E Aggregate aggregate_name is damaged
```

**Privilege required**

The issuer must be logged in as a root user (UID=0) or have READ authority to the
SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Examples**

Figure 31 on page 129 shows an example of a job that invokes the `ioefsutl` utility to convert a version
1.5 aggregate to a version 1.4 aggregate.

```
//USERIDA JOB , 'Convert to version 4',
// CLASS=A, MSGCLASS=X, MSGLEVEL=(1,1)
// CONVERT EXEC PGM=IOEFSUTL, REGION=0M,
// PARM=('converttov4 -aggregate OMVS.PRV.COMPAT.AGGR001')
// SYSPRINT DD SYSOUT=H
// STDOUT DD SYSOUT=H
// STDERR DD SYSOUT=H
// SYSUDUMP DD SYSOUT=H
// CEEDUMP DD SYSOUT=H
/*
```

**Figure 31: Job to convert a version 1.5 aggregate to a version 1.4 aggregate**

In the PARM=('converttov4 -aggregate OMVS.PRV.COMPAT.AGGR001') statement, the converttov4 and
option -aggregate must be in lowercase.
ioefsutl converttov5

**Purpose**

`ioefsutl converttov5` is a batch utility that converts a version 1.4 aggregate to a version 1.5 aggregate.

**Format**

```
ioefsutl converttov5 -aggregate name -aggrversion_only [-verbose][-level][-help]
```

**Options**

- **-aggregate name**
  Specifies the name of the aggregate to be converted. The aggregate name is not case-sensitive. It is translated to uppercase.

- **-aggrversion_only**
  Only the aggregate version is converted from 1.4 to 1.5. No directories are converted.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the `ioefsutl` command. This information is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-verbose**
  Displays starting and ending messages of each directory being converted.

**Usage notes**

1. The `ioefsutl converttov5` command is used when you need to convert a zFS version 1.4 aggregate to a version 1.5 aggregate. All v4 directories are converted to extended (v5) directories. You might use this command if you have migrated all your systems to z/OS V2R1 or later and you want to exploit extended (v5) directories.

2. Converting a directory from version 4 to an extended (v5) directory requires both versions of the directory to exist on disk at the same time, temporarily. If the aggregate becomes full during the allocation of the new directory a dynamic grow will be attempted. See “Dynamically growing a compatibility mode aggregate” on page 26 for information about controlling dynamic growth of an aggregate. If there is not enough space to complete the conversion, the new directory is deleted and the conversion operation fails.

3. When the conversion is completed, the old directory is deleted. The resulting new directory might possibly require more space than the old directory, and could also possibly require less space than the old directory. Results will vary based on the actual directory contents.

4. If a system outage occurs during a directory conversion, the directory will be made consistent during log recovery processing. That is, either the old directory will exist or the new directory will exist, but both will not exist.

5. The conversion causes the backup change activity flag to be set.

6. If the aggregate damaged bit is set, conversion does not start and an error is issued.

7. If the aggregate damaged bit is set, you can still mount the aggregate. The IOEZ00783E console message is displayed:

   ```
   IOEZ00783E Aggregate aggregate_name is damaged
   ```
Privilege required

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Examples

Figure 32 on page 131 shows an example of a job that invokes the ioefsutl utility to convert a version 1.4 aggregate to a version 1.5 aggregate.

```plaintext
//USERIDA JOB ,'Convert to version 5',
// CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//CONVERT EXEC PGM=IOEFSUTL,REGION=0M,
// PARM=('converttov5 -aggregate OMVS.PRV.COMPAT.AGGR001')
//SYSPRINT DD SYSOUT=H
//STDOUT   DD SYSOUT=H
//STDERR   DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP  DD SYSOUT=H
//*
```

Figure 32: Job to convert a version 1.4 aggregate to a version 1.5 aggregate

In the PARM=(‘converttov5 -aggregate OMVS.PRV.COMPAT.AGGR001’) statement, the converttov5 and option -aggregate must be in lowercase.
ioefsutl format

Purpose

ioefsutl format is a batch utility that formats a VSAM linear data set to become a version 4 or version 5 zFS compatibility mode aggregate.

Format

```
ioefsutl format -aggregate name
    [-encrypt|-noencrypt][-compress|-nocompress]
    [-size blocks][-logsize blocks]
    [-owner uid|name][-group gid|name]
    [-perms number][-grow blocks]
    [-overwrite][-version4|-version5]
    [-level][-help]
```

Options

-aggregate name
Specifies the name of the data set to format. This is also the aggregate name. The aggregate name is always converted to uppercase and cannot be longer than 44 characters. The following characters can be included in the name of an aggregate:

- All uppercase and lowercase alphabetic characters (a to z, A to Z)
- All numerals (0 to 9)
- The . (period)
- The - (dash)
- The _ (underscore)
- The @ (at sign)
- The # (number sign)
- The $ (dollar)

-compress
Specifies that the aggregate is compressed. For information about how the default compression option is determined, see “Usage notes for ioefsutl format” on page 133.

-encrypt
Specifies that the aggregate is encrypted. For information about how the default encryption option is determined, see “Usage notes for ioefsutl format” on page 133.

-group gid|name
Specifies the group owner for the root directory of the file system. It can be specified as a z/OS group name or as a GID. The default is the GID of the issuer of ioefsutl format. If only -owner name is specified, the group is that owner's default group. If only -owner uid is specified, the group is the issuer's group.

-grow blocks
Specifies the number of 8-KB blocks that zFS uses as the increment for extension when the -size option specifies a size greater than the primary allocation.

-help
Prints the online help for this command. All other valid options that are specified with this option are ignored.

-logsize blocks
Specifies the size in 8-KB blocks of the log. The valid range is from 13 to 16384 blocks (128 megabytes). The default is 1% of the aggregate size. This default logsize will never be smaller than 14 blocks and it will never be larger than 4096 blocks (32 megabytes). This size is normally sufficient.
However, a small aggregate that is grown to be very large will still have a small log. You might want to specify a larger log if you expect the aggregate to grow very large.

**-level**
Prints the level of the `ioefsutl` command. This information is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

**-nocompress**
Specifies that the aggregate will not be compressed. For information about how the default compression option is determined, see “Usage notes for `ioefsutl format`” on page 133.

**-noencrypt**
Specifies that the aggregate will not be encrypted. For information about how the default encryption option is determined, see “Usage notes for `ioefsutl format`” on page 133.

**-overwrite**
Required if you are reformatting an existing aggregate. Use this option with caution because it deletes any existing data. This option is not usually specified.

**-owner uid | name**
Specifies the owner for the root directory of the file system. It can be specified as a z/OS user ID or as a UID. The default is the UID of the issuer of `ioefsutl format`.

**-perms number**
Specifies the permissions for the root directory of the file system. The number can be specified as octal (for example, o755), as hexadecimal (for example, x1ED), or as decimal (for example, 493). For information about how the permissions for the file system root directory are determined, see “Usage notes for `ioefsutl format`” on page 133.

**-size blocks**
Specifies the number of 8-KB blocks that should be formatted to form the zFS aggregate. The default is the number of blocks that will fit in the primary allocation of the VSAM linear data set. If a number less than the default is specified, it is rounded up to the default. If a number greater than the default is specified, a single extend of the VSAM linear data set is attempted after the primary allocation is formatted unless the -grow option is specified. In that case, multiple extensions of the amount that is specified in the -grow option will be attempted until the -size is satisfied. The size can be rounded up to a control area (CA) boundary by DFSMS. It is not necessary to specify a secondary allocation size on the DEFINE of the VSAM linear data set for this extension to occur. Space must be available on the volume.

**-version4**
Specifies that the aggregate is to be formatted as a version 1.4 aggregate. See “Usage notes for `ioefsutl format`” on page 133 for information about how the default aggregate version is determined.

**-version5**
Specifies that the aggregate is to be formatted as a version 1.5 aggregate. See “Usage notes for `ioefsutl format`” on page 133 for information about how the default aggregate version is determined. IBM recommends that you do not use -version5 until all your systems are at z/OS V2R1 or later.

**Usage notes for `ioefsutl format`**
1. The `ioefsutl format` utility formats an existing VSAM linear data set as a zFS aggregate. All zFS aggregates must be formatted before use.

2. The aggregate name is not case-sensitive. It is converted to uppercase. If -version4 or -version5 is specified, you can run `ioefsutl format` even if the zFS PFS is not active on the system. If neither option is specified, the aggregate version default is determined by a call to the zFS PFS to obtain the value of the format_aggrversion option from the IOEFSPRM file. If the zFS PFS is not active, then the format will fail.

3. The encryption status of the compatibility mode aggregate that was created can be specified by using the -encrypt or the -noencrypt option. If neither option is specified, then the default aggregate encryption status is obtained from the zFS PFS format_encryption setting. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_encryption option. If the zFS
PFS is not active while the format_encryption setting is obtained and if the aggregate is not a version 4 aggregate and already has a key label defined, zFS will format the aggregate with encryption. Otherwise, zFS will format the aggregate without encryption.

4. The compression status of the compatibility mode aggregate that was created can be specified by using the -compress or -nocompress option. If you do not use either option, then the setting of the zFS PFS format_compression is used. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_compression option. If the zFS PFS is not active when the format_compression setting is obtained, zFS will format the aggregate without compression.

5. The permissions on the file system root directory can be specified by using the -perms option. If the -perms option is not used, then the setting of the zFS PFS format_perms IOEFSPRM option is used. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_perms option. When the zFS PFS is not active when obtaining the format_perms setting, the root directory permissions will be o755.

6. The size of the aggregate is either the number of 8-K blocks that fits in the primary allocation of the VSAM linear data set or the number that was specified by the -size option. The -size option can cause one additional extension to occur during formatting. To extend it further, use the zfsadm grow command. If -overwrite is specified, all existing primary and secondary allocations are formatted and the size includes all of that space. If -overwrite is specified, the backup change activity flag is set. If the VSAM linear data set has a SHAREOPTIONS value of other than 3, ioefsutl format changes it to SHAREOPTIONS 3 during format.

7. For a batch job, the ioefsutl format options are specified in the EXEC PARM as a single subparameter (a single character string enclosed in apostrophes with no commas separating the options). You cannot put the ending apostrophe in column 72. If it needs to go to the next line, use a continuation character in column 72 (continuing in column 16 with the ending apostrophe on the second line). A JCL EXEC PARM is limited to 100 characters. For more information about the PARM parameter, see z/OS MVS JCL Reference.

8. ioefsutl format always formats with a unique auditfid.

Privilege required

Before you can issue ioefsutl format, you must have UPDATE authority to the VSAM linear data set.

If you specified -owner, -group, or -perms with values that differ from the defaults, you must also be UID 0 or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIX UNIXPRIV class. The defaults for -owner and -group are determined from the credentials of the issuer. The default for -perms is the value of the IOEFSPRM FORMAT_PERMS option.

Restrictions

The zFS aggregate cannot be mounted (or attached). The batch job must be issued from a V2R1 or later system and the VSAM linear data set must exist. If neither -version4 nor -version5 is specified, the value of the format_aggrversion option on the server is used. In this case, if the value of the format_aggrversion option cannot be determined, the format will fail.

Examples
Figure 33 on page 135 shows an example of a job that creates and formats a version 1.4 aggregate.

```
//USERIDA JOB , 'Compatibility Mode',
//CLASS=A, MSGCLASS=X, MSGLEVEL=(1,1)
//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=H
//SYSDUMP DD SYSOUT=H
//AMSDUMP DD SYSOUT=H
//DASDO DD DISP=OLD, UNIT=3390, VOL=SER=PRV000
//SYSIN DD *
  DEFINE CLUSTER (NAME(OMVS.PRV.COMPAT.AGGR001) -
    VOLUMES(PRV000) -
    ZFS CYL(25 0) SHAREOPTIONS(3))
/*
//CREATE EXEC PGM=IOEFSUTL, REGION=0M,
// PARM=('format -aggregate OMVS.PRV.COMPAT.AGGR001 -version4')
//SYSPRINT DD SYSOUT=H
//STDOUT DD SYSOUT=H
//STDERR DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP DD SYSOUT=H
*/
```

Figure 33: Sample job to create and format a version 1.4 aggregate

In the PARM=('format -aggregate OMVS.PRV.COMPAT.AGGR001 -version4') statement, the format, and options -aggregate and -version4 must be in lowercase.
ioefsutl salvage

**Purpose**

ioefsutl salvage is a batch utility that scans an aggregate and reports inconsistencies. Aggregates can be verified, recovered (that is, the log is replayed), or salvaged (that is, the aggregate is repaired). This utility is known as the *salvager*.

This utility is not normally needed. If a system failure occurs, the aggregate log is replayed automatically the next time the aggregate is attached or mounted. This action typically brings the aggregate back to a consistent state. The aggregate must not be mounted or attached when ioefsutl salvage is run.

**Format**

```
ioefsutl salvage -aggregate name [-verifyonly][-level][-help]
```

**Options**

- **-aggregate name**
  Specifies the name of the aggregate to be verified or salvaged. The aggregate name is not case-sensitive. It is converted to uppercase.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the ioefsutl command. This information is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-verifyonly**
  Specifies that the salvager is to verify the specified aggregate. It should not attempt to repair any damage that was found. The log is replayed before the verification unless an error occurs during the replay. If this option is omitted, the salvager will replay the log, verify the specified aggregate, and then attempt to repair any damage that was found.

**Results**

For -verifyonly, the salvager returns the following return codes:

<table>
<thead>
<tr>
<th>Return code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Success. The aggregate is correct and no repair is needed.</td>
</tr>
<tr>
<td>04</td>
<td>The aggregate has some inconsistencies that need repair.</td>
</tr>
<tr>
<td>08</td>
<td>An error occurred during verification; the report might be incomplete.</td>
</tr>
<tr>
<td>12</td>
<td>A severe error occurred during verification. Verify that processing was halted. The aggregate is not repairable.</td>
</tr>
<tr>
<td>16</td>
<td>Terminating error.</td>
</tr>
<tr>
<td>EIO</td>
<td>The salvager could not read or write the DASD.</td>
</tr>
<tr>
<td>EBUSY</td>
<td>The aggregate was mounted or attached.</td>
</tr>
<tr>
<td>EMVSERR</td>
<td>The salvager had an internal error. This return code is preceded by a dump for an abend 2C3 and reason code EA660701.</td>
</tr>
<tr>
<td>ENOMEM</td>
<td>The salvager ran out of storage.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The salvager arguments were incorrect.</td>
</tr>
</tbody>
</table>
For no options specified, the salvager returns the following return codes:

<table>
<thead>
<tr>
<th>Return code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Success. The aggregate is correct and no repair is needed.</td>
</tr>
<tr>
<td>04</td>
<td>The aggregate has some inconsistencies that were repaired.</td>
</tr>
<tr>
<td>08</td>
<td>An error occurred during verification; the report might be incomplete; the aggregate could not be repaired.</td>
</tr>
<tr>
<td>12</td>
<td>A severe error occurred during verification; verify that processing has stopped; the aggregate could not be repaired.</td>
</tr>
<tr>
<td>16</td>
<td>Terminating error.</td>
</tr>
<tr>
<td>EIO</td>
<td>The salvager could not read or write the DASD.</td>
</tr>
<tr>
<td>E_BUSY</td>
<td>The aggregate was mounted or attached.</td>
</tr>
<tr>
<td>EMVSERR</td>
<td>The salvager had an internal error. This return code is preceded by a dump for an abend 2C3 and reason code EA660701.</td>
</tr>
<tr>
<td>ENOMEM</td>
<td>The salvager ran out of storage.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The salvager arguments were incorrect.</td>
</tr>
</tbody>
</table>

Usage notes

1. You can run `ioefsutl salvage` even if the zFS PFS is not active on the system. The `ioefsutl salvage` utility invokes the salvager on the zFS aggregate that is specified with the `-aggregate` option.

2. The salvager cannot process an aggregate that contains multiple file systems or a clone.

3. The processing of the aggregate is controlled by the specification or the omission of the `-verifyonly` option.
   - Specify the `-verifyonly` option
     To determine whether the structure of the aggregate contains any inconsistencies. Use this option to assess the extent of the damage to an aggregate. The salvager runs log recovery and then determines whether there are any inconsistencies. No repair is attempted other than running log recovery.
   - Omit the `-verifyonly` option
     To run log recovery on the aggregate, verify the aggregate and then attempt to repair any inconsistencies that are found in the structure of the aggregate. Because log recovery eliminates inconsistencies in an undamaged file system, an aggregate is typically recovered before it is salvaged. In general, it is good practice to first recover and then to salvage an aggregate if a system goes down or experiences a hardware failure.

4. The salvager sets the backup change activity flag if log recovery is run or a repair is done.

5. The basic function of the salvager is similar to that of the `fsck` program in many UNIX systems. The salvager recovers a zFS aggregate and repairs problems it detects in the structure of the aggregate. It does not verify or repair the format of user data that is contained in files on the aggregate.

6. The salvager verifies the structure of an aggregate by examining all of the anodes, directories, and other metadata in each file system on the aggregate. An anode is an area on the disk that provides information that is used to locate data such as files, directories, ACLs, and other types of file system objects. Each file system contains an arbitrary number of anodes, all of which must reside on the same aggregate. By following the links between the various types of anodes, the salvager can determine whether the organization of an aggregate and the file system that it contains is correct and make repairs if necessary.

7. Not all aggregates can be salvaged. In cases of extensive damage to the structure of the metadata on an aggregate or damage to the physical disk that houses an aggregate, the salvager cannot repair...
inconsistencies. Also, the salvager cannot verify or repair damage to user data on an aggregate. The salvager cannot detect problems that modified the contents of a file but did not damage the structure of an aggregate or change the metadata of the aggregate.

8. The salvager is designed to make all repairs in one pass. However, due to the nature of the program's inputs (a corrupted, possibly vastly corrupted file system), IBM recommends a second running of the salvage program to verify that the aggregate is truly repaired. If verifying the aggregate shows that it is not repaired, then try running the salvager again to repair the aggregate. If this action does not repair the aggregate, you can create a copy of the aggregate and run the salvager more times to try to repair it. If the salvager cannot repair the aggregate after several repair attempts, the copy of the aggregate and salvager job logs will allow IBM service to determine why.

9. Like the fsck command, the salvager analyzes the consistency of an aggregate by making successive passes through the aggregate. With each successive pass, the salvager examines and extracts a different type of information from the blocks and anodes on the aggregate. Later passes of the salvager use information that was found in earlier passes to help in the analysis.

10. It is possible for the salvager to attempt a dynamic grow of an aggregate. One possible reason for this is if an extended (v5) directory is found to be inconsistent (or broken). The salvager will try to repair it by converting it to a new extended (v5) directory. To do this might require more disk space. If the disk space is not available the directory is marked read-only. The rest of the file system has already been made consistent, so you should still be able to mount the file system and read from the directory.

11. In general, if the salvager is invoked for a VSAM linear data set that it is sure is not a zFS aggregate, it exits with an error code of at least 16 without analyzing the VSAM linear data set. It exits with an error code of EBUSY (114) if a file system on the aggregate to be recovered or salvaged is mounted or attached. (If necessary, you can use the unmount command to unmount the aggregate.)

12. As the salvager runs, it maintains a list of sorted error records that need repair. Each record includes details for the salvager to quickly repair the aggregate. The salvager displays corruption messages if verification found any inconsistencies. It also displays progress messages (IOEZ00782I) during verification to indicate how many objects were processed. Depending on the aggregate size and system usage, the salvager batch job may take hours or even longer to complete.

13. For more information about running the salvage utility, see “Understanding the salvager utility” on page 92.

14. For a batch job, the ioefsut1 salvage options are specified in the EXEC PARM as a single subparameter (a single character string enclosed in apostrophes with no commas separating the options). You cannot put the ending apostrophe in column 72. If it needs to go to the next line, use a continuation character in column 72 (continuing in column 16 with the ending apostrophe on the second line). Remember that a JCL EXEC PARM is limited to 100 characters. For more information about PARM parameter, see z/OS MVS JCL Reference. For an example of the EXEC PARM for ioefsutl salvage, see Figure 34 on page 139.

15. ioefsut1 salvage can also be used to salvage aggregates that contain data that is compressed, encrypted, or both compressed and encrypted.

16. The salvager utility can set or clear the aggregate damaged bit:
- The -verifyonly option can set the bit if a true corruption is found or clear it if no corruption is found.
- Repair (with no option) can clear the bit if a successful repair is done.

17. joefsut1 salvage can also be used to salvage aggregates that contain data that is compressed, encrypted, or both compressed and encrypted.

Privilege required

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Examples
Figure 34 on page 139 shows an example of a job to salvage a zFS aggregate:

```plaintext
//USERIDA JOB , 'Salvage verify',
// CLASS=A, MSGCLASS=X, MSGLEVEL=(1,1)
// SALVAGE EXEC PGM=IOEFSUTL, REGION=0M,
// PARM=('salvage -aggregate OMVS.PRV.COMPAT.AGGR001 -verifyonly')
// IOEZPRM DD DSN=SYS4.PVT.SY1.PARMLIB(IOEFSPRM), DISP=SHR
// SYSPRINT DD SYSOUT=H
// STDOUT DD SYSOUT=H
// STDERR DD SYSOUT=H
// SYSUDUMP DD SYSOUT=H
//CEEDUMP DD SYSOUT=H
/*
```

Figure 34: Job to verify a zFS aggregate using debug parameters specified in IOEZPRM

In the PARM=('salvage -aggregate OMVS.PRV.COMPAT.AGGR001 -verifyonly') statement, the salvage and options -aggregate and -verifyonly must be in lowercase.
Purpose

MOUNT is a TSO/E command that mounts a file system into the z/OS UNIX hierarchy. This section only documents MOUNT options that are unique to zFS. It can also be invoked from the z/OS UNIX shell (/usr/sbin/mount). For more information about MOUNT command description, see z/OS UNIX System Services Command Reference.

Beginning with z/OS V2R3, a newly created VSAM linear data set will be formatted during its first mount if the following conditions are true:

- VSAM linear data set is defined with the ZFS keyword (instead of LINEAR) or defined by using the zfsadm define command from a z/OS V2R3 or later system.
- The size of the aggregate is 0.
- The user who issues the mount also has the authorization that is needed for the format.
- The aggregate can be created with the default format options.
- The root directory of the aggregate can be created by using permissions from the IOEFSprm configuration option format_perms setting. See “IOEFSprm” on page 227 for a description of the format_perms option.

Notes:

1. Beginning with z/OS V2R1, zFS clones are no longer supported. An attempt to mount an aggregate that contains a .bak (clone) file system is denied.
2. Beginning with z/OS V2R1, multi-file system aggregates are no longer supported. An attempt to mount a zFS file system that is contained in a zFS multi-file system aggregate is denied.

Format

```
MOUNT TYPE(file_system_type) [PARM(parameter_string)]
```

Options

**TYPE (file_system_type)**

Specifies the file system type. Specify ZFS or HFS and the correct file system type is determined for the file system that is located by the data set name. If the TYPE specified (HFS) does not match the real file system type (ZFS), any associated ZFS parameters are ignored. For more information, see Mounting considerations in z/OS UNIX System Services Planning.

**PARM(parameter_string)**

Specifies a parameter string to be passed to zFS. Parameters are case-sensitive and separated by a comma. Enclose the parameter string within quotation marks. If a parameter is specified multiple times, the last parameter is used.

If the value specified on the TYPE parameter (HFS) does not match the real file system type (ZFS), any associated ZFS parameters are ignored.

**AGGRFULL(threshold,increment)**

Specifies the threshold and increment for reporting aggregate utilization messages to the operator. The default is the aggrfull specification in the IOEFSprm file. For version 1.5 aggregates, if aggrfull is not specified in the IOEFSpm file, the default is taken from the fsfull specification.

AGGRFULL and FSFULL provide the same function. You can use either one (or both) to monitor the space utilization for an aggregate. However, AGGRFULL tends to give a more accurate view of free space and is the suggested choice.

- For version 1.4 aggregates, if both AGGRFULL and FSFULL are specified, both will be used.
For version 1.5 aggregates, if AGGRFULL is specified, FSFULL is ignored. If AGGRFULL is not specified, the FSFULL specification is used as if it were the AGGRFULL specification.

**AGGRGROW | NOAGGRGROW**
Specifies whether the aggregate is eligible to be dynamically grown. The growth is based on the secondary allocation of the aggregate and will occur when the aggregate becomes full. The default is the aggrgrow specification in the IOEFSPRM file.

**CONVERTTOV5 | NOCONVERTTOV5**
Specifies whether a zFS read/write file system is assigned the converttov5 attribute. If it is assigned the converttov5 attribute and the aggregate is a version 1.5 aggregate, zFS automatically converts directories from v4 to extended (v5) as they are accessed. If the converttov5 attribute is assigned at primary mount time, a version 1.4 aggregate is changed to a version 1.5 aggregate. If automatic directory conversion for a directory fails, the conversion is not attempted again until the file system is unmounted and mounted again.

The converttov5 attribute can also be assigned if the MOUNT option is not specified but the converttov5 specification in the IOEFSPRM file is on when the file system is mounted or remounted.

The default is NOCONVERTTOV5. However, the converttov5 attribute can also be assigned if the converttov5 specification in the IOEFSPRM file is on when the file system is mounted or remounted.

**FSFULL(threshold, increment)**
Specifies the threshold and increment for reporting file system utilization messages to the operator. The default is the fsfull specification in the IOEFSPRM file.

AGGRFULL and FSFULL provide the same function. You can use either one (or both) to monitor space utilization for an aggregate. However, AGGRFULL tends to give a more accurate view of free space and is the suggested choice. For version 1.5 aggregates, if AGGRFULL is specified, this option is ignored. It it is not specified, the FSFULL threshold and increment values are used to report aggregate utilization messages.

**RWSHARE | NORWSHARE**
Specifies whether a zFS read/write mounted file system will be mounted sysplex-aware or non-sysplex aware. zFS must be running sysplex-aware on a file system basis (IOEFSPRM specifies sysplex=filesys) for this parameter to take effect. The default is the sysplex_filesys_sharemode specified in the IOEFSPRM file, or later by using the zfsadm config command. For information about whether to make a read/write file system sysplex aware, see “Using zFS read/write sysplex-aware file systems” on page 15.

**Usage notes**
1. A mount of a compatibility mode aggregate is serialized with other zfsadm commands (because the mount of a compatibility mode aggregate does an implicit attach).
2. If you attempt to mount a compatibility mode aggregate/file system read-only and it fails because it needs to run recovery (return code EROFS (141) and reason code EFxx6271), you should temporarily mount it read/write so it can complete the recovery process. Then, mount it read-only. Alternatively, you can specify the romount_recovery=on configuration option in IOEFSPRM. This causes the file system to automatically be temporarily mounted read/write to allow log recovery to run and then to be mounted read-only.
3. If the file system being mounted is eligible for compression and the user cache is not registered with the zEDC Express service, zFS will attempt to register the user cache after the mount completes. zFS constraints might prevent zFS from registering the entire user cache with the zEDC Express service. The zfsadm compress command will cause the ZFS_VERIFY_COMPRESSION_HEALTH check to be run.
4. If the DASD volume containing the zFS compatibility mode aggregate being mounted is read-only, you can receive message IOEZ00336I. This message indicates that the zFS aggregate indicator cannot be set in the catalog (actually, in the VVDS on the volume). The zFS aggregate is successfully mounted (and attached). DFSMSdss backup (DUMP) will not automatically quiesce and unquiesce the zFS aggregate because it cannot determine that the VSAM linear data set is a zFS aggregate. If the zFS aggregate can be mounted with the DASD volume in read/write, the zFS aggregate indicator will be set.

5. You can determine whether the zFS aggregate indicator is set by using IDCAMS LISTCAT ALL against the zFS aggregate and looking for the zFS indicator in the output.

6. Do not use a path entry as the file system name in the MOUNT command (see DEFINE PATH in z/OS DFSMS Access Method Services Commands). The mount succeeds but the system issues messages similar to the following one:

```
IOEZ00412I Catalog search failed for aggregate PLEX.JMS.AGGR006.PATH. Shareoptions are not altered.
IOEZ00336I PLEX.JMS.AGGR006.PATH could not be marked as a zFS aggregate in the catalog, rc=60 rsn=104
```

**Examples**

The following TSO/E example mounts a zFS file system and specifies a threshold and increment to display a message when the file system becomes almost full:

```
MOUNT FILESYSTEM('OMVS.PRV.AGGR004.LDS0004') MOUNTPOINT('/etc/zfscompat1')
    TYPE(ZFS) MODE(RDWR) PARM('AGGRFULL(90,5)')
```

The same example as a z/OS UNIX command follows:

```
/usr/sbin/mount -f OMVS.PRV.AGGR004.LDS0004 -t ZFS -o 'AGGRFULL(90,5)' /etc/zfscompat1
```

**Related information**

**Commands:**

UNMOUNT. For more information about UNMOUNT, see z/OS UNIX System Services Command Reference.

**Files:**

IOEFSPRM
**Purpose**

This section introduces the zfsadm command suite. The zfsadm command is run from the z/OS UNIX shell. It can also be invoked from TSO/E by using the program name IOEZADM or as a batch job by using PGM=IOEZADM. If PARM is coded in the JCL to pass options or arguments to IOEZADM and any of the options or arguments contain a slash (for example, R/O), you must specify a leading slash as the first character in the PARM string. See Figure 36 on page 154 for an example of invoking IOEZADM from a batch job.

**Command syntax**

The zfsadm commands have the same general structure:

```
command {-option1 argument...} {-option2 {argument1|argument2}...}[-
optional_information]
```

The following example illustrates the elements of a zfsadm command:

```
zfsadm detach {-all | -aggregate name} [-help]
```

The following list summarizes the elements of the zfsadm command:

- **Command**
  A command consists of the command suite (zfsadm in the previous example) and the command name (detach). The command suite and the command name must be separated by a space. The command suite specifies the group of related commands.

- **Options**
  Command options always appear in monospace type in the text, are always preceded by a - (dash), and are often followed by arguments. In the previous example, -aggregate is an option, with name as its argument. An option and its arguments tell the program which entities to manipulate when running the command (for example, which aggregate, or which file system). In general, the issuer should provide the options for a command in the order detailed in the format description. The { | } (braces separated by a vertical bar) indicate that the issuer must enter either one option or the other (-all or -aggregate in the previous example).

  Command options are described in alphabetic order to make them easier to locate; this does not reflect the format of the command. The formats are presented the same as on your system.

- **Arguments**
  Arguments for options are highlighted in the text. The { | } indicate that the issuer must enter either one argument or the other (-all or -aggregate in the preceding example). The ... (ellipses) indicates that the issuer can enter multiple arguments.

- **Options**
  Some commands have optional, as well as required, options, and arguments. Optional information is enclosed in [ ] (brackets). All options except -all or -aggregate in the previous example are optional.

- **Options**
  The following options are used with many zfsadm commands. They are also listed with the commands that use them.

  - **-aggregate name**
    Specifies the aggregate name of the aggregate to use with the command.

  - **-filesystem name**
    Specifies the file system to use with the command.
-help
Prints the online help for this command. All other valid options that are specified with this option are ignored. For complete details about receiving help, see “Receiving help” on page 145.

-size kbytes
Specifies the size in K-bytes for the kbytes argument.

-system sysname
Specifies the name of the system that the request is sent to.

-trace file_name
Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

When an option is specified multiple times on one command, the first one is honored and the subsequent ones are ignored. This can cause a subsequent argument to be interpreted as an option and be diagnosed as unrecognized.

Usage notes
1. Most zfsadm commands are administrative-level commands that are used by system administrators to manage file systems and aggregates. You can issue commands from OMVS, TSO/E, or as a batch job. Use the IOEZADM format for TSO/E and batch. For an example, see Figure 36 on page 154. The description of the zfsadm attach command shows an example of issuing them as a batch job. The other zfsadm commands can be run as a batch job in a similar manner.

2. For a batch job, the zfsadm options are specified in the EXEC PARM as a single subparameter (a single character string enclosed in apostrophes with no commas separating the options). You cannot put the ending apostrophe in column 72. If it needs to go to the next line, use a continuation character in column 72 (continuing in column 16 with the ending apostrophe on the second line). Remember that a JCL EXEC PARM is limited to 100 characters. See the topic on EXEC PARM in z/OS MVS JCL Reference.

3. zfsadm commands are serialized with each other. That is, when a zfsadm command is in progress, a subsequent zfsadm command is delayed until the active zfsadm completes. This also includes MOUNT of a compatibility mode aggregate (because an implicit attach occurs). This does not include zfsadm grow or implicit aggregate grow. This also does not include long-running zfsadm commands such as zfsadm shrink or zfsadm encrypt. zfsadm commands do not delay normal file system activity (except when the zfsadm command requires it, such as zfsadm quiesce).

4. zfsadm commands only work on zFS file systems and aggregates. All zfsadm commands work across sysplex members that are in a shared file system environment.

5. When supplying an argument to a zfsadm command, the option (for example -aggregate) associated with the argument (for example, OMVS.PRV.AGGR001.LDS0001) can be omitted if:
   • All arguments that are supplied with the command are entered in the order in which they appear in the command's syntax. (The syntax for each command is provided.)
   • Arguments are supplied for all options that precede the option to be omitted.
   • All options that precede the option to be omitted accept only a single argument.
   • No options, either those that accept an argument or those that do not, are supplied before the option to be omitted.
   • The first option cannot be followed by an additional option before the vertical bar.
In the case where two options are presented in 

{ | }

(braces separated by a vertical bar), the option associated with the first argument can be omitted if that argument is provided; however, the option associated with the second argument is required if that argument is provided.

If it must be specified, an option can be abbreviated to the shortest possible form that distinguishes it from other options of the command. For example, the -aggregate option found in many zfsadm commands can typically be omitted or abbreviated to be simply -a. (One exception is the zfsadm attach command because it has an -aggrfull option.)

It is also valid to abbreviate a command name to the shortest form that still distinguishes it from the other command names in the suite. For example, it is acceptable to shorten the zfsadm grow command to zfsadm g because no other command names in the zfsadm command suite begin with the letter g. However, there are two zfsadm commands that begin with l: zfsadm lsaggr and zfsadm lsfs. To remain unambiguous, they can be abbreviated to zfsadm lsa and zfsadm lsf.

The following examples illustrate three acceptable ways to enter the same zfsadm grow command:

- Complete command:
  ```bash
  zfsadm grow -aggregate omvs.prv.aggr001.lds0001 -size 50000
  ```

- Abbreviated command name and abbreviated options:
  ```bash
  zfsadm g -a omvs.prv.aggr001.lds0001 -s 50000
  ```

- Abbreviated command name and omitted options:
  ```bash
  zfsadm g omvs.prv.aggr001.lds0001 50000
  ```

6. The ability to abbreviate or omit options is intended for interactive use. If you embed commands in a shell script, do not omit options nor abbreviate them. If an option is added to a command in the future, it might increase the minimum unique abbreviation that is required for an existing option or change the order of options.

7. In general, zfsadm commands are processed on a worker thread while the zfsadm thread waits. If you cancel a zfsadm command that is taking a long time (for example, zfsadm grow or zfsadm config (to shrink a cache), the zfsadm (waiting) thread is canceled, but the worker thread continues to process the request to completion. In addition, most zfsadm commands require a common zfsadm lock while they are processing. If the zfsadm command cannot get the lock, it waits for it to become available. This means, if you issue another zfsadm command (after canceling a previous one), it can be delayed by this common zfsadm lock until the previous (possibly canceled) command completes. The zfsadm fsinfo command does not have either of these possible processing delays.

**Receiving help**

There are several different ways to receive help about zfsadm commands. The following examples summarize the syntax for the different help options available:

**zfsadm help**

Displays a list of commands in a command suite.

**zfsadm help -topic command**

Displays the syntax for one or more commands.

**zfsadm apropos -topic string**

Displays a short description of any commands that match the specified string.

When the zfsadm command displays help text or a syntax error message, it will show the name of the command as IOEZADM, instead of zfsadm. This occurs because the zfsadm command is not a binary
module in the z/OS UNIX file system; rather, it is a shell script that invokes IOEZADM. IOEZADM is an entry that has the sticky bit on in the permissions. The sticky bit means that the IOEZADM module is found and executed from the user’s STEPLIB, link pack area, or link list concatenation. (IOEZADM is usually located in SYS1.SIEALNKE.) However, you cannot run IOEZADM from the shell because IOEZADM is not normally in your PATH.

Privilege required

zfsadm commands that query information (for example, lsfs, aggrinfo) usually do not require the issuer to have any special authority. zfsadm commands that modify (for example, grow) usually require the issuer to have one of the following authorizations:

- UID of 0. If you are permitted READ to the BPX.SUPERUSER resource in the RACF FACILITY class, you can become a UID of 0 by issuing the su command.
- READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Specific privilege information is listed within each command’s description.

Related information

Commands:

zfsadm aggrinfo
zfsadm apropos
zfsadm attach
zfsadm chaggr
zfsadm compress
zfsadm config
zfsadm configquery
zfsadm convert
zfsadm decompress
zfsadm decrypt
zfsadm define
zfsadm delete
zfsadm detach
zfsadm encrypt
zfsadm fileinfo
zfsadm format
zfsadm grow
zfsadm help
zfsadm lsaggr
zfsadm lsfs
zfsadm lssys
zfsadm query
zfsadm quiesce
zfsadm salvage
zfsadm setauditfid
zfsadm shrink
zfsadm unquiesce

File:

IOEFSPRM
**Purpose**

`zfsadm aggrinfo` displays information about an aggregate, or all attached aggregates, if there is no specific aggregate specified.

**Format**

```
zfsadm aggrinfo [-aggregate name|-system sysname][-fast|-long]
[-level][-help][-trace file_name]
```

**Options**

- **-aggregate name**
  Specifies the name of an aggregate about which information is to be displayed. The aggregate must be attached. The aggregate name is not case-sensitive. It is translated to uppercase. If this option is omitted, information is provided about all of the attached aggregates on the system. Compatibility mode aggregates are implicitly attached when they are mounted.

- **-fast**
  Causes the command to display a single line of output for each attached aggregate. See “Usage notes for `zfsadm aggrinfo`” on page 148 for an explanation of the information that is displayed on each line.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the `zfsadm` command. This option is useful when you are diagnosing a problem. Except for `-help`, all other valid options that are specified with `-level` are ignored.

- **-long**
  Causes the output of the command to be extended to display the following additional information about space usage in an aggregate:
  
  - Version of the aggregate
  - File system identification (auditfid)
  - Indicates sysplex-aware when the aggregate is sysplex-aware for read/write
  - Indicates converttov5 if the aggregate has the converttov5 attribute
  - Number of free 8-KB blocks
  - Number of free 1-KB fragments
  - Size of the log file
  - Size of the filesystem table
  - Size of the bitmap file
  - If the aggregate is quiesced, the job name, system name and the time stamp of when the quiesce occurred.

- **-system sysname**
  Specifies the name of the system that owns the attached aggregates for which the information is displayed.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.
For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes for zfsadm aggrinfo

1. The zfsadm aggrinfo command lists information about the total amount of disk space and the amount of disk space currently available on attached aggregates. The -aggregate option can be used to specify a single aggregate about which information is to be displayed. If this option is omitted, information about all aggregates that are attached in the sysplex (if shared file systems are being used) or the system is displayed. In a shared file system environment, you can limit the display to a single system by using the -system option. Compatibility mode aggregates are implicitly attached when they are mounted.

2. This command displays a separate line for each aggregate. Each line displays the following information:
   - The aggregate name.
   - Whether the aggregate is read/write (R/W) or read-only (R/O), it is a mounted compatibility mode aggregate (COMP) or an attached compatibility mode aggregate (MULT), or the aggregate is currently quiesced (QUIESCED), disabled (DISABLED), or both.
   - The amount of space available in KB.
   - The total amount of space in the aggregate in KB. (To grow an aggregate using the zfsadm grow command, specify a number larger than this number.)
   - If -long is specified, the version of the aggregate, the auditfid, sysplex-aware if the aggregate is sysplex-aware for read/write, the converttov5 attribute, the number of free 8-KB blocks, the number of free 1-KB fragments, the size of the log file, the size of the file system table, the size of the bitmap file, and if the aggregate is quiesced, the job name, time stamp, and system name of the job.

Privilege required

The issuer does not need special authorization.

Examples

Following is an example command that displays information about the disk space that is available on all aggregates that are attached in the sysplex.

```
DCEIMGKC:/DCEIMGKC/home/suimgkc> zfsadm aggrinfo -long
IOEZ00369I A total of 1 aggregates are attached to the sysplex.
Plex.AGGR (R/W COMP QUIESCED): 559 K free out of total 720
version 1.5
auditfid C3C6C3F0 F0F3000E 0000
sysplex-aware, converttov5
69 free 8k blocks; 7 free 1K fragments
112 K log file; 16 K filesystem table
8 K bitmap file
Quiesced by job SUIMGKC3 on system DCEIMGKC on Mon Feb 11 16:04:36 2013
```

Figure 35: Example of zfsadm aggrinfo -long command

Related information

Commands:

- zfsadm fsinfo
- zfsadm lsaggr
Files:

IOEFSRPM
**Purpose**

zfsadm apropos shows each help entry that contains a specified string.

**Format**

```
zfsadm apropos -topic string [-level] [-help] [-trace file_name]
```

**Options**

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the zfsadm command. This is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-topic**
  Specifies the keyword string for which to search. If it is more than a single word, surround it with quotation marks ("" ) or another delimiter. Type all strings for zfsadm commands in all lowercase letters.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

**Usage notes**

The zfsadm apropos command displays the first line of the online help entry for any zfsadm command containing the string specified by -topic in its name or short description. To display the syntax for a command, use the zfsadm help command.

**Privilege required**

The issuer does not need special authorization.

**Results**

The first line of an online help entry for a command lists the command and briefly describes its function. This command displays the first line for any zfsadm command where the string specified by -topic is part of the command name or first line.
Examples
The following command lists all `zfsadm` commands that have the word `list` in their names or short descriptions:

```
zfsadm apropos list
lsaggr: list aggregates
lsfs: list filesystem information
```

Related information

Commands:

`zfsadm help`
zfsadm attach

Purpose

zfsadm attach attaches an aggregate to zFS without mounting the file system. Beginning in z/OS V2R2, this aggregate can only contain one file system.

Note: zfsadm aggrinfo displays an attached compatibility mode aggregate as MULT because it is not mounted.

This command will be removed in a future release.

Format

```
zfsadm attach {-aggregate name
               [-system sysname]}
               [-aggrfull threshold,increment]
               [-R/O|-ro|-rw][-nbs|-nonbs]
               [-aggrgrow|-noaggrgrow]
               [-level][-help][-trace file_name]
```

Options

-aggregate name
  Specifies the name of the aggregate to be attached. The aggregate name is not case-sensitive. It is translated to uppercase. This aggregate does not need an entry in the IOEFSPRM file.

  Compatibility mode aggregates do not need to be attached with the zfsadm attach command. They are automatically attached on MOUNT of the compatibility mode file system.

-aggrfull threshold,increment
  Specifies the threshold and increment for reporting aggregate full error messages to the operator. Both numbers must be specified. The first number is the threshold percentage and the second number is the increment percentage. For example, if 90,5 were specified, the operator is notified when the aggregate is 90% full, then again at 95% full, and again at 100% full. The default is the global aggrfull entry of the IOEFSPRM file.

-aggrgrow
  Specifies that the aggregate should be dynamically grown if it runs out of physical space. The aggregate (that is, the VSAM linear data set) must have a secondary allocation specified and there must be space available on the volume. The default is the aggrgrow option of the IOEFSPRM file.

-help
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

-level
  Prints the level of the zfsadm command. This is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

-nbs
  Specifies that new block security is used for file systems in this aggregate. New block security refers to the guarantee made when a system fails. If a file was being extended or new blocks were being allocated for the file, but the user data had not yet made it to the disk when the failure occurred, zFS shows the newly allocated blocks as all binary zeros and not whatever was on disk in those blocks at time of failure.

-nonbs
  The NONBS option is no longer supported; if NONBS is specified, it is ignored. zFS always runs with NBS on.
Specifies that the aggregate should not be dynamically grown if it runs out of physical space. The default is the aggrgrow option of the IOEFSPRM file.

Specifies that the aggregate should be opened in read-only mode. The default is read/write unless -R/O or -ro is specified.

Specifies that the aggregate should be opened in read/write mode. The default is read/write unless -R/O or -ro is specified.

Specifies the name of the system that will be the zFS owner of the aggregate. The system name is not case-sensitive. It is translated to uppercase.

Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes

1. The zfsadm attach command attaches zFS aggregates on this system. Beginning in z/OS V2R2, zFS only attaches aggregates that contain exactly one file system.

2. If the attach fails because log recovery is unsuccessful, you can run the ioefsutl salvage batch utility with the -verifyonly option on the aggregate to determine if there is an inconsistency. If so, use ioefsutl salvage to recover the aggregate and reissue the zfsadm attach command.

3. The zfsadm lsaggr command can be used to display a current list of all aggregates that are attached on this sysplex with the zFS owning system indicated, or this system when -system is used.

4. If the DASD volume containing the zFS aggregate that being attached is read-only, you might receive message IOEZ00336I. This indicates that the zFS aggregate indicator cannot be set in the catalog (actually, in the VVDS on the volume). The zFS aggregate is successfully attached. DFSMSdss backup (DUMP) will not automatically quiesce and unquiesce the zFS aggregate because it cannot determine that the VSAM linear data set is a zFS aggregate. If the zFS aggregate can be attached with the DASD volume in read/write, the zFS aggregate indicator will be set.

5. You can determine if the zFS aggregate indicator is set by using IDCAMS LISTCAT ALL against the zFS aggregate and looking for the zFS indicator in the output.

6. Compatibility mode aggregates do not need to be separately attached because they are attached during MOUNT processing. However, if you want to issue a zfsadm command against a compatibility mode aggregate without mounting the aggregate, you can use the zfsadm attach command. You might attach an aggregate to grow it or display information about it.

Privilege required

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Examples
1. The following command attaches an aggregate.

```bash
zfsadm attach -aggregate OMVS.PRIV.AGGR001.LDS0001
```

2. Figure 36 on page 154 shows the same example as a job that invokes `zfsadm attach`.

```plaintext
//USERIDA JOB , 'Zfsadm Attach',
// CLASS=A, MSGCLASS=X, MSGLEVEL=(1,1)
//AGGRINFO EXEC  PGM=IOEZADM, REGION=0M,
// PARM=('attach -aggregate OMVS.PRIV.AGGR001.LDS0001')
//SYSPRINT DD  SYSOUT=H
//STDOUT   DD    SYSOUT=H
//STDERR   DD  SYSOUT=H
//SYSUDUMP DD  SYSOUT=H
//CEEDUMP  DD  SYSOUT=H
//*
```

**Figure 36: Job to attach an aggregate**

If you want to specify the R/O option, you must specify a leading slash. Otherwise, Language Environment® treats the characters before the slash as Language Environment parameters. That is, you must use `PARM=('attach OMVS.PRIV.AGGR001.LDS0001 -R/O')`.

**Related information**

**Commands:**

- `zfsadm fsinfo`
- `zfsadm lsaggr`

**Files:**

- IOEFSPRM
**Purpose**

`zfsadm chaggr` changes the attributes of an aggregate.

**Restriction:** All systems in the sysplex must be at least the V2R3 level in order to use the `zfsadm chaggr` command.

**Format**

```
zfsadm chaggr -aggregate name
   [-aggrfull{threshold, increment|OFF}] [-aggrgrow {ON|OFF}] [-rwshare| -norwshare]
   [-trace file_name][-level][-help]
```

**Options**

- **-aggregate name**
  Specifies the name of the aggregate whose attributes will be changed. The aggregate name is not case-sensitive. It is translated to uppercase.

- **-aggrfull threshold, increment | OFF**
  Specifies the threshold and increment for reporting aggregate full error messages to the operator, or specifies that aggregate full error messages are not to be issued.

- **-aggrgrow ON|OFF**
  Specifies whether the aggregate is eligible to be dynamically grown.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the `zfsadm` command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-norwshare**
  Specifies that the aggregate is to be made non-sysplex aware.

- **-rwshare**
  Specifies that the aggregate is to be made sysplex aware.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in *z/OS UNIX System Services Command Reference*. 

**Usage notes**

1. All systems in the sysplex must be at least the V2R3 level in order to use the `zfsadm chaggr` command.

2. The aggregate must be mounted.
3. The threshold and increment values must be in the range 1-99.

4. The -norwshare and -rwshare options will cause a samemode remount to be issued if the aggregate is mounted read/write. If the aggregate is mounted read-only, only the mount parameters are updated.

5. In addition to changing the aggregate attributes, the `zfsadm chaggr` command will also cause any corresponding ZFS mount parameters to be updated in the z/OS UNIX couple data set. When a mount parameter is updated, duplicate and related mount parameters are first removed and the new mount parameter is added to the end of the mount parm string. Under certain error conditions, the aggregate attributes and the mount parameters that are stored in the z/OS UNIX couple data set might become mismatched. This will not affect how ZFS behaves. It will only be of concern if the aggregate is remounted using the mount parameters that are stored in the couple data set.

   If the mount parameters do not match the aggregate attributes, an aggregate might not have the same behavior after a remount. Because the mount parameters in a ZFS couple data set are ephemeral, any changes will not survive an unmount. Also, the mount parameters in a Z/OS UNIX couple data set only reflect the ZFS mount parameters that are explicitly specified on a mount or the ZFS mount parameters that are explicitly changed with the `zfsadm chaggr` command. Hence the parameters might not represent all the aggregate attributes in use.

6. The -aggrfull, -aggrgrow, -rwshare, and -norwshare options are mutually exclusive.

**Privilege required**

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Examples**

1. To show the current attributes of aggregate PLEX.ZFS.SMALL1:

   ```bash
   # zfsadm fsinfo plex.zfs.small1
   File System Name: PLEX.ZFS.SMALL1
   *** owner information ***
   Owner: DCEIMGVY Converttov5: OFF,n/a
   Size: 300240K Free 8K Blocks: 24337
   Free 1K Fragments: 7 Log File Size: 3008K
   Bitmap Size: 48K Anode Table Size: 8K
   File System Objects: 7 Version: 1.5
   Overflow Pages: 0 Overflow HighWater: 0
   Thrashing Objects: 0 Thrashing Resolution: 0
   Token Revocations: 0 Revocation Wait Time: 0.000
   Devno: 36 Space Monitoring: 0,0
   Quiescing System: n/a Quiescing Job Name: n/a
   Quiescor ASID: n/a File System Grow: ON,0
   Status: RW,RS,NE,NC
   Audit Fid: C3C6C3F0 0F6F203EC 0000
   File System Creation Time: Nov 2 16:30:08 2015
   Time of Ownership: Nov 2 16:30:21 2015
   Statistics Reset Time: Nov 2 16:30:21 2015
   Quiesce Time: n/a
   Last Grow Time: n/a
   Connected Clients: n/a
   Legend: RW=Read-write, RS=Mounted RWSHARE, NE=Not encrypted
   NC=Not compressed
   ```

2. To change the mount mode of aggregate PLEX.ZFS.SMALL1 to NORWSHARE:

   ```bash
   # zfsadm chaggr plex.zfs.small1 -norwshare
   IOEZ00650I Successfully changed the attributes of aggregate PLEX.ZFS.SMALL1.
   ```
3. To change aggregate PLEX.ZFS.SMALL1 to disallow dynamic growing:

```bash
# zfsadm chaggr plex.zfs.small1 -aggrgrow off
IOEZ00650I Successfully changed the attributes of aggregate PLEX.ZFS.SMALL1.
```

4. To change aggregate PLEX.ZFS.SMALL1 to use space monitoring, with a threshold of 96 percent full and an increment of 2%:

```bash
# zfsadm chaggr plex.zfs.small1 -aggrfull 96,2
IOEZ00650I Successfully changed the attributes of aggregate PLEX.ZFS.SMALL1.
```

5. To display the new attributes of aggregate PLEX.ZFS.SMALL1. Note the changed values in File System Grow, Space Monitoring, the Status area, and the Legend:

```bash
# zfsadm fsinfo plex.zfs.small1
File System Name: PLEX.ZFS.SMALL1
*** owner information ***
Owner:               DCEIMGVY        Converttov5:            OFF,n/a
Size:                300240K         Free 8K Blocks:         37121
Free 1K Fragments:   7               Log File Size:           3008K
Bitmap Size:         48K             Anode Table Size:        8K
File System Objects: 7               Version:                1.5
Overflow Pages:      0               Overflow HighWater:      0
Thrashing Objects:   0               Thrashing Resolution:    0.000
Token Revocations:   0               Revocation Wait Time:    0.000
Devno:               36              Space Monitoring:       96,2
Quiescing System:    n/a             Quiescing Job Name:      n/a
Quiescor ASID:       n/a             File System Grow:       OFF,0
Status:              RW,NS,NE,NC
Audit Fid:           C3C6C3F0 F0F203EC 0000
File System Creation Time: Nov 2 16:30:08 2015
Time of Ownership:   Nov 2 17:03:23 2015
Statistics Reset Time: Nov 2 17:03:23 2015
Quiesce Time:        n/a
Last Grow Time:      n/a
Connected Clients:   n/a

Legend: RW=Read-write,NS=Mounted NORWSHARE,NE=Not encrypted NC=Not compressed
```

Related information

Commands:
- zfsadm config
- zfsadm configquery
- zfsadm fsinfo
- MOUNT

Files:
- IOEFSPRM
**zfsadm compress**

**Purpose**

zfsadm compress compresses a zFS aggregate.

**Format**

```
zfsadm compress -aggregate name [-cancel][-trace file_name][-level][-help]
```

**Options**

- **-aggregate name**
  Specifies the name of the aggregate to be compressed. The aggregate name is not case-sensitive. It is always converted to uppercase.

- **-cancel**
  Cancels an in-progress compress operation for the specified aggregate.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in *z/OS UNIX System Services Command Reference*.

**Usage notes**

1. The zfsadm compress command is a long-running administrative command that uses the zEDC compression method to compress an existing zFS aggregate.

2. To improve performance of the compression I/O, IBM recommends that you specify the edcfixed option in the IOEFSPRM parameter user_cache_size. For more information about user_cache_size, see “IOEFSPRM” on page 227.

3. If the user cache is not registered with the zEDC Express service, zFS will attempt to register the user cache after the zfsadm compress command completes. zFS constraints might prevent zFS from registering the entire user cache with the zEDC Express service. The zfsadm compress command will cause the ZFS_VERIFY_COMPRESSION_HEALTH check to be run.

4. To process the compression request, the long-running command thread pool must have an available foreground thread. See the IOEFSPRM configuration option long_cmd_threads for information about controlling the size of the long-running foreground and background thread pools. The option is described in “IOEFSPRM” on page 227.
5. The command must be issued from a z/OS V2R3 or later system, and the zFS file system must be zFS-owned on a z/OS V2R3 or later system. The aggregate must be at least aggregate version 1.5 and mounted read/write. Do not use this command before you have migrated all your systems to z/OS V2R3 or later. If there are systems that are active prior to z/OS V2R3 in the shared file system environment, compression will not take place.

6. zFS will determine whether the compression can achieve space savings. If not, it will not perform compression. Only regular files that are stored in blocked format can be compressed. Applications can still access the aggregate while it is being compressed.

7. A compress operation can be interrupted by using the -cancel option, UNMOUNT immediate with the -force option, or during a shutdown. If the compress operation is interrupted, the zFS aggregate might be left with both compressed and uncompressed files. This partial state is allowed. Another zfsadm compress command can be issued to resume the compression operation for the rest of the files after the interruption.

8. You cannot compress an aggregate that is in a partially encrypted or partially decrypted state. In other words, if encryption or decryption was interrupted for an aggregate, you cannot compress it.

9. Use either the zfsadm fsinfo or MODIFY FSINFO command to display whether an aggregate is compressed or is being compressed. Progress of the compress operation can be seen in the owner status display.

10. The zfsadm fileinfo command can be used to show whether a particular file is compressed or not.

11. The backup change activity flag is set if any file data is compressed.

12. Aggregates with active file backups cannot be compressed.

**Privilege required**

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILES.SYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Examples**

1. The following command compresses an existing zFS aggregate:

   ```
   zfsadm compress -aggregate PLEX.ZFS.AGGR1
   IOEZ00899I Aggregate PLEX.ZFS.AGGR1 successfully compressed.
   ```

**Related information**

**Commands:**
- zfsadm encrypt
- zfsadm decompress
- zfsadm define
- zfsadm fileinfo
- zfsadm fsinfo
- zfsadm shrink

**Files:**
- IOEFSPRM
**Purpose**

`zfsadm config` changes the value of the zFS configuration file (IOEFSPRM) options in memory. See Chapter 12, “The zFS configuration options file (IOEPRMxx or IOEFSPRM),” on page 227 for a complete list of IOEFSPRM options.

**Format**

```
zfsadm config [-adm_threads number]
    [-user_cache_size cache_size[,fixed][edcfixed]]
    [-meta_cache_size cache_size[,fixed]]
    [-log_cache_size cache_size[,fixed]]
    [-sync_interval number][-vnode_cache_size number][-nbs {ON|OFF}]
    [-fsfull threshold,increment] [-agfrfull threshold,increment][-trace_dsn
    dataset_name]
    [-tran_cache_size number][-msg_output_dsn dataset_name]
    [-metaback_cache_size cache_size[,fixed]][-aggrgrow {ON|OFF}]
    [-vnode_cache_limit number][-romount_recovery {ON|OFF}]
    [-convert_auditfid {ON|OFF}] [-client_reply_storage storage size][-
    file_threads number]
    [-client_cache_size cache_size[,fixed]] [-token_cache_size cache size]
    [-sysplex_filesys_sharemode {rwshare|norwshare}]
    [-change_aggrversion_on_mount {ON|OFF}] [-format_aggrversion {4|5}][-
    converttov5 {ON|OFF}]
    [-modify_cmd_threads number] [-honor_syslist {ON|OFF}]
    [-long_cmd_threads foreground,background]
    [-smf_recording {ON|ON, intul|OFF}]
    [-format_encryption {ON|OFF}]
    [-edc_buffer_pool storage_size]
    [-format_perms number][-system sysname]
    [-trace file_name] [-level] [-help]
```

**Options**

When you change options that apply to zFS aggregates and file systems, the current default changes. However, the change does not affect file systems that were already mounted until they have been unmounted and remounted. Those options are as follows:

- `aggrfull`  
  Specifies the number of threads that are defined to handle pfsctl or mount requests.

- `aggrgrow`  
  Specifies the threshold and increment for reporting aggregate full error messages to the operator.

  **Default value:** None.

- `-aggrgrow ON | OFF`  
  Specifies whether an aggregate should be dynamically extended when it runs out of physical space.

- `-change_aggrversion_on_mount ON | OFF`  
  Specifies whether an aggregate should be changed to a version 1.5 aggregate on mount.
-client_cache_size cache size[,fixed]
   Specifies the size, in bytes, of the client cache. This is only meaningful when zFS is running sysplex-aware. This option is not supported; if it is specified, it is accepted but not used.

-client_reply_storage storage size
   Specifies the number of bytes allocated for sysplex client reply storage. This is only meaningful when zFS is running sysplex-aware.

-convert_auditfid ON | OFF
   Specifies whether the zFS auditfid is automatically changed to the unique format on mount (attach). If ON is specified, or defaulted, mount (attach) changes the standard auditfid format to the unique auditfid format if the mount (attach) is read/write. If OFF is specified (or the mount (attach) is read-only), the auditfid is not affected.

-converttov5 ON | OFF
   Specifies whether directories in a version 1.5 aggregate should be converted from v4 directories to extended (v5) directories as they are accessed. A version 1.4 aggregate is changed to a version 1.5 aggregate. You can override this setting at mount time by specifying CONVERTTOV5 or NOCONVERTTOV5.

-edc_buffer_pool number
   Specifies how much real storage will be permanently fixed by zFS for encryption and compression I/O.

-format_aggrversion 4 | 5
   Specifies whether a version 1.4 aggregate or a version 1.5 aggregate should be formatted by default.

-format_compression ON | OFF
   Specifies whether a newly created zFS aggregate will be formatted with compression.

-format_encryption ON | OFF
   Specifies whether a newly created zFS aggregate will be formatted with encryption.

-file_threads number
   Specifies the current number of file threads. This option is only meaningful when zFS is running sysplex-aware.

-format_perms number
   Specifies the permissions that are used for the root directory of the file system during a format when the -perms option is not specified. The valid values are in the range 0 to 07777. The number can be specified as octal (for example, o755), as hexadecimal (for example, x1ED), or as decimal (for example, 493).

-fsfull threshold,increment
   Specifies the threshold and increment for reporting file system full error messages to the operator.

-help
   Prints the online help for this command. All other valid options that are specified with this option are ignored.

-honor_syslist ON | OFF
   Specifies whether to use the z/OS UNIX AUTOMOVE options when determining the new zFS owner. The -honor_syslist option is no longer supported. Its value can be changed but is ignored when moving zFS ownership. For more information about zFS ownership movement, see “Dynamic movement of the zFS owner” on page 54.

-level
   Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options specified with -level are ignored.

-log_cache_size number [,fixed]
   Specifies the size, in bytes, of the cache that is used to contain buffers for log file pages. The fixed option reserves real storage for usage by zFS only.

-long_cmd_threads <foreground,background>
   Specifies the number of foreground and background threads that are defined to handle long-running administrative commands.
-**meta_cache_size number [,fixed]**
  Specifies the size, in bytes, of the cache that is used to contain metadata. The fixed option reserves real storage for usage by zFS only.

-**metaback_cache_size number**
  Specifies the size of the metadata backing cache. This size is combined with meta_cache_size to get the total size of the metadata cache.

-**modify_cmd_threads number**
  Specifies the current number of threads that are defined to handle zFS modify commands.

-**msg_output_dsn Seq_dataset_name**
  Specifies the name of a data set that contains any output messages that come from the zFS PFS.

-**nbs ON | OFF**
  Controls the global new block security. zFS always runs with new block security on. The OFF option is not supported. If it is specified, it is accepted but not used.

-**romount_recovery ON | OFF**
  Specifies whether zFS will automatically avoid a read-only mount failure (zFS reason code EFxx6271) because log recovery must be run for this aggregate. This situation can occur when the aggregate has been mounted read/write and a failure occurred before it was unmounted. If the next mount is for read-only, log recovery needs to be run before the mount can be successful. If the ON is specified and this situation occurs, zFS temporarily mounts the aggregate read/write to allow log recovery to run. After the log recovery is run, zFS unmounts and then mounts the aggregate read-only.

-**smf_recording ON | ON,intvl | OFF**
  Specifies that data is to be collected and recorded by System Management Facilities (SMF).

  **ON**
  Specifies that SMF is to collect and record zFS data. The SMF parameters that were previously set determines the type that is recorded and the recording interval that is used. For more information about SMF, see z/OS MVS System Management Facilities (SMF).

  **ON,intvl**
  Specifies that SMF is to collect and record zFS data at intvl interval. The SMF parameters that were previously set determines the type of data that is recorded, but the SMF interval is overridden by the intvl specification. The intvl option specifies the number of minutes between periodic recording of statistics.

  **OFF**
  Specifies that SMF is not to collect and record zFS data.

-**sync_interval number**
  Specifies the number of seconds between the times where zFS flushes data in its buffers to disk. The default is 30 seconds.

-**sysplex_filesys_sharemode rwshare | norwshare**
  Specifies the default for the mount PARM when a zFS read/write file system is mounted on a sysplex=filesys system. You can override this setting at mount time by specifying an alternate value in the actual mount PARM.

-**system sysname**
  Specifies the name of the system that the configuration option change request is sent to.

-**token_cache_size cache size**
  Specifies the token cache size maximum. When the token_cache_size is decreased, it is really the maximum size that is being decreased. This is only possible if the current usage is less than the maximum size. The token cache size cannot be decreased to lower than the current usage. The current usage is displayed through the MODIFY ZFS,QUERY,STKM command. This option is only meaningful when zFS is running sysplex-aware.

-**trace_dsn PDSE_dataset_name**
  Specifies the name of a data set that contains the output of any operator MODIFY ZFS,TRACE,PRINT commands or the trace output if zFS abends.
-tran_cache_size number
   Specifies the number of transactions in the transaction cache. This option is not supported; if it is
   specified, it is accepted but not used.

-trace file_name
   Specifies the name of the file that will have the trace records written into it. The trace file can be a
   z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data
   set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM
   Support.

   For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data
   sets for debugging in “zFS installation and configuration steps” on page 11.

   Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS
   data set names in the shell environment. For more information, see Specifying MVS data set names in
   the shell environment in z/OS UNIX System Services Command Reference.

-user_cache_size number [,fixed|edcfixed]
   Specifies the size, in bytes, of the cache that is used to contain file data. The fixed and edcfixed
   options can fix the user file cache in real memory.

   • The fixed option avoids page fix and page unfix for disk I/Os that do not use compression.
   • The edcfixed option avoids page fix and page unfix for disk I/Os that use compression. It also avoids
     data movement for compression I/Os.

-vnode_cache_size number
   Specifies the number of vnodes that zFS will cache.

Usage notes
1. The zfsadm config command changes the configuration options (in memory) that were specified in
   the IOEFSPRM file (or defaulted). The IOEFSPRM file is not changed. If you want the configuration
   specification to be permanent, you must modify the IOEFSPRM file because zFS reads the IOEFSPRM
   file to determine the configuration values when zFS is started. The values that can be specified for
   each option are the same as the values that can be specified for that option in the IOEFSPRM file. You
   can specify that the configuration option change request should be sent to another system by using
   the -system option. The following options cannot be set by using the zfsadm config command:

   • -cmd_trace
   • -debug_dsn
   • -group
   • -msg_input_dsn
   • -trace_table_size
   • -sysplex_state

Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the
SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Examples
The following example changes the size of the user cache:

```
zfsadm config -user_cache_size 64M
IOEZ00300I Successfully set -user_cache_size to 64M
```

Related information
Commands:
zfsadm configquery

Files:

IOEFSprm
**Purpose**

`zfsadm configquery` queries the current value of zFS configuration options.

**Format**

```
```

**Options**

- **-adm_threads**
  Displays the number of threads that are defined to handle pfsctl or mount requests.

- **-aggrfull**
  Displays the threshold and increment for reporting aggregate full error messages to the operator.

- **-aggrgrow**
  Displays whether an aggregate should be dynamically extended when it runs out of physical space.

- **-all**
  Displays the full set of configuration options.

- **-change_aggrversion_on_mount**
  Displays whether a version 1.4 aggregate should be changed to a version 1.5 aggregate when it is mounted.

- **-client_cache_size**
  Displays the size, in bytes, of the client cache. This option is only meaningful when zFS is running sysplex-aware. If you use `zfsadm config` to set `-client_cache_size` to a value, the value is displayed but not used.

- **-client_reply_storage**
  Displays the number of bytes allocated for sysplex client reply storage. This option is only meaningful when zFS is running sysplex-aware.

- **-cmd_trace**
  Displays whether command tracing is active.

- **-converttov5**
  Displays whether an aggregate should be assigned the converttov5 attribute on mount or remount. This attribute controls whether v4 directories will be converted to extended (v5) directories as they are accessed.

- **-convert_auditfid**
  Displays whether the zFS auditfid is automatically changed to the unique format on mount (attach). If on is specified or defaulted and the mount (attach) is read/write, the mount (attach) changes the standard auditfid format to the unique auditfid format. If off is specified or the mount (attach) is read-only, the auditfid is unaffected.

- **-debug_dsn**
  Displays the name of the debug input parameters data set.
-edc_buffer_pool
Displays how much real storage is permanently fixed by zFS for encryption and compression I/O.

-file_threads
Displays the current number of file threads. This option is only meaningful when zFS is running sysplex-aware.

-format_aggrversion
Displays whether an aggregate formatting default should be to format as a version 1.4 or 1.5 aggregate.

-format_compression
Displays whether a newly created zFS aggregate will be formatted with compression.

-format_encryption
Displays whether a newly created zFS aggregate will be formatted with encryption.

-format_perms
Displays the permissions that are used for the root directory of a file system during a format when the -perms format option is not specified.

-fsfull
Displays the threshold and increment for reporting file system full error messages to the operator.

-group
Displays the XCF group that is used by zFS for communication between sysplex members.

-help
Prints the online help for this command. All other valid options that are specified with this option are ignored.

-honor_syslist
Displays the setting of the honor_syslist option that specifies whether to use the z/OS UNIX automove options when determining the new zFS owner. The -honor_syslist option is no longer supported. The option is ignored when moving zFS ownership. For more information about system lists, see “Dynamic movement of the zFS owner” on page 54.

-level
Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

-log_cache_size
Displays the size, in bytes, of the cache that is used to contain buffers for log file pages.

-long_cmd_threads
Displays the number of foreground and background threads that are defined to handle long-running administrative commands.

-meta_cache_size
Displays the size, in bytes, of the cache that is used to contain metadata.

-metaback_cache_size
Displays the size of the backing cache for metadata.

-modify_cmd_threads
Displays the number of threads that are defined to handle zFS modify commands.

-msg_input_dsn
Displays the name of the data set that contains translated zFS messages.

-msg_output_dsn
Displays the name of a data set that contains any zFS initialization output messages that come from the zFS PFS.

-nbs
Controls the global new block security. zFS always runs with new block security on. If you use zfsadm config to set -nbs to off, it is displayed as off, but the value is not used.
-romount_recovery
Displays whether read-only mount recovery is on or off. When romount_recovery=on, zFS temporarily mounts the aggregate read/write to allow log recovery to run, and then zFS unmounts and mounts the aggregate again in read-only format.

-smf_recording
Displays whether data is to be collected and recorded by System Management Facilities (SMF).

-sync_interval
Displays the number of seconds in the interval that zFS flushes data in the buffers to disk.

-syslevel
Displays the zFS kernel (the PFS) information, including:
• The version and release of z/OS
• The service level and FMID of zFS
• The date and time the PFS was built
• Whether the PFS is running sysplex-aware on a file system basis (referred to as filesys), or sysplex-aware on a system basis (referred to as file), or not sysplex-aware (referred to as admin-only), and the zFS XCF protocol level when running in a shared file system environment. (For information about the XCF protocol level, see “Determining the XCF protocol interface level” on page 94.) When filesys is indicated, the default mount PARM (NORWSHARE or RWSHARE) is also displayed.

This is the same information that is displayed by the operator command MODIFY ZFS,QUERY,LEVEL. In contrast, zfsadm configquery -level shows the level information for the zfsadm command itself.

-sysplex_filesys_sharemode
Displays the current default for the mount PARM (RWSHARE or NORWSHARE). It is only meaningful on systems that are running zFS sysplex=filesys.

-sysplex_state
Displays the sysplex state of zFS.
3
zFS is running in a sysplex-aware environment with sysplex=filesys.

-system sysname
Specifies the name of the system the report request is sent to retrieve the requested data.

-token_cache_size
Displays the current token_cache_size maximum. The current usage is displayed through the MODIFY ZFS,QUERY,STKM command. This option is only meaningful when zFS is running sysplex-aware.

-trace_dsn
Displays the name of the data set that contains the output of any operator MODIFY ZFS, TRACE,PRINT commands or the trace output if zFS abends.

-trace_table_size
Displays the size, in bytes, of the internal trace table.

-tran_cache_size
Displays the number of transactions in the transaction cache. If you use zfsadm config to set -tran_cache_size to a value, the value is displayed but not used.

-trace file_name
Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.
Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

- **user_cache_size**
  Displays the size, in bytes, of the cache that is used to contain file data.

- **vnode_cache_size**
  Displays the number of vnodes that will be cached by zFS.

**Usage notes**

1. The `zfsadm configquery` command displays the current value of zFS configuration options. The value is retrieved from zFS address space memory rather than from the IOEFSPRM file. You can specify that the configuration option query request should be sent to another system by using the `-system` option.
2. Ignore the following values when zFS is running non-sysplex aware. No storage is obtained even though a value might be reported.
   - `-client_cache_size`
   - `-client_reply_storage`
   - `-file_threads`
   - `-token_cache_size`

**Privilege required**

The issuer does not need special authorization.

**Examples**

1. The following command displays the current value of the `user_cache_size` option:

   ```bash
   zfsadm configquery -user_cache_size
   IOEZ00317I The value for config option -user_cache_size is 64M.
   ```

2. The following command displays all the zFS configuration options from each member:

   ```bash
   for sys in $(zfsadm lssys | grep -v IOEZ00361I); do; echo; echo $sys; zfsadm configquery -all -system $sys; done
   ```

**Related information**

**Commands:**

- `zfsadm config`

**Files:**

- IOEFSPRM
zfsadm convert

Purpose

zfsadm convert converts a v4 directory that is contained in a read/write mounted version 1.5 aggregate to an extended (v5) directory. The aggregate is changed from a version 1.4 aggregate to a version 1.5 aggregate, if necessary. It can also be used to change a version 1.4 aggregate to a version 1.5 aggregate without converting any directories.

Format

```
zfsadm convert [-path name|-aggrversion name][-level][-help][-trace file_name]
```

Options

- **-aggrversion name**
  Specifies the aggregate name that should be changed from a version 1.4 aggregate to a version 1.5 aggregate. No directories are converted. The aggregate name is not case-sensitive. It is converted to uppercase.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-path name**
  Specifies the path name of a directory that should be converted to an extended (v5) directory. The aggregate is changed to a version 1.5 aggregate first, if necessary.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes

1. The zfsadm convert command can be used to explicitly convert a v4 directory to an extended (v5) directory that is contained in a read/write mounted version 1.5 aggregate. In this case, the -path option is used. If the containing aggregate is a version 1.4 aggregate, the command attempts to change the aggregate to a version 1.5 aggregate before converting the directory. It can also be used to explicitly change a version 1.4 aggregate to a version 1.5 aggregate without converting any directories. In this case, the -aggrversion option is used.

2. The zfsadm convert command might cause the file system to grow if it needs more space for the extended (v5) directory.

3. The command must be issued from a z/OS V2R1 or later system and the zFS file system must be zFS-owned on a z/OS V2R1 or later system. The aggregate must be mounted read/write.
4. Do not use this command before you have migrated all your systems to z/OS V2R1 or later. If there are systems that are prior to z/OS V2R1 active in the shared file system environment, no conversion of a directory nor change of aggregate version takes place.

5. If you use a job to invoke `zfsadm convert`, to specify the `-path` option, you must specify a leading slash in the PARM string if the path argument contains a slash. Otherwise, Language Environment will treat the characters before the slash as Language Environment parameters. That is, you must use `PARM=('/convert -path /home/mynname/mydir')`.

**Privilege required**

The issuer must be the owner of the directory and must have write permission (w) to the directory. If the aggregate version is to be changed, the issuer must be logged in as the root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Examples**

The following example contains the steps to convert an existing version 1.4 aggregate to a version 1.5 aggregate, and to convert a v4 directory to an extended (v5) directory.

1. To display the version of the aggregate:

   ```bash
   # zfsadm aggrinfo PLEX.JMS.AGGR009.LDS0009 -long
   PLEX.JMS.AGGR009.LDS0009 (R/W COMP): 1271 K free out of total 1440
   version 1.4
   auditfid C3C6C3F0 F0F200A2 0000
   158 free 8k blocks; 7 free 1K fragments
   112 K log file; 16 K filesystem table
   8 K bitmap file
   ```

2. To change the version to 1.5:

   ```bash
   # zfsadm convert -aggrversion PLEX.JMS.AGGR009.LDS0009
   IOEZ00810I Successfully changed aggregate PLEX.JMS.AGGR009.LDS0009 to version 1.5.
   ```

3. To verify the aggregate version change:

   ```bash
   # zfsadm aggrinfo PLEX.JMS.AGGR009.LDS0009 -long
   PLEX.JMS.AGGR009.LDS0009 (R/W COMP): 1271 K free out of total 1440
   version 1.5
   auditfid C3C6C3F0 F0F200A2 0000
   158 free 8k blocks; 7 free 1K fragments
   112 K log file; 16 K filesystem table
   8 K bitmap file
   ```

4. To display the version of a directory:

   ```bash
   # zfsadm fileinfo /service9
   path: /service9
   *** global data ***
   fid          1,1
   length       8192
   1K blocks    8
   uid,gid      0,10
   dir model acl 0,0
   file format bits none
   file charset id none
   file time timestamp none
   file cver none
   direc blocks none
   mtime       Jun 13 15:27:10 2012
   atime        Jun 13 10:41:43 2012
   ```
5. To convert the directory to an extended (v5) directory:

```
# zfsadm convert -path /service
```

```
IOEZ00791I Successfully converted directory /service9 to version 5 format.
```

6. To display the version of the directory again:

```
# zfsadm fileinfo /service9
```

**Related information**

**Commands:**

- `zfsadm config`
- `zfsadm fsinfo`

**Files:**

- IOEFSPRM
**zfsadm decompress**

**Purpose**

*zfsadm decompress* decompresses a zFS aggregate that was previously compressed with the zEDC compression method.

**Format**

```
zfsadm decompress -aggregate name [-cancel][-trace file_name][-level][-help]
```

**Options**

- **-aggregate name**
  Specifies the name of the aggregate to be decompressed. The aggregate name is not case-sensitive. It is always converted to uppercase.

- **-cancel**
  Cancels an in-progress decompress operation for the specified aggregate.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

**Usage notes**

1. The *zfsadm decompress* command is a long-running administrative command that uses the zEDC decompression method to decompress an existing compressed zFS aggregate.

2. To process the decompression request, the long-running command thread pool must have an available foreground thread. See the IOEFSprm configuration option long_cmd_threads for information about controlling the size of the long-running foreground and background thread pools. ("IOEFSprm" on page 227)

3. The command must be issued from a z/OS V2R3 or later system, and the zFS file system must be zFS-owned on a z/OS V2R3 or later system. The aggregate must be at least aggregate version 1.5 and mounted read/write. If you ever need to go back to an earlier z/OS V2R3 system, make sure to decompress all previously compressed aggregates first.

4. Applications can still access the aggregate while it is being decompressed.

5. A decompress operation can be interrupted by using the -cancel option or during a shutdown. It can also be interrupted when the shell command unmount or TSO/E command UNMOUNT is issued with
the force option. If the decompress operation is interrupted, the zFS aggregate might end up with both compressed and decompressed files. This partial state is allowed. You can issue another zfsadm decompress command to resume the decompress operation for the rest of files after the interruption. You can also issue zfsadm compress command to compress the partially compressed aggregate.

6. You cannot decompress an aggregate that is in a partially encrypted or partially decrypted state. In other words, if encryption or decryption was interrupted for an aggregate, you cannot decompress it.

7. Use either the zfsadm fsinfo or MODIFY FSINFO command to display whether an aggregate is decompressed or being decompressed. Progress of the decompress operation can be seen in the owner status display. The backup change activity flag is set if any data is decompressed.

8. The zfsadm fileinfo command can be used to show whether a particular file is decompressed.

9. Aggregates with active file backups cannot be decompressed.

**Privilege required**

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Examples**

The following command decompresses aggregate PLEX.ZFS.AGGR1:

```
zfsadm decompress -aggregate PLEX.ZFS.AGGR1
```

IOEZ00900I Aggregate PLEX.ZFS.AGGR1 successfully decompressed

**Related information**

**Commands:**

- zfsadm compress
- zfsadm fileinfo
- zfsadm fsinfo

**Files:**

- IOEFSPRM
zfsadm decrypt

Purpose
zfsadm decrypt decrypts a zFS aggregate that was previously encrypted with DFSMS access method encryption.

Format
```
zfsadm decrypt -aggregate name [-cancel][-trace file_name][-level][-help]
```

Options
- **-aggregate name**
  Specifies the name of the aggregate to be decrypted. The aggregate name is not case-sensitive. It is always converted to uppercase.

- **-cancel**
  Cancels an in-progress decrypt operation for the specified aggregate.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes
1. The zfsadm decrypt command is a long-running administrative command that uses DFSMS access method decryption to decrypt an existing encrypted zFS aggregate.

2. The command must be issued from a z/OS V2R3 or later system, and the zFS file system must be zFS-owned on a z/OS V2R3 or later system. The aggregate must be at least aggregate version 1.5 and mounted read/write.

3. To process the decryption request, the long-running command thread pool must have an available foreground thread. See the IOEFSPRM configuration option long_cmd_threads for information about controlling the size of the long-running foreground and background thread pools. The option is described in “IOEFSPRM” on page 227.

4. A decryption operation can be interrupted by using the -cancel option or during a shutdown. It can also be interrupted when the shell command unmount or TSO/E command UNMOUNT is issued with the force option. If the decompress operation is interrupted, the zFS aggregate might be left with both decrypted and encrypted files. This partial state is allowed. You can issue another zfsadm decrypt
command to resume the decrypt operation for the rest of files after it has been interrupted. You can also issue `zfsadm encrypt` command to encrypt the partially encrypted aggregate.

5. You cannot decrypt an aggregate that is in a partially compressed or partially decompressed state. In other words, if compression or decompression was interrupted for an aggregate, you cannot decrypt it.

6. After the aggregate is fully decrypted, any newly created files are not encrypted. Applications can still access the aggregate while it is being decrypted. The backup change activity flag is set if any data is decrypted.

7. Use either the `zfsadm fsinfo` or `MODIFY FSINFO` command to display whether an aggregate has been decrypted or is being decrypted. Progress of the decrypt operation can be seen in the owner status display.

8. The `zfsadm fileinfo` command can be used to show whether a particular file is decrypted.

9. Aggregates with active file backups cannot be decrypted.

**Privilege required**

The issuer must be logged in as a root user (UID=0) or have READ authority to the `SUPERUSER.FILESYS.PFSCTL` resource in the z/OS UNIXPRIV class.

**Example**

1. The following command decrypts an existing zFS aggregate:

   ```bash
   zfsadm decrypt -aggregate PLEX.ZFS.FS
   IOEZ00878I Aggregate PLEX.ZFS.FS is successfully decrypted.
   ```

**Related information**

**Commands:**

- `zfsadm encrypt`
- `zfsadm fileinfo`
- `zfsadm fsinfo`

**Files:**

- `IOEFSPRM`
Purpose

zfsadm define defines a VSAM linear data set that can be formatted as a zFS aggregate.

Format

```
zfsadm define -aggregate name
  [-keylabel label][-dataclass SMS_data_class]
  [-managementclass SMS_management_class]
  [-storageclass SMS_storage_class]
  [-catalog catalog][-system sysname]
  [-model model][catalog]]
  [-volumes volume[volume ...]]
  [-cylinders primary[secondary]]
  [-kilobytes primary[secondary]]
  [-megabytes primary[secondary]]
  [-records primary[secondary]]
  [-tracks primary[secondary]]
  [-level][-help][-trace file_name]
```

Options

- **-aggregate name**
  Specifies the aggregate name of the aggregate to be defined. The aggregate name is the name of the VSAM linear data set that is defined. The aggregate name is not case-sensitive. It is converted to uppercase.

- **-catalog catalog**
  Specifies the name of the catalog in which the VSAM linear data set is to be defined.

- **-cylinders primary [secondary]**
  Specifies the primary and optionally, the secondary allocation size for the VSAM linear data set in cylinders. The VSAM linear data set must have a secondary allocation size that is specified, if you want to use dynamic grow. See “Dynamically growing a compatibility mode aggregate” on page 26 for more information.

- **-dataclass SMS_data_class**
  Specifies the name of the data class to be used when the VSAM linear data set is defined.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-keylabel label**
  Specifies an encryption key label that is used to locate keys in the cryptographic key data set (CKDS) or the public key data set (PKDS) when a zFS aggregate is defined. The key label is typically managed by the ICSF administrator. For more information, see z/OS Cryptographic Services ICSF Application Programmer's Guide.

- **-kilobytes primary [secondary]**
  Specifies the primary and optionally, the secondary allocation size for the VSAM linear data set in kilobytes. The VSAM linear data set must have a secondary allocation size specified, if you want to use dynamic grow. See “Dynamically growing a compatibility mode aggregate” on page 26 for additional information.

- **-level**
  Prints the level of the zfsadm command. This is useful when you are diagnosing a problem. Except for -help, all other valid options specified with -level are ignored.

- **-managementclass SMS_management_class**
  Specifies the name of the management class to be used when the VSAM linear data set is defined.
-megabytes primary [secondary]
Specifies the primary and optionally, the secondary allocation size for the VSAM linear data set in megabytes. The VSAM linear data set must have a secondary allocation size specified, if you want to use dynamic grow. See “Dynamically growing a compatibility mode aggregate” on page 26 for additional information.

-model model [catalog]
Specifies the name of the model and optionally, the model entry’s catalog to be used when the VSAM linear data set is defined.

.records primary [secondary]
Specifies the primary and optionally, the secondary allocation size for the VSAM linear data set in records. When records is specified, the record size is assumed to be 4089 bytes. The VSAM linear data set must have a secondary allocation size specified, if you want to use dynamic grow. See “Dynamically growing a compatibility mode aggregate” on page 26 for additional information.

-storageclass SMS_storage_class
Specifies the name of the storage class to be used when the VSAM linear data set is defined.

-system sysname
Specifies the name of the system that the define request will be sent to.

-trace file_name
Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

-tracks primary [secondary]
Specifies the primary and optionally, the secondary allocation size for the VSAM linear data set in tracks. The VSAM linear data set must have a secondary allocation size specified, if you want to use dynamic grow. See “Dynamically growing a compatibility mode aggregate” on page 26 for additional information.

-volumes volume
Specifies the volume on which the VSAM linear data set can have space.

Usage notes
1. The zfsadm define command defines a VSAM linear data set. The VSAM linear data set is available to be formatted as a zFS aggregate. The command creates a DEFINE CLUSTER command string for a VSAM linear data set with SHAREOPTIONS(3) and passes it to the IDCAMS utility. If a failure occurs, the zfsadm define command can display additional messages from IDCAMS indicating the reason for the failure.

2. Starting in z/OS V2R3, the DEFINE CLUSTER command includes the ZFS parameter to indicate that this VSAM linear data set is intended to be used as a ZFS aggregate. For more information about the DEFINE CLUSTER command, see DEFINE CLUSTER in z/OS DFSMS Access Method Services Commands.

Privilege required
The issuer of the zfsadm define command requires sufficient authority to create the VSAM linear data set.
zfsadm define

Examples

The following command defines a VSAM linear data set.

```
zfsadm define -aggregate omvs.prv.aggr001.lds0001 -volumes prv000 prv001 -cylinders 10 5
```

Related information

Commands:

- MOUNT
- zfsadm format
**Purpose**

zfsadm delete removes a backup file system in a compatibility mode aggregate. Beginning in z/OS V2R2, .bak file systems can only be deleted on aggregates that are zFS-owned on down-level systems. This command will be removed in a future release.

**Format**

```
zfsadm delete -filesystem name[-aggregate name][-level][-help][-trace file_name]
```

**Options**

- **-aggregate name**
  Specifies the name of the aggregate where the zFS file system resides. It is specified to qualify the zFS file system name (-filesystem) when there are multiple zFS file systems with the same name in different aggregates. The aggregate name is not case-sensitive. It is always folded to uppercase.

- **-filesystem name**
  Specifies the name of the backup file system to be removed. Include the .bak extension. The file system name is case-sensitive.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the zfsadm command. This is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

**Usage notes**

1. The zfsadm delete command removes the backup zFS file system that is indicated by the -filesystem option from its aggregate. The aggregate containing the file system to be deleted must be attached. Removing a backup file system does not remove the read/write file system.

2. Beginning in z/OS V2R2, no aggregates can be attached that contain more than one file system or a clone (.bak). Therefore, file systems can only be deleted from aggregates that are zFS owned on down-level systems.

3. You can delete a compatibility mode file system (and its aggregate) by using the IDCAMS DELETE operation. This operation deletes the VSAM linear data set. For more information about renaming or deleting a compatibility mode aggregate, see “Renaming or deleting a compatibility mode aggregate” on page 40.
zfsadm delete

Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Examples

The following command deletes the backup (clone) file system from its attached compatibility mode aggregate:

```
zfsadm delete OMVS.USER.PAT.bak
IOEZ00105I File System OMVS.USER.PAT.bak deleted successfully
```

Related information

Commands:
- zfsadm attach
- zfsadm detach
- zfsadm lsfs

Files:
- File: IOEFSPRM
zfsadm detach

Purpose
zfsadm detach detaches one or more aggregates from zFS. Any file systems contained in the detached aggregate are unavailable to zFS.

Format
zfsadm detach [-aggregate aggregate name|-all [-system sysname]] [-level][-help][-trace file_name]

Options
-aggregate aggregate name
  Specifies the aggregate name of the aggregate to be detached. Use this option or use -all, but not both. The aggregate name is not case-sensitive. It is always translated to uppercase.

-all
  Specifies that all attached aggregates in the sysplex are to be detached. Use this option or use -aggregate but not both.

-help
  Prints the online help for this command. All other valid options specified with this option are ignored.

-level
  Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options specified with -level are ignored.

-system sysname
  Specifies the name of the system where the aggregates to be detached reside. It cannot be specified without the -all option.

-trace file_name
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes
1. The zfsadm detach command is used to detach an aggregate. Detaching an aggregate makes it unavailable to the system. To detach one or more aggregates, use the -all or the -aggregate option to specify the aggregates to be detached. Use the -system option to limit the detach to a single system. The -system option cannot be specified without the -all option.
2. zfsadm detach does not detach mounted compatibility mode aggregates.

Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.
Examples
The following example shows a `zfsadm detach` command that detaches the aggregate OMVS.PRV.AGGR001.LDS0001.

```
zfsadm detach -aggregate omvs.prv.aggr001.lds0001
```

IOEZ00122I Aggregate OMVS.PRV.AGGR001.LDS0001 detached successfully

Related information

Commands:
`zfsadm attach`

Files:
`IOEFSPRM`
zfsadm encrypt

Purpose

zfsadm encrypt encrypts a ZFS aggregate.

Format

```
zfsadm encrypt -aggregate name [{-cancel|-keylabel label}] [-trace file_name][-level][-help]
```

Options

- **-aggregate name**
  Specifies the name of the aggregate to be encrypted. The aggregate name is not case-sensitive. It is always converted to uppercase.

- **-cancel**
  Cancels an in-progress encrypt operation for the specified aggregate.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-keylabel label**
  Specifies an identifier that is used to locate keys in the cryptographic key data set (CKDS) or the public key data set (PKDS). The key label is typically managed by the ICSF administrator. See z/OS Cryptographic Services ICSF Application Programmer’s Guide for more information.

  The -keylabel option is only needed when a ZFS aggregate is encrypted for the first time if it was not specified when the VSAM linear data set was created. The -keylabel option is not needed in the following situations:
  
  - If encryption is resumed from a partially encrypted ZFS aggregate, or
  - If the key label was already defined by using either the zfsadm define command with the -keylabel option or the IDCAMS DEFINE CLUSTER command with the KEYLABEL keyword, as described in DEFINE CLUSTER z/OS DFSMS Access Method Services Commands.

- **-level**
  Prints the level of the command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “ZFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.
Usage notes

1. The `zfsadm encrypt` command is a long-running administrative command that uses DFSMS access method encryption to encrypt an existing zFS aggregate. Only symbolic links, ACLs, regular files, and fragmented v4 directories can be encrypted.

2. The command must be issued from a z/OS V2R3 or later system, and the zFS file system must be zFS owned on a z/OS V2R3 or later system. The aggregate must be at least aggregate version 1.5 and mounted read/write. Do not use this command before you have migrated all your systems to z/OS V2R3 or later. If there are systems that are active prior to z/OS V2R3 in the shared file system environment, encryption will not take place.

3. To process the encryption request, the long-running command thread pool must have an available foreground thread. See the IOEFSPRM configuration option long_cmd_threads for information about controlling the size of the long-running foreground and background thread pools. The option is described in “IOEFSPRM” on page 227.

4. An encryption operation can be interrupted by using the -cancel option or during a shutdown. It can also be interrupted when the shell command unmount or TSO/E command UNMOUNT is issued with the force option. If the encryption operation is interrupted, the zFS aggregate can be left with both encrypted and unencrypted files. This partial state is allowed. Another `zfsadm encrypt` command can be issued to resume the encryption operation for the rest of the files after the interruption.

5. You cannot encrypt an aggregate that is in a partially compressed or partially decompressed state. In other words, if compression or decompression was interrupted for an aggregate, you cannot encrypt it.

6. After the aggregate is fully encrypted, any newly created files will be encrypted. Applications can still access the aggregate while it is being encrypted. The backup change activity flag is set if any data is encrypted.

7. Use either the `zfsadm fsinfo` or MODIFY FSINFO command to display whether an aggregate is encrypted or being encrypted. Progress of the encrypt operation can be seen in the owner status display.

8. The `zfsadm fileinfo` command can be used to indicate whether a particular file is encrypted.

9. If you encrypt an aggregate that contains files or directories in fragmented format, the files or directories will be converted to blocked format. If there are not enough free 8 K blocks to do the conversion, the encryption can run out of space. In this case, a dynamic grow will be attempted.

10. The encryption conversion process will clear all unused areas of the file system. This action is called scrubbing.

11. Extended format VSAM data sets record the encryption status for each control interval in the dataset, providing improved integrity checking. Therefore, it is recommended that new zFS data sets be defined with the extended format option.

12. Aggregates with active file backups cannot be encrypted.

Privilege required

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Example

The following command encrypts an existing zFS aggregate with the specified key label:

```
zfsadm encrypt  -aggregate PLEX.ZFS.FS  -keylabel PROTKEY.AES.SECURE.KEY.32BYTE
```

IOEZ00877I Aggregate PLEX.ZFS.FS is successfully encrypted.
Related information

Commands:
- zfsadm decrypt
- zfsadm define
- zfsadm fileinfo
- zfsadm format
- zfsadm fsinfo

Files:
- IOEFSPRM
zfsadm fileinfo

Purpose
zfsadm fileinfo displays detailed information about a file or directory.

Format
zfsadm fileinfo -path name [-globalonly|-localonly|-both]
       [-level][-help][-trace file_name]

Options
-both
Causes the command to display both global and local information about the file or directory.

-globalonly
Causes the command to display global (on-disk) information about the file or directory. This option is the default.

-help
Prints the online help for this command. All other valid options that are specified with this option are ignored.

-level
Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

-localonly
Causes the command to display local (in memory on this system) information about the file or directory.

-path name
Specifies the path name of a file or directory about which information should be displayed. The path name is case-sensitive.

-trace file_name
Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes for zfsadm fileinfo
1. The zfsadm fileinfo command can be used to display information about a file or directory. It supports files and directories in version 1.4 aggregates. It also supports files and v4 or extended (v5) directories in version 1.5 aggregates.

2. If an aggregate has the converttov5 attribute assigned to it, accessing a v4 directory with zfsadm fileinfo can cause its conversion to an extended (v5) directory. For more information, see "Converting an existing v4 directory to an extended (v5) directory" on page 25.

3. The command must be issued from a z/OS V2R1 or later system. The file or directory must be contained in a file system that is locally zFS-owned or in a client file system.
4. If you use a job to invoke `zfsadm fileinfo`, to specify the -path option you must specify a leading slash in the PARM string if the path argument contains a slash. Otherwise, Language Environment treats the characters before the slash as Language Environment parameters. That is, you must use PARM=('/fileinfo -path /home/myname/mydata').

5. Some of the fields are only applicable to files, some are only applicable to directories, some are only applicable to the local system and some are only applicable to client systems. There can also be attributes that are sometimes associated with a file or directory, such as ACLs. When these situations occur, the fields of the output display will contain values such as 0 or na or none, depending on the type of value that the field contains when it does have valid information.

6. If the -globalonly option is specified (or defaulted), the following fields are displayed:

   **access acl**
   Anode index to ACL and length of ACL, separated by a comma.

   **anode**
   Anode block and offset into anode block, separated by a comma.

   **atime**
   Last access time.

   **auditor audit**
   Auditor audit flags for read, write, and execute:
   
   F  Audit failed attempts.
   
   N  None.

   S  Audit successful attempts.

   **charspec major,minor**
   Character special file, major number, minor number. Each character special file has a device major number, which identifies the device type, and a device minor number, which identifies a specific device of a given device type.

   **compress-eligible # saved**
   The file is fully compressed on the disk and the total space in kilobytes is saved by the compress operation.

   **converting to compressed**
   The file is partially compressed.

   **converting to decompressed**
   The file is partially decompressed.

   **create time**
   Create time.

   **ctime**
   Last change time.

   **direct blocks**
   The block numbers of the first eight 8-K blocks.

   **dir conversion**
   For an extended (v5) directory, not applicable. For a v4 directory, FAILED (directory conversion was unsuccessful) or not applicable.

   **dir data version**
   A number that is incremented each time that the directory is changed.

   **dir model acl**
   Anode index to directory model ACL and length of ACL separated by a comma.

   **dir name count**
   The number of objects in an extended (v5) directory.
dir tree status
For an extended (v5) directory, VALID (accessed by hash) or BROKEN (accessed as a flat file). Not applicable for a v4 directory.

dir version
The version of the directory; 5 indicates an extended (v5) directory and 4 indicates a v4 directory.

encrypted
The file data is fully encrypted on the disk.

fid
The inode and uniquifier separated by a comma.

file charset id
The coded character set ID. This value is taken from at_charsetid in the z/OS UNIX structure ATTR.

file cver
Creation verifier. This value is taken from AT_cver in the z/OS UNIX structure ATTR.

file format bits
For a file, the txt flag, the defer tag, the file format. For other objects, the text flag, the defer tag, and the file format are not applicable.

file model acl
Anode index to file model ACL and length of ACL separated by a comma.

format
INLINE, FRAGMENTED, or BLOCKED.

indirect blocks
The block numbers of the level 0, level 1, and level 2 trees.

length
Length of data (directories are multiples of 8 K).

mtime
Last modification time.

not compressed
The file data is not compressed on the disk.

not encrypted
The file data is not encrypted on the disk.

object genvalue
Object general attributes. This value is taken from at_genvalue in the z/OS UNIX structure ATTR.

object linkcount
Link count for the object.

object type
DIR or FILE or LINK or CHARSPEC.

partially decrypted [pct%]
The file data is partially decrypted; for a large file with size more than 1 G, the completion percentage is also displayed.

partially encrypted [pct%]
The file data is partially encrypted; for a large file with size more than 1 G, the completion percentage is also displayed.

permissions
Permissions in octal format.

reftime
Last reference time.

seclabel
Security label for file or directory.
set sticky,uid,gid
   Sticky bit, set uid, and set gid, separated by a comma.

uid,gid
   UID and GID of owner that is separated by a comma.

user audit
   User audit flags for read, write, and execute:
   N
      None
   S
      Audit successful attempts
   F
      Audit failed attempts

1K blocks
   Number of blocks that are used to store data, in kilobytes.

7. If the -localonly option is specified, the following fields are displayed:
   backup pct% complete
      Indicates that the file is currently being backed up and shows the percentage of completion.
   client cached anode
      Indicates that the client has the object's attributes and location information for the directory or file.
   client cached fsp
      Indicates that the client has security information that is cached for the directory or file.
   client cached symlink
      Indicates that the content of a symbolic link was cached by the sysplex client. This flag is valid only for symbolic links.
   client meta buffers
      Number of buffers in the metadata or backing cache for this object for the sysplex client.
   client meta updates
      Indicates whether the sysplex client has updated metadata for this object.
   client ops to server
      Number of requests that the client made to the server for this object.
   client revoke
      Indicates whether a revoke is in progress to this sysplex client for this file or directory.
   client thrashing
      Indicates whether the file or directory is considered thrashing by zFS, and as a result, uses the zFS thrash resolution interface to the server.
   client token rights
      Indicates the token rights that are held by the sysplex client for the object.
   client thrash ops
      Number of forwarded requests.
   dirty meta buffers
      For owners, indicates the number of dirty buffers in the metadata cache for this file or directory.
   file dirty segments
      The number of dirty segments in the user file cache. Dirty segments are regions of the file that are either dirty and not yet written to disk, or are waiting for an I/O to disk to complete.
   file meta issued
      Applicable to files or directories that were accessed by the sysplex client. It indicates whether the client made a request recently to the server where the object's metadata was updated.
   file meta pending
      Applicable to files or directories that are accessed by sysplex client. It indicates whether the client has an outstanding request to the server where the object's metadata might be updated.
file segments
  The number of 64 K segments of the file that is cached in the user file cache.

file seq read
  Indicates whether user file cache considers file to be read sequentially. Valid only for files.

file seq write
  Indicates whether user file cache considers file to be written sequentially. Valid only for files.

file unscheduled
  Indicates the number of unscheduled pages (dirty data) in the user file cache for files.

no backup
  Indicates that the file is not currently being backed up.

open deny
  ar
    Number of advisory deny-read opens
  aw
    Number of advisory deny-write opens
  rd
    Number of deny-read opens
  wr
    Number of deny-write opens

opens
  oi
    Number of internal opens
  ow
    Number of tasks that are waiting to open due to deny mode opens
  rd
    Number of read opens
  rw
    Number of write opens

owner
  zFS owning system.

vnode,vntok
  Addresses of the ZFS vnode and the z/OS UNIX vnode.

Privilege required
  The issuer must have lookup authority (x) to the directory and READ authority (r) to the file.

Examples
  The following example displays information for the /service9 directory:

  zfsadm fileinfo -both /service9
  path: /service9
  ***   global data   ***
  fid                    1,1           anode                  69,516
  length                 8192          format                 BLOCKED
  1K blocks              8             permissions            755
  uid,gid                0,10          access acl             0,0
  dir model acl          0,0           file model acl         0,0
  user audit             F,F,F         auditor audit          N,N,N
  set sticky,uid,gid     0,0,0         seclabel               none
  object type            DIR           object linkcount       2
  object genvalue        0x00000000    dir version            4
  dir name count         na            dir data version       0
  dir tree status        na            dir conversion          na
  file format bits       na,na,na     file charset id        na
  file cver              na            charspec major,minor    na
direct blocks 0x000000107
indirect blocks none
reftime none
not encrypted not compressed
*** local data from system DCEIMGVM ***
vnode,vntok 0x00000000,,0x794C0900 0x00FF7CA0,,0x00000000
opens ow=0 oi=0 rd=0 wr=0
open deny rd=0 wr=0 ar=0 aw=0
owner DCEIMGVM file seq read  na
file seq write  na  file unscheduled  na
file pending  na  file segments  na
file dirty segments  na  file meta issued  na
file meta pending  na  client cached fsp  na
client cached anode  na  client cached symlink  na
client revoke  na  client thrashing  na
client token rights  na  client thrash ops  na
client ops to server  na  client meta buffers  na
client meta updates  na  dirty meta buffers  0
backup 99% complete

Related information

Commands:

zfsadm fsinfo
**zfsadm format**

**Purpose**

`zfsadm format` formats a VSAM linear data set to become a version 4 or version 5 zFS compatibility mode aggregate.

**Format**

```
zfsadm format -aggregate name
[[-encrypt|-noencrypt][-compress|-nocompress]
[-initialempty blocks] [-size blocks]
[-perms decimal|octal|hex_number] [-grow blocks]
[-system sysname][-compat]
[-overwrite][-owner {uid|name}]
[-logsize blocks][[-version4|-version5]}
[-perms decimal|octal|hex_number]
[-level][-help][-trace file_name]
```

**Options**

- **-aggregate name**
  Specifies the name of the aggregate to be formatted. The aggregate name is not case-sensitive. It is translated to uppercase.

- **-compat**
  Specifies that the zFS aggregate should be formatted as a compatibility mode aggregate. That is, it should be formatted as an aggregate and then a zFS file system should be created in the aggregate. The zFS file system will have the same name as the aggregate. -compat is the default but is ignored.

- **-compress**
  Specifies that the aggregate will be compressed. See “Usage notes for zfsadm format” on page 194 for the default value that is used.

- **-encrypt**
  Specifies that the aggregate will be encrypted. See “Usage notes for zfsadm format” on page 194 for the default value that is used.

- **-group {gid | name}**
  Specifies the group owner of the root directory of the file system. It can be specified as a z/OS group ID or as a GID. The default is the GID of the issuer of the zfsadm format command. If only -owner is specified, the group is that owner's default group.

- **-grow blocks**
  Specifies the number of 8 KB blocks that zFS uses as the increment for extension when the -size option specifies a size greater than the primary allocation.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-initialempty blocks**
  This option is being allowed for compatibility with earlier versions and is ignored. One 8-KB block at the beginning of the aggregate is reserved for IBM use.

- **-logsize blocks**
  Specifies the size in 8 KB blocks of the log. The valid range is from 13 to 16384 blocks (128 megabytes). The default is 1% of the aggregate size. This default logsize will never be smaller than 14 blocks and it will never be larger than 4096 blocks (32 megabytes). This size is normally sufficient.
However, a small aggregate that is grown to be very large will still have a small log. You might want to specify a larger log if you expect the aggregate to grow very large.

-newauditfid
Specifies that the aggregate should be formatted with the zFS auditfid and stored in the aggregate. This is the default.

-nocompress
Specifies that the aggregate will not be compressed. See “Usage notes for zfsadm format” on page 194 for the default value that is used.

-noencrypt
Specifies that the aggregate will not be encrypted. See “Usage notes for zfsadm format” on page 194 for the default value that is used.

-nonewauditfid
Specifies that the aggregate should not be formatted with a zFS auditfid stored in it.

-overwrite
Specifies that an existing zFS aggregate should be overlaid. All existing data is lost. Use this option with caution. This option is not usually specified.

-owner {uid | name}
Specifies the owner of the root directory of the file system. It can be specified as a z/OS user ID or as a UID. The default is the UID of the issuer of the zfsadm format command.

-perms number
Specifies the permissions of the root directory of the file system. It can be specified as an octal number (for example, o755), as a hexadecimal number (for example, x1ED), or as a decimal number (for example, 493). See “Usage notes for zfsadm format” on page 194 for the default value that is used.

-size blocks
Specifies the number of 8 KB blocks that should be formatted to form the zFS aggregate. The default is the number of blocks that fits in the primary allocation of the VSAM linear data set. If a number less than the default is specified, it is rounded up to the default. If a number greater than the default is specified, a single extend of the VSAM linear data set is attempted after the primary allocation is formatted unless the -grow option is specified. In that case, multiple extensions of the amount that is specified in the -grow option are attempted until the -size is satisfied. Space must be available on the volume.

-system sysname
Specifies the system that the format request will be sent to.

-trace file_name
Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

-version4
Specifies that the aggregate should be a version 1.4 aggregate. See “Usage notes for zfsadm format” on page 194 for the default value that is used.

-version5
Specifies that the aggregate should be a version 1.5 aggregate. See “Usage notes for zfsadm format” on page 194 for the default value that is used.
Usage notes for zfsadm format

1. The zfsadm format command formats a VSAM linear data set as a zFS aggregate. All zFS aggregates must be formatted before use. The zfsadm format command requires the zFS PFS to be active on the system. The size of the aggregate is as many 8-KB blocks as fits in the primary allocation of the VSAM linear data set or as specified in the -size option. To extend it, use the zfsadm grow command. If -overwrite is specified, all existing primary and secondary allocations are formatted and the size includes all of that space, and the backup change activity flag is set.

2. If the VSAM linear data set has a SHAREOPTIONS value of other than 3, zfsadm format changes it to SHAREOPTIONS 3 during format.

3. If the -overwrite option is specified, the backup change flag is set.

4. The aggregate version of the compatibility mode aggregate that was created can be specified by using the -version4 or the -version 5 option. If you do not use either option, the setting of the zFS PFS format_aggrversion IOEFSPRM option is used. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_aggrversion option.

5. The aggregate encryption status will be as specified if the -encrypt or -noencrypt option is used. If neither option is used, then the default encryption status will be obtained from the zFS PFS format_encryption setting. See “IOEFSPRM” on page 227 for a description of the format_encryption variable.

6. The compression status of the compatibility mode aggregate that was created can be specified by using the -compress or the -nocompress option. If you do not use either option, the setting of the zFS PFS format_compress IOEFSPRM option is used. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_compression option.

7. The permissions on the file system root directory can be specified by using the -perms option. If the -perms option is not used, the setting of the zFS PFS format_perms IOEFSPRM option is used. See “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for a description of the format_perms option.

Privilege required

Before you can issue zfsadm format, you must have UPDATE authority to the VSAM linear data set.

If you specified -owner, -group, or -perms with values that differ from the defaults, you must also be UID 0 or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIX UNIXPRIV class. The defaults for -owner and -group are determined from the credentials of the issuer. The default for -perms is the value of the IOEFSPRM FORMAT_PERMS option.

Examples

The following command formats the VSAM linear data set as a compatibility mode aggregate.

```
zfsadm format -aggregate omvs.prev.aggr001.lds0001 -owner usera -group audit -perms o750
```

Related information

Commands:
- zfsadm define

Files:
- IOEFSPRM
**zfsadm fsinfo**

**Purpose**

*zfsadm fsinfo* displays detailed information about a zFS file system, which is also known as a zFS aggregate.

**Format**

```
zfsadm fsinfo [-aggregate name|-path path|-all]
[-select criteria|-exceptions]
[-sort sort_name]
[-level][-help][-trace file_name]
```

**Options**

**-aggregate name**

Specifies the name of the aggregate to be displayed. The aggregate name is not case-sensitive and is translated to uppercase. To specify multiple aggregates with similar names, use an asterisk (*) at the beginning, at the end, or both at the beginning and the end of name as a wildcard. If `-aggregate name` is specified with wildcards, the default display is `-basic`. Otherwise, the default display is `-owner`. See “Usage notes for zfsadm fsinfo” on page 196 for more information.

**-all**

Displays information for all aggregates in the sysplex. It is the default when `-aggregate` and `-path` are not specified. The default information display will be as if `-basic` were specified.

**-basic**

Displays a line of basic file system information for each specified file system. This option is the default in the following situations:

- The `-all` option is specified but `-full`, `-owner`, and `-reset` are not specified.
- None of `-aggregate`, `-all`, `-path`, `-full`, `-owner`, and `-reset` options are specified.
- The `-sort` and `-exceptions` options are specified and neither `-full` nor `-owner` is specified.
- The `-aggregate` option is specified with one or more wildcards.

See “Usage notes for zfsadm fsinfo” on page 196 for more information.

**-exceptions**

Displays information about any specified aggregate that is quiesced, disabled, had grow failures, is low on space or damaged. Any specified aggregate is also displayed if it has had XCF communication failures or an error because it ran out of space or when doing an I/O operation. This option cannot be specified with `-reset`, `-path`, `-select` and `-aggregate` with no wildcard in name. Information is displayed by default as if the `-basic` option were specified. See “Usage notes for zfsadm fsinfo” on page 196 for more information.

**-full**

Displays information that is maintained by the system that owns each specified file system. See Table 16 on page 199 for a description of the information that is displayed for the owner. It also displays information that is locally maintained by each system in the sysplex that has each specified file system locally mounted. For information about local statistics that are displayed when the `-full` option is specified, see Table 18 on page 201.

**-help**

Prints the online help for this command. All other valid options that are specified with this option are ignored.

**-level**

Prints the level of the zfsadm command. This information is useful when you are diagnosing a problem. Except for `-help`, all other valid options that are specified with `-level` are ignored.
-**owner**
  Displays only information that is maintained by the system that owns each specified file system. This option is the default when -aggregate without wildcards is specified. See “Usage notes for zfsadm fsinfo” on page 196 for more information.

-**path path**
  Specifies the path name of a file or directory that is contained in the file system for which information is to be displayed. The path name is case-sensitive and can start with or without a slash (/). The default information display will be as if -owner were specified.

-**reset**
  Resets zFS statistics that are related to each specified file system.

-**select criteria**
  Displays each specified file system that matches the criteria. Information is displayed by default as if the -basic option were specified. The information that is displayed can also be sorted by using the -sort option.
  
  To use this option, specify a selection criteria from Table 14 on page 197.
  
  This option cannot be specified with -exceptions, -reset, -path, and -aggregate with no wildcard in name. See “Usage notes for zfsadm fsinfo” on page 196 for more information.

-**sort sort_name**
  Specifies that the information displayed is to be sorted as specified by the value of sort_name. The default is sort by Name. This option cannot be specified with -reset. The valid sorting options are listed in Table 17 on page 200.

-**trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.
  
  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.
  
  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

**Usage notes for zfsadm fsinfo**

1. The zfsadm fsinfo command displays detailed information about the specified file systems. Normally, file systems must be attached before this command can be used to display their information. However, when a specific aggregate name (with no wildcards) is specified, the file system does not need to be attached. You can use several methods to specify aggregates, based on their names, as follows:
   - **-aggregate** with an exact aggregate name. The aggregate name is not case-sensitive and is translated to uppercase.
   - **-aggregate** using a wildcard (‘*’) at the beginning of the name value to select aggregates with a common suffix.
   - **-aggregate** using a wildcard (‘*’) at the end of the name value to select aggregates with a common prefix.
   - **-aggregate** using a wildcard (‘*’) at the beginning and the end of the name value to select aggregates with both a common prefix and a common suffix.
   - **-path** with the path name of a file or directory in a zFS file system. Information for the file system that contains the file or directory is displayed.
Tip: To ensure proper processing by the z/OS UNIX shell, put single quotation marks around the wildcard (*).

The -all option selects all file systems that are attached in the sysplex. It is the default.

2. The -owner option displays all available information for each specified file system from the zFS-owning system. The information is obtained via XCF communication with the owning system if the owning system is not the local system.

3. Aggregates can be selected by use of the -select option. To use this option, specify a criteria from Table 14 on page 197. You can specify more than one criteria by using a comma to separate them.

<table>
<thead>
<tr>
<th>Value</th>
<th>Shows aggregates that ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>BK</td>
<td>Contain files currently being backed up.</td>
</tr>
<tr>
<td>CE</td>
<td>Had XCF communication failures between client systems and owning systems. This result typically means that applications have gotten timeout errors.</td>
</tr>
<tr>
<td>CO</td>
<td>Are compressed or partially compressed.</td>
</tr>
<tr>
<td>DA</td>
<td>Are marked damaged by the zFS salvager.</td>
</tr>
<tr>
<td>DI</td>
<td>Are disabled for reading and writing.</td>
</tr>
<tr>
<td>EN</td>
<td>Are encrypted or partially encrypted.</td>
</tr>
<tr>
<td>EP</td>
<td>Are partially encrypted or partially compressed.</td>
</tr>
<tr>
<td>GD</td>
<td>Are disabled for dynamic grow.</td>
</tr>
<tr>
<td>GF</td>
<td>Have failed dynamic grow attempts.</td>
</tr>
<tr>
<td>GR</td>
<td>Are currently being grown.</td>
</tr>
<tr>
<td>IE</td>
<td>Have had disk I/O errors.</td>
</tr>
<tr>
<td>L</td>
<td>Have less than 1 MB of free space, which means that increased XCF traffic is required for writing files.</td>
</tr>
<tr>
<td>NC</td>
<td>Are not compressed.</td>
</tr>
<tr>
<td>NE</td>
<td>Are not encrypted.</td>
</tr>
<tr>
<td>NS</td>
<td>Are mounted NORWSHARE.</td>
</tr>
<tr>
<td>OV</td>
<td>Contain extended (v5) directories that are using overflow pages.</td>
</tr>
<tr>
<td>Q</td>
<td>Are currently quiesced.</td>
</tr>
<tr>
<td>R0</td>
<td>Are mounted read-only.</td>
</tr>
<tr>
<td>RQ</td>
<td>Had application activity.</td>
</tr>
<tr>
<td>RW</td>
<td>Are mounted read/write.</td>
</tr>
<tr>
<td>RS</td>
<td>Are mounted RWSHARE.</td>
</tr>
<tr>
<td>SE</td>
<td>Have returned ENOSPC errors to applications.</td>
</tr>
<tr>
<td>SH</td>
<td>Are currently being shrunk.</td>
</tr>
<tr>
<td>SL</td>
<td>Are currently being salvaged.</td>
</tr>
<tr>
<td>TH</td>
<td>Have sysplex thrashing objects in them.</td>
</tr>
<tr>
<td>V4</td>
<td>Are version 1.4.</td>
</tr>
<tr>
<td>V5</td>
<td>Are version 1.5.</td>
</tr>
<tr>
<td>V5D</td>
<td>Are disabled for conversion to version 1.5.</td>
</tr>
<tr>
<td>WR</td>
<td>Had application write activity.</td>
</tr>
</tbody>
</table>
4. Aggregates can be selected by using the -exceptions option. This option can be useful for identifying file systems that have encountered unexpected conditions, and might need attention. Unexpected conditions include I/O errors, XCF communication failures or being low on space. An aggregate can also be damaged, quiesced, or disabled.

5. The -basic option displays the file system name, the zFS-owning system name, and file system status. Table 15 on page 198 lists the values of the file system status. A Legend string is also displayed at the end of the output as a quick reference to show the definitions of the abbreviated status values.

6. When you use the -owner option, the displayed information has the file system status as part of the output. The status field contains abbreviated values. For quick reference, these values are defined in a Legend string at the end of the output. The full definitions of these abbreviations are listed in Table 15 on page 198.

<table>
<thead>
<tr>
<th>Values</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>BK</td>
<td>The aggregate contains files that are currently being backed up.</td>
</tr>
<tr>
<td>CE</td>
<td>The aggregate had XCF communication failures (timeout errors) since the last statistics reset.</td>
</tr>
<tr>
<td>CI</td>
<td>The aggregate is partially compressed.</td>
</tr>
<tr>
<td>CO</td>
<td>The aggregate is compressed.</td>
</tr>
<tr>
<td>DA</td>
<td>The salvage operation considered the aggregate damaged and it has not been repaired yet.</td>
</tr>
<tr>
<td>DC</td>
<td>The aggregate is partially decompressed.</td>
</tr>
<tr>
<td>DE</td>
<td>The aggregate is partially decrypted.</td>
</tr>
<tr>
<td>DI</td>
<td>The aggregate is disabled for access.</td>
</tr>
<tr>
<td>EI</td>
<td>The aggregate is partially encrypted.</td>
</tr>
<tr>
<td>EN</td>
<td>The aggregate is encrypted.</td>
</tr>
<tr>
<td>GD</td>
<td>Dynamic grow was disabled. This value is set if an aggregate has the AGGRGROW attribute assigned to it but due to a dynamic grow failure will not attempt future dynamic grows until an explicit administrator grow command is issued against that file system.</td>
</tr>
<tr>
<td>GF</td>
<td>The aggregate had failed dynamic grow attempts.</td>
</tr>
<tr>
<td>GR</td>
<td>The aggregate is being grown.</td>
</tr>
<tr>
<td>IE</td>
<td>The aggregate had disk I/O errors since the last statistics reset.</td>
</tr>
<tr>
<td>L</td>
<td>The aggregate is low on space as defined by the zFS distributed bitmap reservation algorithms (less than 1 MB of free space left).</td>
</tr>
<tr>
<td>NC</td>
<td>The aggregate is not compressed.</td>
</tr>
<tr>
<td>NE</td>
<td>The aggregate is not encrypted.</td>
</tr>
<tr>
<td>NM</td>
<td>The aggregate is attached, but not mounted.</td>
</tr>
<tr>
<td>NS</td>
<td>The aggregate is mounted NORSHARE, or the aggregate is attached.</td>
</tr>
<tr>
<td>OV</td>
<td>The aggregate has directories with overflow pages.</td>
</tr>
<tr>
<td>Q</td>
<td>The aggregate is quiesced.</td>
</tr>
<tr>
<td>RO</td>
<td>The aggregate is mounted in R/O mode.</td>
</tr>
<tr>
<td>RQ</td>
<td>The aggregate had application activity.</td>
</tr>
<tr>
<td>RW</td>
<td>The aggregate is mounted R/W.</td>
</tr>
<tr>
<td>RS</td>
<td>The aggregate is mounted RWSHARE.</td>
</tr>
<tr>
<td>SE</td>
<td>The aggregate ran out of space at some time since the last statistics reset.</td>
</tr>
</tbody>
</table>
### Table 15: Definitions of abbreviated values when the -basic or -owner options are specified (continued)

<table>
<thead>
<tr>
<th>Values</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>The aggregate is currently being shrunk.</td>
</tr>
<tr>
<td>SL</td>
<td>The aggregate is currently being salvaged.</td>
</tr>
<tr>
<td>TH</td>
<td>The aggregate has objects in the sysplex that are undergoing thrashing.</td>
</tr>
</tbody>
</table>

7. The -owner option displays the statistics that are shown in Table 16 on page 199.

### Table 16: Statistics displayed when the -owner option is specified

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Table Size</td>
<td>Total space that is occupied by the anode table in kilobytes, including indirect blocks.</td>
</tr>
<tr>
<td>Audit Fid</td>
<td>The auditfid that is used to represent the file system for SAF auditing.</td>
</tr>
<tr>
<td>Backups</td>
<td>Number of files that are being backed up.</td>
</tr>
<tr>
<td>Backup File Space</td>
<td>Space that is pinned on disk for files being backed up. These are blocks that have been freed but cannot be used for new files until the backup is complete.</td>
</tr>
<tr>
<td>Bitmap Size</td>
<td>Size of the bitmap file in kilobytes, including indirect blocks.</td>
</tr>
<tr>
<td>Compress Progress</td>
<td>Indicates whether the compress operation is running or stopped with the percentage completion. If the compress operation is running, it also shows the time of the day when the long-running compress command was started and its task ID.</td>
</tr>
<tr>
<td>Connected Clients</td>
<td>All client systems in the sysplex that have local mounts for a file system that is mounted RWSHARE.</td>
</tr>
<tr>
<td>Converttov5</td>
<td>Indicates whether the file system has the CONVERTTOV5 attribute assigned to it. If the aggregate is version 1.4, or is version 1.5 and does not have the CONVERTTOV5 attribute assigned to it, the second value is n/a. If the aggregate has the CONVERTTOV5 attribute assigned to it, the second value indicates whether automatic conversion is enabled or disabled. One possible reason it could be disabled is that the aggregate was quiesced after this system assumed ownership of the file system.</td>
</tr>
<tr>
<td>Decrypt Progress</td>
<td>Indicates whether the decrypt operation is running or stopped with the percentage completion. If the decrypt operation is running, it also shows the time of the day when the long-running decrypt command was started and its task ID.</td>
</tr>
<tr>
<td>Encrypt Progress</td>
<td>Indicates whether the encrypt operation is running or stopped with the percentage completion. If the encrypt operation is running, it also shows the time of the day when the long-running encrypt command was started and its task ID.</td>
</tr>
<tr>
<td>Encrypt-Scrubbing Progress</td>
<td>Indicates whether the scrubbing phases (clearing of unused disk space) is running or stopped with the percentage completion. If the encrypt operation is running, it also shows the time of the day when the long-running encrypt command was started and its task ID.</td>
</tr>
<tr>
<td>File System Creation Time</td>
<td>Time that the file system was last formatted.</td>
</tr>
<tr>
<td>File System Grow</td>
<td>Shows whether the Aggrgrow attribute is enabled (ON or OFF). It also shows the number of grows that were performed since this system assumed ownership of the file system.</td>
</tr>
<tr>
<td>File System Objects</td>
<td>The number of objects in the file system. The number includes files, directories, symbolic links, ACLs, and z/OS UNIX special files.</td>
</tr>
<tr>
<td>Free 8K Blocks</td>
<td>Number of free 8 K blocks.</td>
</tr>
<tr>
<td>Free 1K Fragments</td>
<td>Number of free fragments in partially allocated blocks.</td>
</tr>
</tbody>
</table>
Table 16: Statistics displayed when the -owner option is specified (continued)

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Grow Time</td>
<td>The time that the file system was last grown (by command or dynamically) since this system assumed ownership of the file system.</td>
</tr>
<tr>
<td>Log File Size</td>
<td>Total space in kilobytes occupied by the log file, including indirect blocks.</td>
</tr>
<tr>
<td>Overflow HighWater</td>
<td>The highest number of overflow pages that were ever allocated on disk in extended (v5) directories.</td>
</tr>
<tr>
<td>Overflow Pages</td>
<td>The number of overflow pages that are allocated to extended (v5) directories.</td>
</tr>
<tr>
<td>Owner</td>
<td>The name of the system that currently owns the aggregate.</td>
</tr>
<tr>
<td>Quiesce ASID</td>
<td>ASID of the job that quiesced the aggregate.</td>
</tr>
<tr>
<td>Quiesce Jobname</td>
<td>Name of job that quiesced the aggregate.</td>
</tr>
<tr>
<td>Quiesce System</td>
<td>Name of the system where the application was running that quiesced the aggregate.</td>
</tr>
<tr>
<td>Quiesce Time</td>
<td>The time that the file system was last quiesced. For critical I/O operations, zFS sends I/O operations in parallel, up to the maximum number that the parallel access volume (PAV) device can handle concurrently.</td>
</tr>
<tr>
<td>Revocation Wait Time</td>
<td>The average time that it took to revoke tokens from clients.</td>
</tr>
<tr>
<td>Salvage Progress</td>
<td>Indicates that a salvage operation is running. It also shows the time of the day when the long-running salvage operation was started, its task ID, and which step of the salvage process is currently being performed.</td>
</tr>
<tr>
<td>Shrink Progress</td>
<td>Indicates that a shrink operation is running. It also shows the time of the day when the long-running shrink operation was started, its task ID, and which step of the shrink process is currently being performed.</td>
</tr>
<tr>
<td>Size</td>
<td>Size of the aggregate in kilobytes.</td>
</tr>
<tr>
<td>Space Monitoring</td>
<td>The threshold and increment for space monitoring. 0, 0 is used to mean that there is no space monitoring in use for the file system.</td>
</tr>
<tr>
<td>Statistics Reset</td>
<td>Time that the owner statistics were last reset.</td>
</tr>
<tr>
<td>Time</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>The status of the aggregate as known by the owning system. The display is a subset of the information that is available in the -basic display because it shows only what the owner knows. The -basic display is a one-line summary for all chosen sysplex members.</td>
</tr>
<tr>
<td>Thrash Resolutions</td>
<td>The number of times the owner invoked the thrash resolution protocol (as opposed to the normal direct I/O protocol) to resolve sysplex contention of objects in the file system.</td>
</tr>
<tr>
<td>Thrasing Objects</td>
<td>The current number of sysplex thrashing objects in the file system at one time.</td>
</tr>
<tr>
<td>Time of Ownership</td>
<td>Time that the current owning system assumed ownership of the file system. That is, the time of its primary mount or when it last assumed ownership due to aggregate movement.</td>
</tr>
<tr>
<td>Token Revocations</td>
<td>The number of times the owner revoked tokens from other sysplex members, which means there was contention on an object and a callback had to be made to one or more clients.</td>
</tr>
<tr>
<td>Version</td>
<td>The version of the aggregate. For example, 1.4 or 1.5.</td>
</tr>
</tbody>
</table>

8. Table 17 on page 200 lists the sorting options when the -sort option is specified.

Table 17: Sorting options when the -sort option is specified

<table>
<thead>
<tr>
<th>Sorting option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Sort by file system name, in ascending order. This sorting option is the default.</td>
</tr>
<tr>
<td>Requests</td>
<td>Sort by the number of external requests that are made to the file system by user applications, in descending order. The most actively requested file systems are listed first.</td>
</tr>
</tbody>
</table>
Table 17: Sorting options when the -sort option is specified (continued)

<table>
<thead>
<tr>
<th>Sorting option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>Sort by response time of requests to the file system, in descending order. The slower responding file systems are listed first.</td>
</tr>
</tbody>
</table>

9. The -full option displays statistics for each specified file system from the zFS owning system and from each system in the sysplex that has it locally mounted. This is obtained via XCF communication with each system in the sysplex. The owning system statistics are described in Table 16 on page 199. The local statistics are described in Table 18 on page 201.

Table 18: Local statistics displayed when the full option is specified

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Reads</td>
<td>The number of read requests that were made by applications for files and directories in this file system.</td>
</tr>
<tr>
<td>Application Writes</td>
<td>The number of write requests that were made by applications for files or directories in this file system.</td>
</tr>
<tr>
<td>Average</td>
<td>The average task wait time when it had to wait for an I/O operation. This is the full wait time, including any queue wait time and device response time.</td>
</tr>
<tr>
<td>Avg. Rd XCF Resp. Time</td>
<td>The average response time for XCF read requests for objects on the owning system.</td>
</tr>
<tr>
<td>Avg. Read Resp. Time</td>
<td>The average response time for read requests that were made by applications for files or directories in this file system.</td>
</tr>
<tr>
<td>Avg. Wr XCF Resp. Time</td>
<td>The average response time for XCF write requests for objects on the owning system.</td>
</tr>
<tr>
<td>Avg. Write Resp. Time</td>
<td>The average response time for write requests that were made by applications for files or directories in this file system.</td>
</tr>
<tr>
<td>Canceled Operations</td>
<td>The number of times a task was asynchronously abended (forced or canceled) while accessing this file system.</td>
</tr>
<tr>
<td>DDNAME</td>
<td>The DDNAME for the data set allocation on this system.</td>
</tr>
<tr>
<td>Disk IO Errors</td>
<td>The number of disk I/O errors for disk I/O operations performed on this system.</td>
</tr>
<tr>
<td>ENOSPC Errors</td>
<td>The number of out of space (ENOSPC) errors that were seen by applications for this file system on this system.</td>
</tr>
<tr>
<td>Kbytes</td>
<td>The number of kilobytes read from the DASD volume for this system.</td>
</tr>
<tr>
<td>LFS Held Vnodes</td>
<td>The number of vnodes that the z/OS UNIX logical file system has allocated for the file system.</td>
</tr>
<tr>
<td>Metadata Cache 8K Pages</td>
<td>The number of 8 K pages in the metadata cache for this file system.</td>
</tr>
<tr>
<td>Mount Time</td>
<td>The time the file system was mounted on this system.</td>
</tr>
<tr>
<td>Open objects</td>
<td>Number of files or directories that are open.</td>
</tr>
<tr>
<td>PAV</td>
<td>The number of noncritical concurrent I/O operations that zFS will send to the DASD at one time for this DASD volume. For critical I/O operations, zFS will send I/O operations in parallel, up to the maximum number that the parallel access volume (PAV) device can handle concurrently. An I/O operation is deemed critical if a task is, or will be waiting on that I/O operation to complete.</td>
</tr>
<tr>
<td>Quiesce Waiters</td>
<td>YES if there are tasks that are waiting for the file system to be unquiesced. Otherwise, NO.</td>
</tr>
<tr>
<td>Reads</td>
<td>The number of disk reads to the DASD volume for this system.</td>
</tr>
<tr>
<td>Read XCF Calls</td>
<td>The number of XCF requests to read objects from the system that owns the file system. This will be zero (0) on the owning system.</td>
</tr>
<tr>
<td>Statistics Reset Time</td>
<td>The time that the statistics for the local file system were last reset.</td>
</tr>
</tbody>
</table>
Table 18: Local statistics displayed when the full option is specified (continued)

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokens</td>
<td>The number of tokens that are held for objects in the file system by the token manager.</td>
</tr>
<tr>
<td>TOTALS</td>
<td>The totals for all DASD volumes for the file system on this system.</td>
</tr>
<tr>
<td>User Cache 4K Pages</td>
<td>The number of 4 K pages in the user file cache for this file system.</td>
</tr>
<tr>
<td>Vnodes</td>
<td>Number of vnodes in memory for the file system.</td>
</tr>
<tr>
<td>VOLSER</td>
<td>The DASD VOLSER that the file system resides on.</td>
</tr>
<tr>
<td>Waits</td>
<td>The number of times a task had to wait for an I/O operation to complete for disk I/O operations on this system.</td>
</tr>
<tr>
<td>Writes</td>
<td>The number of disk writes to the DASD volume for this system.</td>
</tr>
<tr>
<td>Write XCF Calls</td>
<td>The number of XCF requests to write objects to the system that owns the file system. This will be zero (0) on the owning system.</td>
</tr>
<tr>
<td>XCF Comm. Failures</td>
<td>The number of XCF communication failures (for example, timeouts) on XCF requests made for this file system on this system.</td>
</tr>
</tbody>
</table>

10. All times are in milliseconds. Large numbers are displayed using the following suffixes:

   - t: Multiply the shown value by 1,000,000,000.
   - m: Multiply the shown value by 1,000,000.
   - t: Multiply the shown value by 1000.
   - tr: Multiply the shown value by 1,000,000,000.
   - K: Multiply the shown value by 1024.
   - M: Multiply the shown value by 1048576.

11. When you use the -owner option, the displayed file system status will indicate whether a long-running administrative operation is running on the aggregate. The statistics and legend sections will display status information about the current progress of the long operation. Also, you will see percentage complete indicators for certain steps of the long operation that are expected to occupy the bulk of the time in the operation. For more information about the overall processing of the long option, refer to the appropriate zfsadm command.

Privilege required

To use the -reset option, the issuer must be a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class. Otherwise, the issuer does not need special authorization.

Examples

1. To display basic file system information for zFS aggregate PLEX.DCEIMGNK.FSINFO:

   ```
   zfsadm fsinfo -aggregate PLEX.DCEIMGNK.FSINFO -basic
   ```

   PLEX.DCEIMGNK.FSINFO.DCEIMGNJ_RW,RS,GF,GD,L,SE,NE,NC
   Legend: RW=Read-write, Q=Quiesced, GF=Grow failed, GD=AGGRGROW disabled

202 z/OS: Distributed File Service zFS Administration
2. To display full file system status for zFS aggregate PLEX.DCEIMGNK.FSINFO:

```
zfsadm fsinfo -aggregate PLEX.DCEIMGNK.FSINFO -full
```

File System Name: PLEX.DCEIMGNK.FSINFO

*** owner information ***

- **Owner:** DCEIMGNJ
- **Converttov5:** ON,DISABLED
- **Size:** 336K
- **Free 8K Blocks:** 23
- **Log File Size:** 112K
- **Anode Table Size:** 8K
- **Version:** 1.5
- **Overflow HighWater:** 0
- **Revocation Wait Time:** 0
- **File System Grow:** ON,0
- **Quiescing Job Name:** SUIMGNJ
- **Owner:** DCEIMGNJ
- **Status:** RW,RS,Q,GF,GD,L,SE
- **Audit Fid:** 00000000 00000000 0000
- **File System Creation Time:** Nov 5 15:15:54 2013
- **File System Grow:** ON,0
- **Space Monitoring:** 0,0
- **Quiesce Time:** Nov 5 15:28:39 2013
- **Last Grow Time:** n/a
- **Connected Clients:** DCEIMGNK
- **Legend:** RW=Read-write, Q=Quiesced, GF=Grow failed, GD=Grow disabled, L=Low on space, RS=mounted RWSHARE, SE=Space errors reported, NE=Not encrypted, NC=Not compressed

*** local data from system DCEIMGNJ (owner: DCEIMGNJ) ***

- **Vnodes:** 1
- **LFS Held Vnodes:** 4
- **Open Objects:** 0
- **Tokens:** 3
- **Application Reads:** 167837
- **Avg. Read Resp. Time:** 0.059
- **Application Writes:** 23460
- **Avg. Writes Resp. Time:** 0.682
- **Read XCF Calls:** 0
- **Avg. Rd XCF Resp. Time:** 0.000
- **Write XCF Calls:** 0
- **Avg. Wr XCF Resp. Time:** 0.000
- **ENOSPC Errors:** 0
- **Disk IO Errors:** 0
- **XCF Comm. Failures:** 0
- **Cancelled Operations:** 0

**DDNAME:** SYS00004

- **Mount Time:** Nov 6 09:46:44 2013

**VOLSER PAV Reads KBytes Writes KBytes Waits Average**

- **CFC001**
  - 1
  - 88
  - 25767
  - 384116
  - 18796
  - 1.032

- **TOTALS**
  - 12
  - 88
  - 25767
  - 384116
  - 18796
  - 1.032

---

3. To display the status of the file system owner by using a wildcard:

```
zfsadm fsinfo -aggregate PLEX.DCEIMGNJ.*'
```

- **PLEX.DCEIMGNJ.FS1.**
  - DCEIMGNJ RW,NS,NE,NC
- **PLEX.DCEIMGNJ.FS2**
  - DCEIMGNJ RW,RS,NE,NC
- **PLEX.DCEIMGNJ.FS3**
  - DCEIMGNJ RW,NS,NE,NC
- **PLEX.DCEIMGNJ.FS2**
  - DCEIMGNJ RW,RS,NE,NC
- **PLEX.DCEIMGNJ.FS3**
  - DCEIMGNJ RW,NS,NE,NC

- **Legend:** RW=Read-write, NS=Mounted NORWSHARE, SE=Space errors reported, NE=Not encrypted, NC=Not compressed

---

4. A job to obtain the file system information by using a wildcard:

```
//USERIDA JOB ,Zfsadm fsinfo',
// CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//GETINFO EXEC PGM=IOEZADM,REGION=0M,
// PARM=('fsinfo -aggregate PLEX.DCEIMGNJ.FS*')
//SYSPRINT DD SYSOUT=H
//STDOUT DD SYSOUT=H
```

---

**zFS commands 203**
The following lines are possible output from the job:

PLEX.DCEIMGNJ.FS1                          DCEIMGNJ RW,NS,NE,NC
Legend: RW=Read-write, NS=Mounted NORWSHARE, NE=Not encrypted
        NC=Not compressed

5. A job to obtain information for the file system that contains directory /u/userida/fs1:

//USERIDA JOB ,'Zfsadm fsinfo',
// CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//GETINFO EXEC PGM=IOEZADM,REGION=0M,
// PARM=('/fsinfo -path /u/userida/fs1')
//SYSPRINT DD SYSOUT=H
//STDOUT DD SYSOUT=H
//STDERR DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP DD SYSOUT=H

The following lines are possible output from the job:

PLEX.DCEIMGNJ.FS1.                         DCEIMGNJ RW,NS,NE,NC
Legend: RW=Read-write, NS=Mounted NORWSHARE, NE=Not encrypted
        NC=Not compressed

Related information

Commands:
  zfsadm aggrinfo
  zfsadm lsaggr
  zfsadm lsfs

Files:
  IOEFSPRM
  MODIFY ZFS PROCESS
zfsadm grow

Purpose
zfsadm grow makes the physical size of an aggregate larger.

Format
```
zfsadm grow -aggregate name -size kbytes [-level] [-help] [-trace file_name]
```

Options
- **-aggregate name**
  Specifies the name of the aggregate to be grown. The aggregate name is not case-sensitive. It is always translated to uppercase.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options specified with -level are ignored.

- **-size kbytes**
  Specifies the new total size in kilobytes of the aggregate after the grow operation. The size is rounded up to a control area (CA). A control area is normally a cylinder or less and is based on the primary and secondary allocation units. See z/OS DFSMS Using Data Sets for more information about allocation size boundary. If zero is specified, the secondary allocation size is used. The value that is specified cannot exceed the size of a single volume.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes
1. The zfsadm grow command attempts to extend the size of an aggregate when the size specified is greater than the current size of the aggregate or when the size is specified as zero. If the extend fails (for example, if there is no space on the volume, or if size zero is specified and there is no secondary allocation specified for the VSAM linear data set), the grow operation fails. If the size specified is less than or equal to the current size of the aggregate, no extend is attempted and the command successfully returns. An aggregate cannot be made smaller than its current size. In any case, if the aggregate's high used value is less than the aggregate's high allocated value, the aggregate will be formatted up to the high allocated value (making the high used value equal to the high allocated value). The current (formatted) size of an aggregate can be determined by using the zfsadm aggrinfo command. The high used value (HI-U-RBA) and the high allocated value (HI-A-RBA) can be determined by using the IDCAMS LISTCAT ALL command. For an explanation of the rules that apply to extending a VSAM linear data set, see z/OS DFSMS Using Data Sets.

2. The size of the file system free space is increased by the amount of additional space available.
Privilege required

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Examples

The following command displays the online help entry for the zfsadm grow command:

```
zfsadm grow -help
Usage: zfsadm grow -aggregate <name> -size <size in K bytes> [-level] [-help]
```

Related information

Commands:

```
zfsadm aggrinfo
zfsadm fsinfo
```

**zfsadm help**

**Purpose**

zfsadm help shows syntax of specified zfsadm commands or lists functional descriptions of all zfsadm commands.

**Format**

```
zfsadm help [-topic command...] [-level] [-help] [-trace file_name]
```

**Options**

* -help
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

* -level
  Prints the level of the zfsadm command. This is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

* -topic command
  Specifies each command whose syntax is to be displayed. Provide only the second part of the command name (for example, lsfs, not zfsadm lsfs). Multiple topic strings can be specified. If this option is omitted, the output provides a short description of all zfsadm commands.

* -trace file_name
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.
Usage notes

1. The `zfsadm help` command displays the first line (name and short description) of the online help entry for every `zfsadm` command if `-topic` is not provided. For each command name specified with `-topic`, the output lists the entire help entry.

2. The online help entry for each `zfsadm` command consists of the following two lines:
   - The first line names the command and briefly describes its function.
   - The second line, which begins with `Usage:`, lists the command options in the prescribed order.

   Use the `zfsadm apropos` command to show each help entry containing a specified string.

Privilege required

The issuer does not need special authorization.

Examples

The following command displays the online help entry for the `zfsadm lsfs` command and the `zfsadm lsaggr` command:

```
zfsadm help -topic lsfs lsaggr
```

```
zfsadm lsfs: list filesystem information
Usage: zfsadm lsfs [-aggregate <aggregate name>] [-fast|-long] [-level] [-help]
zfsadm lsaggr: list aggregates
Usage: zfsadm lsaggr [-level] [-help]
```

Related information

Commands:

`zfsadm apropos`
zfsadm lsaggr

Purpose

zfsadm lsaggr lists all currently attached aggregates for zFS. The owning system is displayed in a shared file system (sysplex) environment.

Format

```
  zfsadm lsaggr [-system name] [-level] [-help] [-trace file_name]
```

Options

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-system name**
  Specifies the name of the system that owns the attached aggregates to be displayed.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes

1. zfsadm lsaggr displays information about all attached aggregates.

2. zfsadm lsaggr displays a separate line for each aggregate. Each line displays the following information:
   - The aggregate name.
   - The name of the system that is the zFS owner of the aggregate. If the aggregate is unowned, *UNOWNED is displayed.
   - The mode of the aggregate.
   - The status of the aggregate (for example, QUIESCED, DISABLED, or both).

   You can use the zfsadm aggrinfo command to display information about the amount of disk space available on a specific aggregate or on all aggregates on a system.

Privilege required

The issuer does not need special authorization.
Examples

The following example shows that five aggregates are attached to the system or the sysplex when running in a shared file system environment.

```
zfsadm lsaggr
OMVS.PRV.AGGR004.LDS0004 JS000END R/W
OMVS.PRV.AGGR003.LDS0002 JS000END R/O
OMVS.PRV.AGGR003.LDS0001 JS000END R/W
OMVS.PRV.AGGR002.LDS0002 JS000END R/W
OMVS.PRV.AGGR001.LDS0001 JS000END R/W
```

Related information

Commands:

```
zfsadm aggrinfo
zfsadm fsinfo
```

Files:

```
IOEFSPRM
```
**Purpose**

zfsadm lsfs lists all the file systems on a given aggregate or all attached aggregates.

**Format**

```
zfsadm lsfs [-aggregate name] -system sysname]
[-fast | -long] [-level] [-help] [-trace file_name]
```

**Options**

- **-aggregate name**
  Specifies an aggregate name that is used to retrieve file system information. The aggregate name is not case-sensitive. It is always translated to uppercase. If this option is not specified, the command displays information for all attached aggregates.

- **-fast**
  Causes the output of the command to be shortened to display only the aggregate name.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-long**
  Causes the output of the command to be extended to display the following additional information about space usage in a file system: the allocation limit, the free space limit, the size of the inode table, the number of file requests, the version of the file system, the creation date and time, and the last update date and time.

- **-system sysname**
  Specifies the name of the system that owns the aggregates that contain the file systems to be displayed.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

**Usage notes**

1. The zfsadm lsfs command displays information about file systems in aggregates. The file systems do not need to be mounted. The zfsadm lsfs command displays the following information for a specified aggregate or all attached aggregates on a system or all attached aggregates in the sysplex:
   - The total number of file systems that are contained in the aggregate.
   - The name of the file system (with a . bak extension, if appropriate).
   - The type (RW for read/write, or BK for backup).
- Whether it is mounted.
- The allocation usage and the free space usage, in kilobytes.
- Whether the file system is online.
- Whether the backup is being deleted.
- The total number of file systems online, offline, busy, and mounted appear at the end of the output for all file systems.

If `-fast` is specified, it only displays the file system names.
If `-long` is specified, the following information is displayed:
- Total number of file systems that are contained in the aggregate.
- The name of the file system.
- The ID of the file system.
- The type (RW for read/write, or BK for backup).
- Whether it is mounted or not.
- State vector of the file system.
- Whether the file system is online or not.
- Whether the backup is being deleted.
- Allocation limit and allocation usage.
- Free space limit and free space usage.
- Size of the Filesystem Inode Table and the number of file requests.
- Version of the aggregate.
- Day, date, and time when the file system was created.
- Day, date, and time when the contents of the file system were last updated.
- Total number of file systems online, offline, busy, and mounted appears at the end of the output for all file systems.

**Privilege required**

The issuer does not need special authorization.

**Examples**

The following example displays information for the aggregate OMVS.PRV.AGGR001.LDS0001:

```
zfsadm lsfs -aggregate omvs.prv.aggr001.lds0001 -long
IOEZ001291 Total of 1 file systems found for aggregate OMVS.PRV.AGGR001.LDS0001
OMVS.PRV.FS1 100000,,5 RW (Not Mounted) states 0x10010005 On-line
4294967232 K alloc limit;          9 K alloc usage
25000 K quota limit;          9 K quota usage
8 K Filesystem Inode Table    0 file requests
version 1.4
Creation Thu Aug  9 17:17:03 2001
Last Update Thu Aug  9 17:17:03 2001

Total file systems online 1; total off-line 0; total busy 0; total mounted 0
```

**Related information**

**Commands:**

- `zfsadm fsinfo`
Purpose
zfsadm lssys displays the names of the members in a sysplex.

Format
zfsadm lssys [-level][-help] [-trace file_name]

Options
-help
Prints the online help for this command. All other valid options specified with this option are ignored.

-level
Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options specified with -level are ignored.

-trace file_name
Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Privilege required
The issuer does not need special authorization.

Examples
The command that follows shows the current list of system names in the XCF group for zFS.

zfsadm lssys
IOEZ00361I A total of 3 systems are in the XCF group for zFS
DCEIMGVM
DCEIMGVQ
DCEIMGVN

Related information
Related commands:

zfsadm lsaggr
zfsadm query

Purpose

zfsadm query displays internal zFS statistics (counters and timers) that are maintained in the zFS Physical File System (PFS).

Format

zfsadm query [-system sysname][-compress]
[-locking][-reset][-storage][-usercache][-trancache]
[-iocounts][-iobyaggregate][-iobydasd][-knpfs] -logcache
[-metacache][-dircache][-vnodecache][-ctkc][-svi][-stsm]
[-level][-help][-trace file_name]

Options

-ctkc
Displays the sysplex client operations report. For more information about this report, see “Statistics Sysplex Client Operations Information” on page 423

-compress
Displays the compression statistics. For more information, see “Statistics Compression Information” on page 352.

-ctkc
Displays the sysplex client operations report. For more information about this report, see “Statistics Sysplex Client Operations Information” on page 423

-dircache
Displays the directory cache counters report. Beginning in z/OS V1R13, this option is not meaningful; the report will show zeros. For more information about this report, see “Statistics Directory Cache Information” on page 356.

-help
Prints the online help for this command. All other valid options that are specified with this option are ignored.

-iobyaggregate
Displays the I/O count by aggregate report. For more information about this report, see “Statistics Iobyaggr Information” on page 360.

-iobydasd
Displays the I/O count by direct access storage device (DASD) report. For more information about this report, see “Statistics Iobydasd Information” on page 367.

-iocounts
Displays the I/O count report. For more information about this report, see “Statistics Iocounts Information” on page 373.

-knpfs
Displays the kernel counters report. This option only displays counters for PFS calls on the zFS owner. It does not display (a second set of) counters for PFS calls when this system is a zFS client. For more information about this report, see “Statistics Kernel Information” on page 379.

-level
Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

-locking
Displays the locking statistics report. For more information about this report, see “Statistics Locking Information” on page 385.
zfsadm query

-**logcache**
  Displays the log cache counters report. For more information about this report, see “Statistics Log Cache Information” on page 393.

-**metacache**
  Displays the metadata cache counters report. For more information about this report, see “Statistics Metadata Cache Information” on page 402.

-**reset**
  Resets the report counters to zero. Should be specified with a report type. The reset takes place after the current values are displayed. For example, if you enter `zfsadm query -knfs -reset`, the command returns the current values for the kernel counters report before resetting to zero.

-**stkm**
  Displays the server token manager report. For more information about this report, see “Statistics Server Token Management Information” on page 408.

-**storage**
  Displays the storage report. For more information about this report, see “Statistics Storage Information” on page 413.

-**svi**
  Displays the server vnode interface statistics report. For more information about this report, see “Statistics Sysplex Owner Operations Information” on page 429.

-**system sysname**
  To retrieve the data requested, specifies the name of the system that will receive the report request.

-**trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

-**trancache**
  Displays the transaction cache counters report. Beginning with z/OS V2R2, this option is not meaningful; the report will show zeros. For more information about this report, see “Statistics Transaction Cache Information” on page 435.

-**usercache**
  Displays the user cache report. For more information about this report, see “Statistics User Cache Information” on page 439.

-**vnodecache**
  Displays the vnode cache counters report. For more information about this report, see “Statistics Vnode Cache Information” on page 449.

**Usage notes**
Use the `zfsadm query` command to display performance statistics that are maintained by the zFS Physical File System.

**Privilege required**
The issuer does not need special authorization.
**Examples**

The following example is one of the queries that displays performance statistics.

<table>
<thead>
<tr>
<th>VOLSER</th>
<th>I/Os Mode</th>
<th>Reads</th>
<th>K bytes</th>
<th>Writes</th>
<th>K bytes</th>
<th>Dataset Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC000</td>
<td>R/W</td>
<td>13</td>
<td>92</td>
<td>7641</td>
<td>30564</td>
<td>PLEX.JMS.AGGR001.LDS0001</td>
</tr>
<tr>
<td>CFC000</td>
<td>R/O</td>
<td>9</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td>PLEX.JMS.AGGR002.LDS0002</td>
</tr>
<tr>
<td>CFC000</td>
<td>R/W</td>
<td>26</td>
<td>188</td>
<td>4483</td>
<td>17952</td>
<td>PLEX.JMS.AGGR004.LDS0004</td>
</tr>
</tbody>
</table>

| TOTALS | 3         | 48    | 340     | 12124  | 48516   | *TOTALS*               |

Total number of waits for I/O: 52
Average I/O wait time: 3.886 (msecs)

**Related information**

**Commands:**

- zfsadm fsinfo
- zfsadm lsaggr
zfsadm quiesce

Purpose
zfsadm quiesce specifies that an aggregate and the file system that is contained in it should be quiesced.

Format
```
zfsadm quiesce {-all | -aggregate name} [-level] [-help] [-trace file_name]
```

Options
-**aggregate name**
  Specifies the name of the aggregate that is to be quiesced. The aggregate name is not case-sensitive. It is always translated to uppercase. An aggregate must be attached to be quiesced. All current activity against the aggregate is allowed to complete but no new activity is started. Any mounted file systems are quiesced.

-**all**
  Specifies that all attached aggregates are to be quiesced. Use this option or use -aggregate.

-**help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

-**level**
  Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

-**trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes
1. The zfsadm quiesce command is used to temporarily drain activity to the aggregate. During this time:
   - The aggregate cannot be detached, or grown.
   - No activity can occur against mounted file systems.
   - If you attempt to unmount a quiesced compatibility mode aggregate, the attempt fails unless you specify unmount force.

2. The aggregate can be the target of lsaggr, aggrinfo, lsf (file systems are indicated as busy). While at least one RWSHARE aggregate remains quiesced, message IOEZ00581E is displayed on the zFS owning system's console. Also, if there is at least one task that is waiting for access to the quiesced file system, message IOEZ00830E is displayed.

3. While an RWSHARE file system is quiesced, the command D OMVS,F displays QUIESCED in the PFS EXCP field.
4. The aggregate is typically quiesced prior to backing up the aggregate. After the backup is complete, the aggregate can be unquiesced.

**Privilege required**

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Examples**

The following command quiesces the aggregate OMVS.PRVR001.LDS0001.

```
zfsadm quiesce -aggregate omvs.prv.aggr001.lds0001
```

IOEZ00163I Aggregate OMVS.PRV.AGGR001.LDS0001 successfully quiesced

**Related information**

**Commands:**

- `zfsadm aggrinfo`
- `zfsadm fsinfo`
- `zfsadm unquiesce`
**zfsadm setauditfid**

**Purpose**

`zfsadm setauditfid` sets (or resets) the zFS auditfid in the mounted aggregate.

**Format**

```
zfsadm setauditfid -aggregate aggrname [-force|-old][-level][-help]
[-trace file_name]
```

**Options**

- **-aggregate aggrname**
  Specifies the name of the aggregate whose auditfid is to be set. The aggregate must be attached (mounted). The aggregate name is not case-sensitive. It is always converted to uppercase.

- **-force**
  Specifies to change the auditfid to a new zFS auditfid. If the aggregate already contains the new form of the zFS auditfid that you want to change to a different new zFS auditfid (for example, if you copy an aggregate and then rename it, but keep the old aggregate), you must specify -force to avoid inadvertently changing the zFS auditfid.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-old**
  Specifies that the zFS auditfid is set to binary zeros.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

**Usage notes**

1. The `zfsadm setauditfid` command sets or resets the zFS auditfid in the aggregate on disk (based on the VOLSER and the cylinder, cylinder, head, head [CCHH] of the first extent of the aggregate). The aggregate must be attached (mounted). If you do not specify either -force or -old, a standard form auditfid (binary zeros) is changed to the unique form auditfid. If the aggregate already contains the unique form of the zFS auditfid and you want to change it to a different unique zFS auditfid (for example, if you copy an aggregate and then rename it - keeping the old one), you must specify -force to avoid inadvertently changing the zFS auditfid. The zFS auditfid is based on the VOLSER and the CCHH of the first extent, unless you specify -old. In that case, the zFS auditfid is set to binary zeros.

2. In a shared file system environment, whether the `zfsadm setauditfid` command is issued from the system owning the zFS aggregate or from a client system, the new auditfid value will only be visible on the zFS owning system. To make it visible on client systems, issue a remount to the same mode.
Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Examples

```
zfsadm setauditfid -aggregate OMVS.PRV.AGGR001.LDS0001 -force
```

Related information
Commands:
- zfsadm aggrinfo
- zfsadm format
Files:
- IOEFSPRM
# zfsadm salvage

## Purpose

`zfsadm salvage` verifies and repairs file systems while they are still mounted. Use it only when the file system cannot be unmounted for repairs.

## Format

```
zfsadm salvage -aggregate name [{-verifyonly|-cancel}] [-trace file_name][-level][-help]
```

## Options

- **-aggregate name**
  Specifies the name of the aggregate. The aggregate name is not case-sensitive. It is always converted to uppercase.

- **-cancel**
  Specifies that the salvage for this aggregate is to be canceled.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the `zfsadm` command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11. Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in `z/OS UNIX System Services Command Reference`.

- **-verifyonly**
  Indicates whether only verification should be performed. If -verifyonly is not specified, then both verification and repair are performed.

## Usage notes

1. Use the `zfsadm` salvage command only when a file system cannot be unmounted. When a file system can be unmounted, it is recommended that a batch job be used to run the salvager. See “ioefsutl salvage” on page 136 for additional information about the salvager program and running it in a batch job.

2. The salvage operation might take a long time, especially if the aggregate is large. No writes are allowed to the aggregate while a salvage operation is running. Because the salvage command is a long-running command, there must be an available foreground thread in the long-running command thread pool. See the IOEFSPRM configuration option long_cmd_threads in “Processing options for IOEFSPRM and IOEPRMxx” on page 229 for information about controlling the size of the long-running foreground and background thread pools.
3. The verification portion of a salvage operation can be interrupted by issuing another `zfsadm salvage` command with the `-cancel` option at shutdown or with the shell or TSO unmount command issued with the force option. Once the repair portion of a salvage operation is started, the salvage cannot be interrupted.

4. Salvage processing is driven by the zFS owner. The `zfsadm salvage` command does not provide detailed status information. This information is available in the system log of the zFS owner. The `zfsadm fsinfo` command can also be used to display minimal point in time information about the progress of a salvage operation.

5. An outage during a salvage operation of the owner will result in a new owner but the salvage operation will not be resumed unless the aggregate is later disabled.

6. When the `-verifyonly` option is specified, if a problem is found during verification, the aggregate is disabled and a repair is attempted.

**Privilege required**

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Example**

```
zfsadm salvage -aggregate OMVS.PRV.COMPAT.AGGR001 -cancel
```

**Related information**

**Commands:**

- `zfsadm config`
- `zfsadm configquery`
- `zfsadm fsinfo`
- MOUNT

**Files:**

- IOEFSPRM
**zfsadm shrink**

**Purpose**

`zfsadm shrink` reduces the physical size of a zFS aggregate. The aggregate must be mounted before it can be shrunk.

The `zfsadm shrink` command releases unused space from the aggregate data set so that the resulting physical size of the data set is approximately the new total size that was requested by the `-size` option.

**Format**

```
zfsadm shrink -aggregate name {-size KBytes [-noai] | -cancel}
[-trace file_name][-level][-help]
```

**Options**

- **-aggregate name**
  - Specifies the name of the aggregate to be shrunk. The aggregate name is not case-sensitive. It is always converted to uppercase.

- **-cancel**
  - Cancels an in-progress shrink operation for the specified aggregate.

- **-help**
  - Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  - Prints the level of the `zfsadm shrink` command. This option is useful when you are diagnosing a problem. Except for `-help`, all other valid options that are specified with `-level` are ignored.

- **-noai**
  - The new total size is not to be increased if more space is needed. For more information about active increase, see "**Usage notes for zfsadm shrink**" on page 222.

- **-size Kbytes**
  - Specifies the new total size in kilobytes of the aggregate after the shrink operation is completed. The size is rounded up to an 8 K boundary.

- **-trace file_name**
  - Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in "**zFS installation and configuration steps**" on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see **Specifying MVS data set names in the shell environment** in **z/OS UNIX System Services Command Reference**.

**Usage notes for zfsadm shrink**

1. Shrinking an aggregate is a long-running administrative operation. This process involves moving any blocks that are in the portion of the data set to be released into the portion that will remain. This can be a long process because each internal aggregate structure has to be scanned to determine whether it owns any blocks that need to be moved. The two aggregate structures that can be the largest are the bitmap and the anode table (also called the File System Inode Table). The larger the bitmap and
anode table are, the longer this will take. Therefore, it is expected the bulk of the time of the shrink operation will occur in scanning them. After all block movement is completed, the free space is released. zFS will consider the new size of the aggregate to be the new total size, even if the partial space release fails. See z/OS DFSMSdss Storage Administration and z/OS DFSMSdfp Advanced Services for more information about releasing space from VSAM data sets.

2. You can monitor the progress of the shrink operation by checking the progress indicators that are displayed in the owner information of an FSINFO command to the aggregate. These steps are intended for use by IBM Service personnel and should not be used as a programming interface. The movements of the bitmap and the anode table are the steps that require the bulk of the time, so they have a percentage complete value. The percentage complete value for the anode table movement can at times appear to be decreasing. This change can happen because user activity is causing the creation of new files and directories, which in turn causes an increase in size of the anode table. The percentage complete is calculated each time FSINFO is called, so even though more anodes have been processed, these anodes can be a smaller percentage of the current total number of anodes. The FSINFO owner display contains the size of the bitmap and anode table.

3. The difference between the new total size of the aggregate and the current size of the aggregate cannot be larger than the free space in the aggregate.

4. To process the request, the long-running command thread pool must have an available foreground thread. See the IOEFSPRM configuration option long_cmd_threads for information about controlling the size of the long-running foreground and background thread pools. ("IOEFSPRM" on page 227)

5. Most of the shrink operation allows other applications to access file and directory blocks during the shrink operation. This might cause additional blocks to be allocated. If this allocation causes more space to be needed in the aggregate than the new total size specified in -size, zFS will actively increase the new total size. The shrink command ends with an error if the size is actively increased back to the original size of the aggregate. You can prevent active increase by specifying -noai. If -noai is specified, and an active increase is needed, the shrink command ends with an error.

6. Ideally, aggregates should be shrunk during periods of inactivity because shrink operations can take longer to complete if applications are updating files and directories.

7. A shrink operation can be interrupted by using the -cancel option or during a shutdown. It can also be interrupted when the shell command unmount or TSO/E command UNMOUNT is issued with the force option. If the system that is performing the shrink operation ends (via shutdown or abnormally), any new zFS owner of the aggregate will not continue the shrink operation. Another shrink command will need to be issued if you still want to do the shrink operation.

8. You can control whether SMS-managed zFS aggregates that are assigned to a management class are allowed to shrink by use of the Partial Release setting in the management class definition. zFS aggregates that are allocated with guaranteed space will use the Conditional Partial Release setting to determine if a shrink is allowed. zFS aggregates that are not SMS-managed, or are SMS-managed and not assigned to a management class, will always be allowed to shrink. For more information about management classes, see Defining management classes in z/OS DFSMSdfp Storage Administration.

9. You cannot shrink an aggregate that is in a partially encrypted, partially decrypted, partially compressed, or partially decompressed state. In other words, if encryption, decryption, compression, or decompression was interrupted for an aggregate, you cannot shrink it.

10. Files and directories that are in the fragmented format will be converted to blocked format if the shrink operation needs to move them. If there are not enough free 8 K blocks for this conversion, the shrink operation will fail.

11. Aggregates with active file backups cannot be shrunk.

If you attempt to unmount a shrinking compatibility mode aggregate, the attempt fails unless you specify unmount force.

Privilege required
The user must have UPDATE authority to the VSAM linear data set.
**Examples**
The following command shrinks aggregate PLEX.ZFS.AGGR1 to a size of 1400480 K:

```
zfsadm shrink -aggr PLEX.ZFS.AGGR1 -size 1400480
IOEZ00873I Aggregate PLEX.ZFS.AGGR1 successfully shrunk.
```

**Related information**

**Commands:**
- `zfsadm fsinfo`
- `zfsadm grow`

**Files:**
- IOEFSPRM
zfsadm unquiesce

Purpose
zfsadm unquiesce makes an aggregate (and the file system that is contained in the aggregate) available to be accessed.

Format
```
zfsadm unquiesce {-all | -aggregate name} [-level] [-help] [-trace file_name]
```

Options
- **-aggregate name**
  Specifies the name of the aggregate that is to be unquiesced. The aggregate name is not case-sensitive. It is always translated to uppercase. An aggregate must be attached to be unquiesced. All current activity against the aggregate is allowed to resume. Any mounted file systems are unquiesced.

- **-all**
  Specifies that all attached aggregates are to be unquiesced. Use this option or use -aggregate.

- **-help**
  Prints the online help for this command. All other valid options that are specified with this option are ignored.

- **-level**
  Prints the level of the zfsadm command. This option is useful when you are diagnosing a problem. Except for -help, all other valid options that are specified with -level are ignored.

- **-trace file_name**
  Specifies the name of the file that will have the trace records written into it. The trace file can be a z/OS UNIX file, an existing MVS sequential data set, or a member of either an existing partitioned data set (PDS) or partitioned data set extended (PDSE). Use this option only at the direction of IBM Support.

  For information about preallocation instructions for debugging, see Step 5 (Optional) Preallocate data sets for debugging in “zFS installation and configuration steps” on page 11.

  Because MVS data set names must be fully qualified, z/OS UNIX has special rules for specifying MVS data set names in the shell environment. For more information, see Specifying MVS data set names in the shell environment in z/OS UNIX System Services Command Reference.

Usage notes
1. The zfsadm unquiesce command allows activity that was suspended by zfsadm quiesce, to be resumed.

2. The aggregate is typically quiesced prior to backing up the aggregate. After the backup is complete, the aggregate can be unquiesced and the backup change activity flag can be reset.

Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.
Examples
The following command unquiesces the aggregate OMVS.PRVDAGRO001.LDS0001.

```plaintext
zfsadm unquiesce -aggregate omvs.prv.aggr001.lds0001
IOEZ00166I Aggregate OMVS.PRVAGGR001.LDS0001 successfully unquiesced
```

Related information
Commands:
- `zfsadm aggrinfo`
- `zfsadm info`
- `zfsadm quiesce`
Chapter 12. The zFS configuration options file (IOEPRMxx or IOEFSPRM)

This section describes the IOEFSPRM file, which is a data set that is used during zFS processing.

IOEFSPRM

Purpose

The IOEFSPRM file lists the configuration options for the zFS PFS and the batch utilities ioeufsut1 and ioeagsl1v. There is no mandatory information in this file; therefore, it is not required. The options all have defaults. However, if you need to specify any options (for tuning purposes, for example), you must have an IOEFSPRM file.

zFS allows for more than one method to specify the location of the IOEFSPRM configuration file. zFS uses the following criteria to determine which method to use:

• If an IOEZPRM DD statement exists in the JCL, the data set that it defines will be the configuration file for the local system.
• If there is no IOEZRPMM DD statement, the IOEPRMxx parmlib members that are specified in the PARM string of the zFS FILESYSTYPE statement is used.
• If there is no PARM string on the zFS FILESYSTYPE statement, parmlib member IOEPRM00 is used.
• If there is no IOEPRM00 parmlib member, no zFS configuration data set will be used.

The location of the IOEFSPRM file can be specified by the IOEZPRM DD statement in the ZFS PROC and in the JCL for the ioeufsut1 or ioeagsl1v batch utilities. (See “Terminology and concepts” on page 4 for a definition of the term “ZFS PROC.”) However, the preferred method for specifying the zFS configuration option file is to use the IOEPRMxx parmlib member as described in “Using PARMLIB (IOEPRMxx)” on page 228. If you still want to use a single IOEFSPRM file, specify the IOEZPRM DD statement in your JCL. The IOEFSPRM file is typically a PDS member, so the IOEZPRM DD statement might look like the following example:

```
//IOEZPRM DD DSN=SYS4.PVT.PARMLIB(IOEFSPRM),DISP=SHR
```

If you need to have separate IOEFSPRM files and you want to share the ZFS PROC in a sysplex, you can use a system variable in the ZFS PROC so that it points to different IOEFSPRM files. The IOEZPRM DD might look like the following:

```
//IOEZPRM DD DSN=SYS4.PVT.&SYSNAME..PARMLIB(IOEFSPRM),DISP=SHR
```

Your IOEFSPRM file might reside in SYS4.PVT.SY1.PARMLIB(IOEFSPRM) on system SY1; in SYS4.PVT.SY2.PARMLIB(IOEFSPRM) on system SY2; and others.

If you want to share a single IOEFSPRM file, you can use system symbols in data set names in the IOEFSPRM file. For example, msg_output_dsn=USERA.&SYSNAME..ZFS.MSGOUT results in USERA.SY1.ZFS.MSGOUT on system SY1. Each system has a single (possibly shared) IOEFSPRM file.

Any line beginning with # or * is considered a comment. The text in the IOEFSPRM file is not case-sensitive. Any option or value can be uppercase or lowercase. Blank lines are allowed. Do not have any sequence numbers in the IOEFSPRM file. If you specify an invalid text value, the default value is assigned. If you specify an invalid numeric value, and it is smaller than the minimum allowed value, the minimum value is assigned. If you specify an invalid numeric value, and it is larger than the maximum allowed value, the maximum value is assigned.
Using PARMLIB (IOEPRMxx)

The preferred alternative to a IOEZPRM DDNAME is specifying the IOEFSPRM file as a parmlib member. In this case, the member has the name IOEPRMxx, where xx is specified in the parmlib member list.

When the IOEFSPRM is specified in a DD statement, there can only be one IOEFSPRM file for each member of a sysplex. Using PARMLIB, zFS configuration options can be specified in a list of configuration parmlib files. This allows an installation to specify configuration options that are common among all members of the sysplex (for example, adm_threads) in a shared IOEPRMxx member and configuration options that are system-specific (for example, trace_dsn) in a separate, system-specific IOEPRMxx member. If a configuration option is specified more than once, the first one found is taken. For more information about the IOEPRMxx parmlib member, z/OS MVS Initialization and Tuning Reference.

The IOEPRMxx files are contained in the logical parmlib concatenation. The logical parmlib concatenation is a set of up to ten partitioned data sets defined by parmlib statements in the LOADxx member of either SYSn.IPLPARM or SYS1.PARMLIB. The logical parmlib concatenation contains zFS IOEPRMyy members that contain zFS configuration statements. Columns 72-80 are ignored in the IOEPRMyy member. The yy values are specified in the PARM option of the FILESYSTYPE statement for the zFS PFS (in the BPXPRMxx parmlib member). The only valid value that can be specified on the PARM option for the zFS PFS is the parmlib search parameter PRM=. The PARM string is case-sensitive. As the following example shows, you must enter the string in uppercase.

```
FILESYSTYPE TYPE(ZFS) ENTRYPOINT(IOEFSCM)
  ASNAME(ZFS, 'SUB=MSTR')
  PARM('PRM=(01,02,03)')
```

The parmlib concatenation can also be specified in the ioeagslv and ioeufsut1 batch utility parameters. Specify the -PRM keyword in the PARM string on the EXEC statement to use IOEPRMxx parameter file members. For more information, see “ioeagslv” on page 122 and “ioefsutl” on page 127.

Up to 32 member suffixes can be specified. You can also use any system symbol that resolves to two characters.

```
FILESYSTYPE TYPE(ZFS) ENTRYPOINT(IOEFSCM)
  ASNAME(ZFS, 'SUB=MSTR')
  PARM('PRM=(01,&SYSCLONE.)')
```

See Figure 30 on page 126 for an example of using PRM.

If &SYSCLONE.=AB, parmlib member IOEPRMAB is searched after parmlib member IOEPRM01. IOEPRM01 can contain common configuration options and IOEPRMAB can contain configuration options that are specific to system AB. If a parmlib member is not found, the search for the configuration option will continue with the next parmlib member.

To specify 32 members, type the member suffixes up to column 71; then, continue them in column 1 on the next line, as shown in the following example:

```
FILESYSTYPE TYPE(ZFS) ENTRYPOINT(IOEFSCM)
  ASNAME(ZFS, 'SUB=MSTR')
  PARM('PRM=(00,01,02,03,04,05,06,07,08,09,10,11,12,13,14,
             15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31)')
```

If no PRM suffix list is specified (and no IOEZPRM DD is specified in their respective JCL), then parmlib member IOEPRM00 is read. Parmlib support is only used when no IOEZPRM DD is present in the JCL.

IOEFSPRM and IOEPRMxx

Descriptions of the valid configuration variables and their respective allowed values follow. If no IOEFSPRM file is found, the default values for each configuration value are used.
Processing options for IOEFSPRM and IOEPRMxx

The following processing options are used for the zFS PFS.

adm_threads
Specifies the number of threads that are defined to handle pfsctl or mount requests. The expected value is a number in the range 1 - 256. For example:

adm_threads=5

The default value is 10.

aggrfull
Specifies the threshold and increment for reporting aggregate utilization messages to the operator. The expected value is two numbers separated by a comma in the range 1 - 99 within parentheses. For example:

aggrfull(90,5)

The aggrfull parameter is independent of fsfull. However, aggrfull reports are based on free 8 K blocks; while fsfull reports are based on free 1 K blocks. The aggrfull value tends to give a more accurate view of free space and is the recommended choice.

If aggrfull is specified for version 1.5 aggregates, fsfull is ignored.

The default value is OFF for version 1.4 aggregates. For version 1.5 aggregates, the fsfull threshold and increment values are used as if they were specified on aggrfull.

aggrgrow
Specifies whether aggregates can be dynamically extended when they become full. By default, a zFS read/write mounted file system that is mounted on a system running z/OS V1R13 or later attempts to dynamically extend when it runs out of space. The aggregate (that is, the VSAM linear data set) must have a secondary allocation that is specified to be dynamically extended and there must be space on the volumes. This global value can be overridden on the MOUNT command for compatibility mode aggregates. For an explanation of the rules for extending a VSAM LDS, see z/OS DFSMS Using Data Sets.

The expected value is ON or OFF. For example:

aggrgrow=on

The default value is ON.

change_aggrversion_on_mount
Specifies whether a version 1.4 aggregate should be changed to a version 1.5 aggregate on a primary read/write mount. No directories are converted to extended (v5) directories. The CONVERTTOV5 or NOCONVERTTOV5 MOUNT PARM overrides this option.

The expected value is ON or OFF. For example:

change_aggrversion_on_mount=off

The default value is ON.

client_reply_storage
Specifies the amount of storage that is used to handle sysplex server replies. The expected value is a number in the range 2 M - 128 M. K or M can qualify the number. For example:

client_reply_storage=8M

The default value is 10 M.
**convert_auditfid**
Specifies whether the zFS auditfid of an aggregate is automatically converted from the old form auditfid (binary zeros) to the new form auditfid on a read/write mount (attach). If the auditfid is already the new form, it is not changed. An auditfid of the new form will cause zFS to generate new auditids for files and directories in the file system.

The expected value is ON or OFF. For example:

```
convert_auditfid=on
```

The default value is ON.

**converttov5**
Specifies whether a zFS read/write file system is assigned the converttov5 attribute. If it is assigned the converttov5 attribute and the aggregate is a version 1.5 aggregate, zFS will automatically convert directories from v4 to extended (v5) as they are accessed. If the converttov5 attribute is assigned at primary mount time, a version 1.4 aggregate will be changed to a version 1.5 aggregate. The CONVERTTOV5 or NOCONVERTTOV5 MOUNT PARM overrides this option.

If automatic directory conversion for a directory fails, it is not attempted again until the file system is unmounted and mounted again.

The expected value is ON or OFF. For example:

```
converttov5=off
```

The default value is OFF.

**edc_buffer_pool**
Specifies the real storage that will be reserved for encryption and compression I/O. The expected value is a number in the range 1 M - 1 G. For example:

```
edc_buffer_pool=64M
```

The default value is 32 M for the zFS PFS, 10 M for the ioeags1v or ioefsutl batch utilities.

**file_threads**
Specifies the number of threads that handle sysplex server requests. The expected value is a number in the range 1 - 256. For example:

```
file_threads=50
```

The default value is 32.

**format_aggrversion**
Specifies the default version of an aggregate when formatting it. Each method for formatting a zFS aggregate gets this value from the zFS PFS if no version is specified.

The expected value is (meaning format a version 1.4 aggregate) or 5 (meaning format a version 1.5 aggregate). For example:

```
format_aggrversion=4
```

The default value is 5.

**format_compression**
Specifies whether a newly created zFS aggregate will be formatted with compression. This is the default compression value of an aggregate when the -compress option is not used. Each method for formatting a zFS aggregate obtains this value from the zFS PFS if no compression value is specified.

The expected value is ON or OFF. For example:

```
format_compression=on
```

The default value is OFF.
Example:

**format_encryption**
Specifies whether a newly created zFS aggregate will be formatted with encryption. This is the default encryption value of an aggregate when the -encrypt option is not used. Each method for formatting a zFS aggregate obtains this value from the zFS PFS if no encryption value is specified.

The expected value is ON or OFF. For example:

```
format_encryption=on
```

The default value is OFF.

**format_perms**
Specifies the default permissions that are used for the root directory of the file system during a format when the -perms option is not used. Each method for formatting a zFS aggregate obtains this value from the zFS PFS if -perms is not specified.

The expected values are in the range 0 to o7777. The number can be specified as octal (for example, o755), as hexadecimal (for example, x1ED), or as decimal (for example, 493). For example:

```
format_perms=o644
```

The default value is o775.

**fsfull**
Specifies the threshold and increment for reporting file system utilization messages to the operator. The fsfull parameter is independent of aggrfull. While aggrfull reports are based on free 8 K blocks, fsfull reports are based on free 1 K blocks. The aggrfull parameter tends to give a more accurate view of free space and is the recommended choice.

fsfull is ignored for version 1.5 aggregates when aggrfull is specified.

The expected values are two numbers in the range 1 - 99 within parentheses and separated by a comma. For example:

```
fsfull(85,5)
```

The default value is OFF.

**group**
Specifies the XCF group that zFS uses to communicate between sysplex members. The Expected value characters must be acceptable to XCF. Generally, the characters A-Z, 0-9 and the national characters ($, # and @) are acceptable. The value that is specified must match on all systems in the sysplex that participate in a shared file system environment. Normally, there is no reason to specify this option. For more details, see the GRPNAME parameter of the IXCJOIN macro in z/OS MVS Programming: Sysplex Services Reference.

The expected value is 1 to 8 characters. For example:

```
group=IOEZFS1
```

The default value is IOEZFS.

**honor_syslist**
Specifies whether to use the z/OS UNIX automove option that is specified during mount to control zFS ownership movement. The default is ON. For more information about zFS ownership movement, see “Dynamic movement of the zFS owner” on page 54.

The honor_syslist option is no longer supported. If it is specified, it is accepted but not used.

The expected value is ON or OFF. For example:

```
honor_syslist=on
```

The default value is ON.
**log_cache_size**

Specifies the size of the cache that is used to contain buffers for log file pages. You can also specify a fixed option, which indicates that the pages are permanently fixed for performance. The fixed option reserves real storage for usage by zFS only.

The expected value is a number in the range of 2 M - 1024 M. A K or M can be appended to the value to mean kilobytes or megabytes, respectively. For example:

```
log_cache_size=32M,fixed
```

The default value is 16 M.

**long_cmd_threads**

Specifies the number of foreground and background threads that are defined to handle long-running administrative commands. A foreground thread handles the overall operation while the background threads are used by the foreground thread to allow for parallelism in the processing of individual anodes.

For the expected value, the first value must be in the range 1-3 and the second value in the range 1-64. For example:

```
long_cmd_threads=3,30
```

The default value is 1,24.

**meta_cache_size**

Specifies the size of the cache that is used to contain metadata. You can also specify a fixed option, which indicates that the pages are permanently fixed for performance. The fixed option reserves real storage for usage by zFS only.

If metaback_cache_size is specified, the size of the entire metadata cache will be a combination of the two values. It is not required, but it is recommended to keep your IOEFSPRM configuration file clean of outdated specifications for simplicity. Therefore, IBM recommends not to use the metaback_cache_size option. Rather, the size of the entire metadata cache should be assigned to the meta_cache_size option.

zFS provides a check to see if the metadata cache size is less than the calculated default metadata cache size. For more information, see ZFS_VERIFY_CACHESIZE in IBM Health Checker for z/OS User's Guide.

The expected value is a number in the range 1 M - 64 G. A K or M or G can be appended to the value to mean kilobytes, megabytes, or gigabytes, respectively. For example:

```
meta_cache_size=64M,fixed
```

For the default value, if metaback_cache_size is specified, then meta_cache_size is 64 M. If metaback_cache_size is not specified, zFS calculates 10% of real storage that the system has available during zFS initialization.

- If this amount is less than 64 M, then meta_cache_size is assigned 64 M.
- If this amount is between 64 M and 2 G+100 M, then meta_cache_size is assigned 10% of real storage size.
- If the amount is greater than 2 G+100 M, then meta_cache_size is assigned 2 G+100 M

**metaback_cache_size**

Specifies the size of the backing portion of the metadata cache. The backing cache is no longer in a data space. Rather, it is combined with meta_cache_size into one cache with a size of the sum of the two values.

**Tip:** To avoid confusion, do not keep outdated specifications in your IOEFSPRM configuration file. Use only the meta_cache_size option to specify the entire size of the metadata cache.
zFS provides a check to see if the sum of the metadata cache size and metadata backing cache size is less than the sum of the default metadata cache size and metadata backing cache size. For more information, see ZFS_VERIFY_CACHESIZE in *IBM Health Checker for z/OS User's Guide*.

zFS provides a check to indicate whether this configuration option is specified. For more information, see ZFS_CACHE_REMOVALS in *IBM Health Checker for z/OS User's Guide*

The expected value is a number in the range 1 M - 2048 M. A K or M can be appended to the value to mean kilobytes or megabytes, respectively. For example:

```
metaback_cache_size=64M
```

There is no default value for the metaback cache if meta_cache_size is specified. Otherwise, see the default calculation description in meta_cache_size.

**modify_cmd_threads**
Specifies the number of threads that are defined to handle zFS modify commands. The expected value is a number in the range 1 - 256. For example:

```
modify_cmd_threads=1
```

The default value is 3.

**quiesce_message_delay**
Specifies the minimum number of seconds to delay issuing the IOEZ00830E message after it is determined that there is at least one quiesced aggregate and it needs to be displayed. The expected value is a number in the range 30 - 21474836. For example:

```
quiesce_message_delay=300
```

The default value is 30.

**quiesceinfo_message_delay**
Specifies the minimum number of seconds to delay issuing the IOEZ00581E message after it is determined that there is at least one task waiting to access a quiesced aggregate and it needs to be displayed. The expected value is a number in the range 30 - 21474836. For example:

```
quiesceinfo_message_delay=300
```

The default value is 30.

**recovery_max_storage**
Indicates the maximum amount of zFS address space storage to use for concurrent log recovery during multiple concurrent aggregate mounts (attaches). This allows multiple concurrent mounts to occur when sufficient storage is available for multiple concurrent log recovery processing.

The expected value is a number in the range 128 M - 512 M. For example:

```
recovery_max_storage=128M
```

The default value is 256 M.

**romount_recovery**
Specifies whether zFS will automatically avoid a read-only mount failure because of the need to run log recovery for this aggregate. This can occur when the aggregate has been mounted read/write, and then a failure occurs before it was unmounted. If the next mount is for read-only, log recovery must run for the mount to be successful. When this situation occurs and romount_recovery=on, zFS temporarily mounts the aggregate read/write to run log recovery, and then zFS unmounts and mounts the aggregate read-only.

The expected value is ON or OFF. For example:

```
romount_recovery=off
```

The default value is ON.
Specifies that data is to be collected and recorded by System Management Facilities (SMF). The expected value is ON, OFF, or on,intvl, where intvl specifies the number of minutes between the periodic recording of statistics. The number must be in the range 1 - 60. For example:

```plaintext
smf_recording=ON,60
```

The default value is OFF.

**sync_interval**

Specifies the number of seconds between syncs. The expected value is a number in the range 11 - 21474836. For example:

```plaintext
sync_interval=45
```

The default value is 30.

**sysplex**

Starting with z/OS V1R13, zFS always runs sysplex-aware by file system, regardless of the sysplex specification. If you specify sysplex=on, zFS changes the default of sysplex_filesys_sharemode to rwshare. Otherwise, the default for sysplex_filesys_sharemode is norwshare. If you specify sysplex=off, the result is the same as specifying sysplex=filesys. For information about whether to make a read/write file system sysplex-aware, see “Using zFS read/write sysplex-aware file systems” on page 15.

The expected value is Off, filesys, or On, if BPXPRMxx specifies SYSPLEX(YES). For example,

```plaintext
sysplex=filesys
```

Ignored, if BPXPRMxx does not specify SYSPLEX(YES).

The default value is filesys.

**Tip:** Specify sysplex=filesys.

**sysplex_filesys_sharemode**

Specifies the default for the mount PARM for a zFS read/write file system that is mounted in a shared file system environment. For information about whether to make a read/write file system sysplex-aware, see “Using zFS read/write sysplex-aware file systems” on page 15.

The expected value is rwshare or norwshare. For example:

```plaintext
sysplex_filesys_sharemode=rwshare
```

The default value is norwshare (unless sysplex=on was specified, then the default is rwshare).

**token_cache_size**

Specifies the maximum number of tokens in the server token manager cache to use for cache consistency between zFS members. The number of tokens that are initially allocated for the server token manager cache is 20480.

The expected value is a number in the range 20480 - 20 million. For example:

```plaintext
token_cache_size=30720
```

For the default value, double the number of vnodes (see vnode_cache_size) when running in a shared file system environment. If you are not running in a shared file system environment, then there is no default value. This option is meaningful only when zFS is running sysplex-aware.

**user_cache_size**

Specifies the size, in bytes, of the cache that is used to contain file data. You can also specify a fixed option, which indicates that the pages are permanently fixed for performance. The fixed and edcfixed options can fix the user file cache in real memory.

- The fixed option avoids page fix and page unfix for disk I/Os that do not use compression.
• The edcfixed option avoids page fix and page unfix for disk I/Os that use compression. It also avoids data movement for compression I/Os.

zFS provides a check to see if the user cache size is less than the default user cache size. For more information, see ZOMIGV2R1_ZFS_VERIFY_CACHESIZE in IBM Health Checker for z/OS User's Guide.

zFS also provides a check to see if all the user cache pages are registered with the zEDC Express service if there are compressed aggregates. This check raises an exception if the user cache pages are not registered. For more information, see ZFS_VERIFY_COMPRESSION_HEALTH in IBM Health Checker for z/OS User's Guide.

The expected value is a number in the range 10 MB - 65536 MB (64 G) if the edcfixed option is not used. If the edcfixed option is used, the user cache size should be in the range 10 MB – 14336 MB (14 G) due to zEDC compression limitations. K or M can be appended to the value to mean kilobytes or megabytes. For example:

```
user_cache_size=64M, fixed
```

For the default value, zFS calculates 10% of real storage the system has available during zFS initialization. If this amount is less than 256 M, then the default is 256 M. If this amount is between 256 M and 2 G, then the default is 10% of real storage. If the amount is greater than 2 G, then the default is 2 G.

**user_running_hangdump**

Specifies whether a hang dump should be taken for a user task that has been hanging for approximately 5 minutes. The expected value is ON or OFF. For example:

```
user_running_hangdump=on
```

The default value is OFF.

**vnode_cache_size**

Specifies the initial number of vnodes that will be cached by zFS. The number of vnodes with vnode extensions will not exceed this number.

The expected value is a number in the range 1000 to 10 million. For example:

```
vnode_cache_size=131072
```

The default value is 32768. That number will be increased if z/OS UNIX needs more than this number.

The following options are used during debugging of the zFS PFS and the batch utilities (ioeagfmt, ioeagslv, and ioeftsutl). They might not apply to the utilities and commands that are listed in the preceding section.

**cmd_trace**

Specifies whether command tracing is done for the batch utilities. If On, a zFS trace will be printed in the data set that is specified by the zFS PFS trace_dsn configuration option after the batch utility completes.

- Traces from ioeagfmt have a member name of IOEAGT01.
- Traces from ioeagslv have a member name of SALVAT01.
- Traces from ioeftsutl have a member name of FSUTLT01.

The expected value is ON or OFF. For example:

```
cmd_trace=on
```

The default value is OFF.

**debug_settings_dsn**

Specifies the name of a data set containing debug classes to enable when the zFS PFS or the batch utilities start. It is read when zFS is started (or restarted). The debug classes are also used by the batch utilities.
The expected value is the name of a data set containing debug classes to enable. For example:

```
default_settings_dsn=usera.zfs.debug.input(file1)
```

There is no default value.

**max_errors**

The maximum number of errors that the salvager program allows before it stops. If this limit is exceeded, the salvager program ends with message IOEZ00752E.

The expected value is a number in the range 1000 - 1000000. For example:

```
MAX_ERRORS=5000
```

The default value is 100000.

**msg_input_dsn**

Specifies the name of a data set containing translated zFS messages. It is specified when the installation uses messages that are in languages other than English. (When you use English messages, do not specify this option.) It is read when zFS or the batch job is started (or restarted). Currently, Japanese messages are supported.

The expected value is the name of the data set that contains translated zFS messages. For example:

```
msg_input_dsn=usera.sioemjpn
```

There is no default value.

**msg_output_dsn**

Specifies the name of a data set that contains any output messages that come from the zFS PFS during initialization. See Chapter 8, “Performance and debugging,” on page 65. This is not a required parameter.

The expected value is the name of a data set that contains the zFS PFS messages that were issued. For example:

```
msg_output_dsn=usera.zfs.msg.out
```

There is no default value.

**trace_dsn**

Specifies the name of a data set that contains the output of any operator MODIFY ZFS,TRACE,PRINT commands or the trace output if the zFS PFS or the batch utilities abends. Each trace output creates a member in the PDSE. This is not a required parameter. If it is not specified, only a dump is generated if an abend occurs.

- Traces that come from the ioegfmt program are named IOEAGTnn.
- Traces that come from the zFS PFS kernel have member names of ZFSKNTnn.
- Traces from the salvager program have member names of SALVATnn.
- Traces that come from the ioefsut1 program have member names that start with FSULTLTnn. Note that nn starts with 01 and increments for each trace output. nn is reset to 01 when zFS is started (or restarted). See Chapter 8, “Performance and debugging,” on page 65.

The expected value is the name of a PDSE data set. For example:

```
trace_dsn=usera.zfs.trace.out
```

There is no default value.

**trace_table_size**

Specifies the size, in bytes, of the internal trace table. This is the size of the wrap-around trace table in the zFS address space and the batch utility address spaces that is used for internal tracing that is always on. The trace can be sent to the trace_dsn by using the operator MODIFY ZFS,TRACE,PRINT
command. You can set the trace_table_size up to 65535 M, but to print the trace to a PDSE you must limit its size to 750 M.

The expected value is a number in the range 1 M - 65535 M. For example:

```
trace_table_size=256M
```

The default value is as follows:

- 16 M for the zFS address space.
- 64 M for the batch utility address spaces.

**user_running_hangdump**

Specifies that if a user task appears to be hung for approximately 5 minutes, a dump of the user address space is obtained by the ZFS hang detector. This dump is with abend code 2C3 and reason code EA5805DB. This dump is accompanied by message IOEZ00605I. Use this message description to diagnose the problem.

The expected value is ON or OFF. For example:

```
user_running_hangdump=ON
```

The default is OFF.

**xcf_trace_table_size**

Specifies the size of the XCF trace table. The expected value is a number in the range 1 M - 65535 M.

For example:

```
xcf_trace_table_size=8M
```

The default value is 4 M.

**Examples**

Following is a sample IOEFSPRM file that contains program options.

```
**********************************************************************
* zFS Sample Parameter File:  IOEFSPRM
* For a description of these and other zFS parameters, refer to the
* zFS Administration document.
* Notes:
*  1. The IOEFSPRM file and parameters in the file are optional but it
   is recommended that the parameter file be created in order to be
   referenced by the DDNAME=IOEZPRM statement the PROCLIB JCL for
   the zFS started task or through the IOEFPRMxx parmlib member.
*  2. An asterisk in column 1 identifies a comment line.
*  3. A parameter specification must begin in column 1.
**********************************************************************
* The following msg_output_dsn parameter defines the optional output
* message data set. If this parameter is not specified, or if the data
* set is not found, messages will be written to the system log.
* You must delete the * from a line to activate the parameter.
**********************************************************************
*msg_output_dsn=usera.zfs.msg.out
**********************************************************************
* The following msg_input_dsn parameter is ONLY required if the optional
* NLS feature is installed. The parameter specifies the
* message input data set containing the NLS message text which is
* supplied by the NLS feature. If this parameter is not specified or if
* the data set is not found, English language messages will be generated
* by zFS. You must delete the * from a line to activate the parameter.
**********************************************************************
*msg_input_dsn=usera.sioemjpn
**********************************************************************
* The following are examples of some of the optional parameters that
* control the sizes of caches, tuning options, and program operation.
* You must delete the * from a line to activate a parameter.
**********************************************************************
*adm_threads=5
*aagrfin(90,5)
```

The zFS configuration options file (IOEPRMxx or IOEFSPRM) 237
*aggrgrow=on
*change_aggrversion_on_mount=off
*client_reply_storage=10M
*cmd_trace=off
*convert_auditfid=off
*converttov5=off
*file_threads=40
*format_aggrversion=4
*fsfull(85,5)
*group=IOEZFS1
*log_cache_size=32M
*meta_cache_size=64M
*romount_recovery=off
*recovery_max_storage=128M
*sync_interval=45
*sysplex=filesys
*sysplex_filesys_sharemode=norwshare
*token_cache_size=65536
*user_cache_size=256M
*vnode_cache_size=131072

**********************************************************************
* The following are examples of some of the options that control zFS
* debug facilities. These parameters are not required for normal
* operation and should only be specified on the recommendation of IBM.
* You must delete the * column from a line to activate a parameter.
**********************************************************************
*debug_settings_dsn=usera.zfs.debug(file1)
*trace_dsn=usera.zfs.trace.out
*trace_table_size=256M
*xcf_trace_table_size=8M
zFS commands and their respective subcommands can be used to manage zFS aggregates and file systems, and to query or set configuration options. Following is a list of the zFS commands:

- ZFSCALL_AGGR (0x40000005)
- ZFSCALL_CONFIG (0x40000006)
- ZFSCALL_FILESYS (0x40000004)
- ZFSCALL_FSINFO (0x40000013)
- ZFSCALL_STATS (0x40000007)

The z/OS UNIX pfsctl (command X'C000000B') can also retrieve zFS reason code text. For more information, see the description of the PC#ErrorText pfsctl command in the usage notes for the BPX1PCT service in z/OS UNIX System Services Programming: Assembler Callable Services Reference.

For information about how to invoke the pfsctl (BPX1PCT) application programming interface in a 64-bit environment, refer to Appendix A, “Running the zFS pfsctl APIs in 64-bit mode,” on page 461.

This topic also describes a zFS w_pioctl call for fileinfo and file snapshot.
pfsctl (BPX1PCT)

Purpose

The pfsctl (BPX1PCT) application programming interface is used to send requests to a physical file system. See the information about the BPX1PCT service in z/OS UNIX System Services Programming: Assembler Callable Services Reference. zFS is a physical file system and supports several zFS-specific pfsctl functions, which are documented in this section.

Format

BPX1PCT (File_system_type,
Command,
Argument_Length,
Argument,
Return_value,
Return_code,
Reason_code);

Parameters

File_system_type

An eight-character field. In the case of zFS, it contains the characters ZFS, followed by five blanks.

Command

An integer. There are five major ZFS commands:

- ZFSCALL_AGGR (0x40000005)
- ZFSCALL_CONFIG (0x40000006)
- ZFSCALL_FILESYS (0x40000004)
- ZFSCALL_FSINFO (0x40000013)
- ZFSCALL_STATS (0x40000007)

Each command has a set of subcommands.

Argument_Length

An integer that contains the length of the argument.

Argument

A structure that has the pfsctl parameters followed by the subcommand parameters. The definitions of any structures that have padding bytes added by the compiler, have the padding bytes explicitly declared in the examples.

The fields of the structures are described in the Format sections of each API. These descriptions contain structure names, field names inside the structures, the length of the field, and a brief description of what the field is used for. The lengths of the field names contain C types and are as follows:

- int or unsigned int are four bytes.
- long long, unsigned long long, long long int, and unsigned long long int are 8 bytes.

The following list shows the general format of the Argument for all subcommands, where \( n \) depends on the particular subcommand:

<table>
<thead>
<tr>
<th>Subcommand operation code</th>
<th>Parameter0</th>
<th>Parameter1</th>
<th>Parameter2</th>
<th>Parameter3</th>
<th>Parameter4</th>
<th>Parameter5</th>
</tr>
</thead>
<tbody>
<tr>
<td>int</td>
<td>int</td>
<td>int</td>
<td>int</td>
<td>int</td>
<td>int</td>
<td>int</td>
</tr>
</tbody>
</table>
Parameter6                    int
Buffer[n]                     char[n]

Return_value
An integer that contains 0 if the request is successful or -1 if it is not successful.

Return_code
An integer in which the return code is stored. See z/OS UNIX System Services Messages and Codes for these codes.

Reason_code
An integer that stores the reason code. If this code is of the form 0xEFnnxxxx, see z/OS Distributed File Service Messages and Codes. Otherwise, see z/OS UNIX System Services Messages and Codes.

Usage notes for pfsctl
1. The major commands are summarized in Table 19 on page 242 and described in detail in the following sections. The zFS pfsctl APIs will work across sysplex members. That is, zFS pfsctl APIs can query and set information on zFS aggregates that are owned by the current system. They can also access and set file system information from other systems in the sysplex.

2. The z/OS UNIX pfsctl (command X'C000000B') can also retrieve zFS reason code text. For more information, see the description of the PC#ErrorText pfsctl command in the usage notes for the BPX1PCT service in z/OS UNIX System Services Programming: Assembler Callable Services Reference.

3. Most of the zFS pfsctl APIs have structures as input that allow a caller to specify both the version of input structures and the version of the desired output structures. Refer to the Usage Notes and Example sections of each individual zFS pfsctl API description to determine what versions need to be specified to produce the output structures that you want.
Table 19: Summary of APIs for pfsctl.

<table>
<thead>
<tr>
<th>For</th>
<th>Command</th>
<th>Subcommands (opcodes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>ZFSCALL_AGGR (0x40000005)</td>
<td>• Attach Aggregate (105)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Change Aggregate Attributes (160)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Compress Aggregate (264)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Define Aggregate (139)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Delete File System (136)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Detach Aggregate (104)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Encrypt Aggregate (262)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Decompress Aggregate (265)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Decrypt Aggregate (263)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Format Aggregate (134)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Grow Aggregate (129)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• List Aggregate Status (137)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• List Aggregate Status (Version 2) (146)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• List Attached Aggregate Names (135)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• List Attached Aggregate Names (Version 2) (140)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• List File System Names (138)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• List File System Names (Version 2) (144)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Quiesce Aggregate (132)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Salvage Aggregate (155)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shrink Aggregate (266)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Auditfid (149)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Unquiesce Aggregate (133)</td>
</tr>
<tr>
<td>File System</td>
<td>ZFSCALL_FILESYS (0x40000004)</td>
<td>• List File System Status (142)</td>
</tr>
<tr>
<td>Configuration</td>
<td>ZFSCALL_CONFIG (0x40000006)</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• List Systems (174)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Adm_threads Setting (180)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Aggrfull Setting (181)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Aggrgrow Setting (182)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Change_aggrversion_on_mount (246)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Client_cache_size (231)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Client_reply_storage (223)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Cmd_trace (184)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Convert_auditfid (237)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Converrtov5 (250)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Debug_settings_dsn Setting (186)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query EDC_buffer_pool (265)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query File_threads (217)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Format_aggrversion (248)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Format_compression (262)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Format_encryption (261)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Format_perms (267)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Fsfull Setting (187)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Group Setting (214)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Honor_syslist Setting (253)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Log_cache_size Setting (193)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Long_cmd_threads (255)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Meta_cache_size Setting (198)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Metaback_cache_size Setting (199)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Modify_cmd_threads (251)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Msg_input_dsn Setting (200)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Msg_output_dsn Setting (201)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Romount_recovery (233)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query SMF_recording (257)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Sync_interval Setting (205)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Syslevel (238)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Sysplex_filesys_sharemode (244)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Sysplex_state (215)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Token_cache_size (216)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Trace_dsn Setting (206)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Trace_table_size Setting (207)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Tran_cache_size Setting (208)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query User_cache_size Setting (210)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Query Vnode_cache_size Setting (212)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Set Adm_threads (150)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Set Aggrfull (158)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Set Aggrgrow (171)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 19: Summary of APIs for pfsctl. (continued)

<table>
<thead>
<tr>
<th>For</th>
<th>Command</th>
<th>Subcommands (opcodes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configuration</strong></td>
<td>ZFSCALL_CONFIG</td>
<td>• Set Change_aggrversion_on_mount (245)</td>
</tr>
<tr>
<td>(continued)</td>
<td>(0x40000006)</td>
<td>• Set Client_cache_size (230)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Client_reply_storage (222)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Convert_auditfid (236)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Converttov5 (249)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set File_threads (176)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Format_aggrversion (247)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Format_perms (266)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Fsfull (157)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Honor_syslist (252)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Log_cache_size (153)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Long_cmd_threads (255)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Meta_cache_size (152)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Metaback_cache_size (163)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Modify_cmd_threads (173)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Msg_output_dsn (161)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Romount_recovery (232)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Sync_interval (154)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Sysplex_filesys_sharemode (243)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Token_cache_size (177)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Trace_dsn (159)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Tran_cache_size (160)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set User_cache_size (151)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set Vnode_cache_size (155)</td>
</tr>
<tr>
<td><strong>Statistics</strong></td>
<td>ZFSCALL_STATS</td>
<td>• Statistics Compression Information (256)</td>
</tr>
<tr>
<td></td>
<td>(0x40000007)</td>
<td>• Statistics Directory Cache Information (249)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Iobyaggr Information (244)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Iobydasd Information (245)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Iocounts Information (243)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Kernel Information (246)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Locking Information (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Log Cache Information (247)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Metadata Cache Information (248)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Storage Information (241)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Transaction Cache Information (250)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics User Data Cache Information (242)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Vnode Cache Information (251)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Server Token Management Information (252)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Client Vnode Operations (253)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Statistics Server Vnode Operations (254)</td>
</tr>
<tr>
<td><strong>File System</strong></td>
<td>ZFSCALL_FSINFO</td>
<td>• List Detailed File System Information (153)</td>
</tr>
<tr>
<td>Information</td>
<td>(0x40000013)</td>
<td>• Reset File System Statistics (154)</td>
</tr>
</tbody>
</table>
The following table lists a summary of `w_pioctl` calls for zFS.

**Table 20: Summary of `w_pioctl` calls for zFS.**

<table>
<thead>
<tr>
<th>Command</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>file snapshot</td>
<td>0x0000A903</td>
</tr>
<tr>
<td>fileinfo</td>
<td>0x0000A901</td>
</tr>
</tbody>
</table>

zFS application programming interface information 245
Attach Aggregate

Purpose
This subcommand call is an aggregate operation that attaches an aggregate to a system. This action makes the aggregate and all its file systems known to the zFS physical file system running on that system. (Compatibility mode aggregates are attached during mount so that a separate attach is not necessary.)

Format

```
syscall_parmlist
  opcode      int  105    AGOP_ATTACH_PARMDATA
  parms[0]    int  offset to AGGR_ID
  parms[1]    int  offset to AGGR_ATTACH
  parms[2]    int  offset to system name (optional)
  parms[3]    int  0
  parms[4]    int  0
  parms[5]    int  0
  parms[6]    int  0

AGGR_ID
  aid_eye     char[4]  "AGID"
  aid_len     char     sizeof(AGGR_ID)
  aid_ver     char     1
  aid_name    char[45]  "OMVS.PRV.AGGR001.LDS0001"
  aid_reserved char[33]  0

AGGR_ATTACH
  at_eye      char[4]  "AGAT"
  at_len      short   sizeof(AGGR_ATTACH)
  at_ver      char     1
  at_res1     char     0
  at_threshold char     90
  at_increment char     5
  at_flags    char
    ATT_MONITOR 0x80    Monitor aggregate full
    ATT_RO      0x40    Attach aggregate as read-only
    ATT_NBS     0x20    Use New Block Security
    ATT_NONBS   0x10    No longer supported
    ATT_GROW    0x04    Allow dynamic grow
    ATT_NOGROW  0x02    Disallow dynamic grow
  at_res2     char     0
  at_reserved int[64]  0 reserved for future use

systemname    char[9]
  Return_value  0 if request is successful, -1 if it is not successful

Return_code
  EEXIST      Aggregate already attached
  EINTR       ZFS is shutting down
  EMVSERR     Internal error using an osi service
  EPERM       Permission denied to perform request
  EINVAL      Attempt to attach a multi-file system aggregate

Reason_code
  0xEFnnxxxx  See z/OS Distributed File Service Messages and Codes
```

Usage notes
1. The ATT_NBS and ATT_NONBS flags are no longer supported; zFS always runs with NBS on. If either of these parameters is specified, it is ignored.

2. ATT_GROW and ATT_NOGROW are mutually exclusive. If neither is specified, the default is the aggrgrow setting in the IOEFSPRM file. See “Dynamically growing a compatibility mode aggregate” on page 26 for a description of dynamic grow.

3. The at_threshold and at_increment values are ignored unless ATT_MONITOR is set.

4. Reserved fields and undefined flags must be set to binary zeros.
Privilege required
The issuer must be logged in as root or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Related services
Detach Aggregate

Restrictions
None.

Examples

```c
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_ATTACH_PARMDATA 105

typedef struct syscall_parmlist_t {
    int   opcode;   /* Operation code to perform */
    int   parms[7]; /* Specific to type of operation, provides access to the parms */
    /* parms[4]-parms[6] are currently unused */
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44

struct aggr_id_t {
    char   aid_eye[4];                 /* Eye Catcher */
    char  aid_len;                      /* Length of this structure */
    char  aid_ver;                      /* Version */
    char  aid_name[ZFS_MAX_AGGRNAME+1]; /* aggr name, null terminated */
    char  aid_reserved[33];             /* Reserved for the future */
} AGGR_ID;

struct aggr_attach_t {
    char at_eye[4];                   /* Eye catcher */
    short at_len;                     /* Length of structure */
    char at_ver;                      /* Structure version */
    char at_res1;                     /* Reserved for internal use */
    char at_threshold;                /* Threshold for monitoring */
    char at_increment;                /* Increment */
    char at_flags;                    /* Processing flags */
    char at_res2;                     /* Reserved for future use */
} AGGR_ATTACH;

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID          aggr_id;
    AGGR_ATTACH      myaggr;
    char             systemname[9]; /* System to attach on */
};

int main(int argc, char **argv)
```

{ int bpxrv; int bpxrc; int bpxrs; struct parmstruct myparmstruct; char aggrname[45] = "PLEX.DCEIMGQX.FS"; /* aggregate name to attach */
AGGR_ID *idp = &myparmstruct.aggr_id;
AGGR_ATTACH *atp = &myparmstruct.myaggr;
char *asp = myparmstruct.systemname;
myparmstruct.myparms.opcode = AGOP_ATTACH_PARMDATA;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
myparmstruct.myparms.parms[2] = 0;
/* Only specify a non-zero offset for the next field (parms[2]) if you are running z/OS 1.7 and above, and you want the owner of the one aggregate to be a different system than this one */
/* myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist) + sizeof(AGGR_ID) + sizeof(AGGR_ATTACH); */
myparmstruct.myparms.parms[3] = 0;
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;
/* Ensure reserved fields are 0 */
memset(idp, 0, sizeof(AGGR_ID));
memset(atp, 0, sizeof(AGGR_ATTACH));
memset(asp, 0, sizeof(myparmstruct.systemname));
memcpy(&myparmstruct.aggr_id.aid_eye, AID_EYE, 4);
myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
strcpy(myparmstruct.aggr_id.aid_name, aggrname);
memcpy(&myparmstruct.myaggr.at_eye[0], AT_EYE, 4);
myparmstruct.myaggr.at_len = sizeof(AGGR_ATTACH);
myparmstruct.myaggr.at_ver = AT_VER_INITIAL;
myparmstruct.myaggr.at_threshold = 90; /* 90 percent threshold */
myparmstruct.myaggr.at_increment = 5; /* 5 percent increment */
myparmstruct.myaggr.at_flags = 0;
myparmstruct.myaggr.at_flags |= ATT_MONITOR; /* Use threshold and */
/* increment */
myparmstruct.myaggr.at_flags |= ATT_GROW; /* allow dynamic growing */
/* This next field should only be set if parms[2] is non-zero */
strcpy(myparmstruct.systemname,"DCEIMGVQ"); /* */
BPX1PCT("ZFS ",
 ZFSCALL_AGGR, /* Aggregate operation */
 sizeof(myparmstruct), /* Length of Argument */
(&char *)&myparmstruct, /* Pointer to Argument */
&bpxrv, /* Pointer to Return_value */
&bpxrc, /* Pointer to Return_code */
&bpxrs); /* Pointer to Reason_code */
if (bpxrv < 0)
{
 printf("Error attaching aggregate %s on system %s\n", aggrname, myparmstruct.systemname);
 printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
 return bpxrc;
}
else
{ /* Return from attach was successful */
 printf("Aggregate %s attached successfully on system %s\n", aggrname, myparmstruct.systemname);
}
return 0;}

248 z/OS: Distributed File Service zFS Administration
Change Aggregate Attributes

Purpose
An aggregate operation that changes the attributes of the specified aggregate.

Format
syscall_parmlist
  opcode     int          160      AGOP_CHAGGR_REQ_PARMDATA
  parms[0]   int          offset to CHAGGR_REQ
  parms[1]   int          0
  parms[2]   int          0
  parms[3]   int          0
  parms[4]   int          0
  parms[5]   int          0
  parms[6]   int          0

CHAGGR_REQ
  ch_eye     char[4]      "CARQ"
  ch_len     short        sizeof(CHAGGR_REQ)
  ch_version char         Structure version, must be 1
  ch_name    char[45]     Name of aggregate, null-terminated
  ch_growflags char       Flag bits; defined as:
                          0x01 - Dynamic grow should be enabled.
                          0x02 - Dynamic grow should be disabled for aggregate.
  ch_fullflags char       Indicates if aggrfull processing is desired:
                          1 - Aggrfull processing should be enabled.
                          2 - Aggrfull processing should be disabled.
  ch_full_threshold char   Threshold for aggrfull monitoring
  ch_full_increment char   Increment for aggrfull monitoring
  ch_rwshareflags char     Indicates if aggregate should be mounted RWSHARE or NORWSHARE.
                          1 - File system should be mounted RWSHARE.
                          2 - File system should be mounted NORWSHARE.
  ch_reserved  char(23)   Future use.

Return_value  0 if request is successful, -1 if it is not successful

Return_code
  EPERM      Caller does not have authority to perform request.
  EACCESS    The file system is not mounted.
  EINVAL     Bad parameter lists; various reason codes might apply.
  EMVSERR    Internal error in zFS or z/OS UNIX that prevents the operation from running.
  EBUSY      The file system is quiesced or cannot handle the operation now. Try again later.
  EIO        A general failure to communicate between sysplex members or prior communication
             errors (that have not yet been resolved by name space correction) prevented the
             command from operating properly.

Reason_code
  0xEFnnxxxx  See z/OS Distributed File Service Messages and Codes

Usage notes
1. The aggregate must be mounted (as opposed to just attached).
2. ch_name is converted to uppercase before it is used.
3. The ch_growflags, ch_fullflags, and ch_rwshareflags fields are mutually exclusive. Unused flags must
   be set to 0.
4. The changed attribute remains with the aggregate, even if the zFS ownership of the aggregate changes
   to another system in the sysplex. Any changes will disappear when the aggregate is unmouted.
5. Reserved fields and undefined flags must be set to binary zeros.

Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the
SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.
Related services

List Detailed File System Information

Restrictions

The aggregate cannot be attached as read-only. It also cannot be quiesced or be the object of any other zFS command.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_CHAGGR_PARMDATA 160 /* change aggregate attributes */
typedef struct syscall_parmlist_
{
    int opcode;   /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;
#define ZFS_MAX_AGGRNAME 44
typedef struct chaggr_req_t
{
    char ch_eye[4];                   /* eyecatcher "CARQ"              */
    short ch_len;                     /* sizeof CHAGGR_REQ              */
    char ch_ver;                      /* 1                              */
    char ch_name[ZFS_MAX_AGGRNAME+1]; /* NULL terminates aggregate name */
    char ch_growflags;                /* 1=aggrgrow on 2=aggrgrow off    */
    char ch_fullflags;                /* 1=aggrfull on 2=aggrfull off   */
    char ch_full_threshold;           /* value between 1 and 99         */
    char ch_full_increment;           /* value between 1 and 99         */
    char ch_rwshareflags;             /* 1=rwshare 2=norwshare          */
    char ch_reserved1[3];             /* reserved must be 0             */
    int  ch_reserved[5];              /* reserved must be 0             */
} CHAGGR_REQ;
struct parmstruct {
    syscall_parmlist myparms;
    CHAGGR_REQ chreq;
};
int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    struct parmstruct myparmstruct;
    char aggrname[45] = "PLEX.DCEIMGQX.FS"; /* Ensure reserved fields are 0 */
    CHAGGR_REQ *reqp = &myparmstruct.chreq;
    memset(&myparmstruct.chreq, 0, sizeof(CHAGGR_REQ));
    /* Set fields to change the aggrgrow attribute to ON */
    memcpy(&myparmstruct.chreq.ch_eye, "CARQ", 4);
    myparmstruct.chreq.ch_len = sizeof(CHAGGR_REQ);
    myparmstruct.chreq.ch_ver = 1;
    myparmstruct.chreq.ch_name = aggrname;
    myparmstruct.chreq.ch_growflags = 1;
    myparmstruct.myparms.opcode = AGOP_CHAGGR_PARMDATA;
```
BPX1PCT("ZFS     ",            /* must be blank padded to length 8 */
    ZFSCALL_AGGR,          /* Aggregate operation */
    sizeof(myparmstruct),  /* Length of Argument */
    (char *)&myparmstruct, /* Pointer to Argument */
    &bpxrv,                /* Pointer to Return_value */
    &bpxrc,                /* Pointer to Return_code */
    &bpxrs);               /* Pointer to Reason_code */
if (bpxrv < 0)
{
    printf("Error changing attributes for aggregate %s\n", aggrname);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else /* Return from change aggregate attributes was successful */
{
    printf("Attributes for aggregate %s successfully changed.\n", aggrname);

    return 0;
}
Define Aggregate

Purpose
An aggregate operation that defines (creates) a VSAM linear data set, which can then be formatted as a zFS aggregate.

Format

```c
syscall_parmlist
opcode      int       139       AGOP_DEFINE_PARMDATA
parms[0]    int       Offset to AGGR_DEFINE
parms[1]    int       Size of Buffer
parms[2]    int       Offset to system name (optional)
parms[3]    int       0
parms[4]    int       0
parms[5]    int       0
parms[6]    int       0
AGGR_DEFINE
eye         char[4]   "AGDF"
len         short     sizeof(AGGR_DEFINE)
ver         char       1
aggrName    char[45]  Name of aggregate dataset to create
dataClass   char[9]    Name of a data class
managementClass char[9] Name of a management class
storageClass char[9]  Name of a storage class
model       char[45]  Name of a model
catalog     char[45]  Name of a catalog
volumes[59] char[7]   Null terminated list of VOLSERs
reservedChars1 char    Reserved
numVolumes  int       Number of volumes to use
spaceUnit   int       Units space is allocated in
spacePrimary unsigned int Primary allocation
spaceSecondary unsigned int Secondary allocation
reservedInts1 int[32]  Reserved space for future use
--or--
AGGR_DEFINE
eye         char[4]   "AGDF"
len         short     sizeof(AGGR_DEFINE)
ver         char       2
aggrName    char[45]  Name of aggregate dataset to create
dataClass   char[9]    Name of a data class
managementClass char[9] Name of a management class
storageClass char[9]  Name of a storage class
model       char[45]  Name of a model
catalog     char[45]  Name of a catalog
volumes[59] char[7]   Null terminated list of VOLSERs
reservedChars1 char    Reserved
numVolumes  int       Number of volumes to use
spaceUnit   int       Units space is allocated in
spacePrimary unsigned int Primary allocation
spaceSecondary unsigned int Secondary allocation
keylabel    char[65] Null terminated key label
reservedChar char[3]  Reserved space for future use
reservedInts1 int[32]  Reserved space for future use
systemname  char[9]  System name where DEFINE should run
```

Return_value  0 if request is successful, -1 if it is not successful

Return_code
EINTR         ZFS is shutting down
EINVAL        Invalid parameters
EMVSERR       Internal error using an osi service
ENDENT        Aggregate is not attached
EPERM         Permission denied to perform request
Reason_code
0xEFnnxxxx    See z/OS Distributed File Service Messages and Codes
Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.
2. Output buffer is space for IDCAMS to return error messages.
3. In order to specify a key label for the data set that is being defined, specify ver=2 in the AGGR_DEFINE structure.

Privilege required

The issuer must have sufficient authority to create the VSAM linear data set.

Related services

Format Aggregate

Restrictions

The VSAM linear data set to be defined cannot already exist.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANG_LVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>

#define ZFSCALL_AGGR 0x40000005
#define AGOP_DEFINE_PARMDATA 139

typedef struct syscall_parmlist_t {
    int          opcode;        /* Operation code to perform */
    int          parms[7];      /* Specific to type of operation, */
    int          /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44
#define ZFS_MAX_SMSID 8
#define ZFS_MAX_VOLID 6

typedef struct aggr_define_t {
    char         eye[4];                /* Eye catcher */
    char         ver;                   /* Version */
    char         aggrName[ZFS_MAX_AGGRNAME+1];
    char         dataClass[ZFS_MAX_SMSID+1];
    char         managementClass[ZFS_MAX_SMSID+1];
    char         storageClass[ZFS_MAX_SMSID+1];
    char         model[ZFS_MAX_AGGRNAME+1];
    char         modelCatalog[ZFS_MAX_AGGRNAME+1];
    char         catalog[ZFS_MAX_AGGRNAME+1];
    char         volumes[59][ZFS_MAX_VOLID+1];
    char         reservedChars1;
    int          numVolumes;
    int          spaceUnit;
    int          spacePrimary;
    int          spaceSecondary;
    char         keylabel[65];
    char         reservedChar[3];
    int          reservedInts1[32];
} AGGR_DEFINE;
```
struct parmstruct {
    syscall_parmlist myparms;
    AGGR_DEFINE aggdef;
    char Buffer[1024];
    char systemname[9];
};

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    char aggrname[45] = "PLEX.DCEIMGQX.LDS"; /* aggregate name to define */
    char dataclass[9] = "";
    char managementclass[9] = "";
    char storageclass[9] = "";
    char model[45] = "";
    char modelcatalog[45] = "";
    char catalog[45] = "";
    char volumes[7] = "CFC000";

    struct parmstruct myparmstruct;
    AGGR_DEFINE *agp = &(myparmstruct.aggdef);
    char *bufp = &(myparmstruct.Buffer[0]);

    /* This next field should only be set if parms[3] is non-zero */
    /* strcpy(myparmstruct.systemname,"DCEIMGVN"); */
    /* set system to run define on */
    myparmstruct.myparms.opcode = AGOP_DEFINE_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = sizeof(myparmstruct.Buffer);
    myparmstruct.myparms.parms[2] = sizeof(AGGR_DEFINE); /* offset to Buffer */
    myparmstruct.myparms.parms[3] = 0;

    /* Only specify a non-zero offset for the next field (parms[3]) if */
    /* you are running z/OS 1.7 and above, and */
    /* you want the define to run on a different system than this one */
    /* myparmstruct.myparms.parms[3] = */
    /* myparmstruct.myparms.parms[0] + sizeof(AGGR_DEFINE)+ */
    /* sizeof(myparmstruct.Buffer); */

    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    memset(agp, 0, sizeof(*agp));
    strcpy(agp->eye, ADEF_EYE);
    agp->ver = ADEF_VER_INITIAL;
    agp->len = sizeof(AGGR_DEFINE);

    memcpy(bufp, 0, sizeof(myparmstruct.Buffer));
    strcpy(agp->aggrName, aggrname);
    strcpy(agp->model, model); /* If included next 4 can be null */
    strcpy(agp->dataClass, dataclass);
    strcpy(agp->managementClass, managementclass);
    strcpy(agp->storageClass, storageclass);
    strcpy(agp->modelCatalog, modelcatalog);
    strcpy(agp->volumes[0], (char *)volumes);
    agp->numVolumes = 1;
    agp->spaceUnit = ZFS_SPACE_CYLS;
    agp->spacePrimary = 10;
    agp->spaceSecondary = 1;
    BPX1PCT("ZFS     ",
           ZFSCELL_AGGR,
           sizeof(myparmstruct),
           (char *)&myparmstruct,
           &bpxrv,
           &bpxrc,
           &bpxrs);}

if (bpxrv < 0)
{
    printf("define: Error defining LDS %s\n", aggrname);
    printf("define: BPXRV = %d BPXRC = %d BPXRS = %x\n",
           bpxrv, bpxrc, bpxrs);
    printf("define: job output:\n\n", myparmstruct.Buffer);
    return bpxrc;
}
else

254 z/OS: Distributed File Service zFS Administration
printf("define: LDS %s defined successfully\n", aggrname);
return 0;
}
Detach Aggregate

Purpose

Detach Aggregate is an aggregate operation that detaches an attached, but not mounted, compatibility mode aggregate. Mounted compatibility aggregates are detached during unmount.

Format

<table>
<thead>
<tr>
<th>syscall_parmlist</th>
<th>int</th>
<th>104</th>
<th>AGOP_DETACH_PARMDATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>opcode</td>
<td>int</td>
<td>0</td>
<td>offset to AGGR_ID</td>
</tr>
<tr>
<td>parms[0]</td>
<td>int</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>parms[1]</td>
<td>int</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>parms[2]</td>
<td>int</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>parms[3]</td>
<td>int</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>parms[4]</td>
<td>int</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>parms[5]</td>
<td>int</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>parms[6]</td>
<td>int</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AGGR_ID</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>aid_eye</td>
<td>char[4]</td>
<td>AGID</td>
<td></td>
</tr>
<tr>
<td>aid_len</td>
<td>char</td>
<td>sizeof(AGGR_ID)</td>
<td></td>
</tr>
<tr>
<td>aid_ver</td>
<td>char</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>aid_name</td>
<td>char[45]</td>
<td>&quot;OMVS.PRV.AGGR001.LDS0001&quot;</td>
<td></td>
</tr>
<tr>
<td>aid_reserved</td>
<td>char[33]</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Return_value

0 if request is successful, -1 if it is not successful

Return_code

EBUSY       Aggregate could not be detached due to mounted file system
EINTR       ZFS is shutting down
EMVSERR     Internal error using an osi service
ENOENT      Aggregate is not attached
EPERM       Permission denied to perform request

Reason_code

0xEFnnxxxx  See z/OS Distributed File Service Messages and Codes

Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.

Privilege required

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Related services

Attach Aggregate

Restrictions

All file systems in the aggregate must be unmounted before the aggregate can be detached.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLEVEL(EXTENDED)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_DETACH_PARMDATA 104
```
typedef struct syscall_parmlist_t {
    int opcode;        /* Operation code to perform */
    int parms[7];      /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
    char aid_eye[4];                    /* Eye catcher */
    #define AID_EYE "AGID"
    char aid_len;                       /* Length of this structure */
    char aid_ver;                       /* Version */
    #define AID_VER_INITIAL 1               /* Initial version */
    char aid_name[ZFS_MAX_AGGRNAME+1];  /* Name, null terminated */
    char aid_reserved[33];              /* Reserved for the future */
} AGGR_ID;

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID          aggr_id;
};

int main(int argc, char **argv)
{
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    char              aggrname[45] = "PLEX.DCEIMGQX.FS";
    struct parmstruct myparmstruct;

    myparmstruct.myparms.opcode = AGOP_DETACH_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = 0;
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;

    /* Ensure reserved fields are 0 */
    memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID));
    memcpy(&myparmstruct.aggr_id, AID_EYE, 4);
    myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
    myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
    strcpy(myparmstruct.aggr_id.aid_name, aggrname);
    
    BPX1PCT("ZFS     
    ZFSERVICE
    " sizeof(myparmstruct), /* Length of Argument */
    sizeof(myparmstruct), /* Pointer to Argument */
    &bpxrv, /* Pointer to Return_value */
    &bpxrc, /* Pointer to Return_code */
    &bpxrs); /* Pointer to Reason_code */

    if (bpxrv < 0)
    {
        printf("Error detaching aggregate %s\n", aggrname);
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        return bpxrc;
    } else
    {
        printf("Aggregate %s detached successfully\n", aggrname);
    }
    return 0;
}
Encrypt (Decrypt, Compress, or Decompress) Aggregate

**Purpose**

To encrypt, decrypt, compress, or decompress a zFS aggregate.

**Format**

<table>
<thead>
<tr>
<th>syscall_parmlist</th>
<th>int</th>
<th>262</th>
<th>AGOP_ENCRYPT_PARMDATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>opcode</td>
<td>int</td>
<td>263</td>
<td>AGOP_DECRYPT_PARMDATA</td>
</tr>
<tr>
<td></td>
<td>int</td>
<td>264</td>
<td>AGOP_COMPRESS_PARMDATA</td>
</tr>
<tr>
<td></td>
<td>int</td>
<td>265</td>
<td>AGOP_DECOMPRESS_PARMDATA</td>
</tr>
</tbody>
</table>

| parms[0] | int  | Offset to AGGR_ID |
| parms[1] | int  | One of the following flags: |
|          |      | 1 Encrypt request |
|          |      | 2 Decrypt request |
|          |      | 3 Cancel request. (See parms[4]) |
|          |      | 4 Compress request |
|          |      | 5 Decompress request |

| parms[2] | int  | Length of the key label if parms[1] is 1 (encrypt), or 0 |
| parms[3] | int  | Offset to the key label string if parms[1] is 1 |
|          |      | One of the following flags: |
|          |      | 1 Cancel encryption |
|          |      | 2 Cancel decryption |
|          |      | 3 Cancel compression |
|          |      | 4 Cancel decompression |

| parms[5] | int  | 0 |
| parms[6] | int  | 0 |

**Return_value**

0 if request is successful, -1 if it is not successful

**Return_code**

- EACCES: Caller does not have authority to perform request.
- ENOENT: File system is not mounted.
- EROFS: Attempt to run operation against a R/O mounted file system.
- EINVAL: Bad parameter lists.
- EMVSERR: Internal error in zFS or z/OS UNIX.
- EBUSY: File system is quiesced or cannot handle the operation at this time.
- EIO: A general failure to talk to an owner or the disk (in other words, I/O error).
- ENOSPC: If you run out of space during the conversion.

**Reason_code**

0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

**Usage notes**

1. Reserved fields and undefined flags must be set to binary zeros.
2. Encryption, decryption, compression, and decompression can take a long time to complete. Use the FSINFO command to check progress.
3. This operation will run on a zFS task that belongs to the long-running administrative command pool. If all tasks in that pool are busy, the operation is rejected with EBUSY.
4. You cannot encrypt or decrypt an aggregate that is in a partially compressed or partially decompressed state. In other words, if encryption or decryption was stopped for an aggregate, you cannot encrypt or decrypt it.
5. You cannot compress or decompress an aggregate that is in a partially encrypted or partially decrypted state. In other words, if compression or decryption was stopped for an aggregate, you cannot compress or decompress it.
Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Related services
List Detailed File System Information.

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_ENCRYPT_PARMDATA 262 /* encrypt specified aggregate */

typedef struct syscall_parmlist_
{
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
} syscall_parmlist;
#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
    char  aid_eye[4]; /* Eye Catcher */
    char  aid_len; /* Length of this structure */
    char  aid_ver; /* Version */
    char  aid_name[ZFS_MAX_AGGRNAME+1]; /* aggr name, null terminated */
    char  aid_reserved[33]; /* Reserved for the future */
} AGGR_ID;

struct parmstruct {
    syscall_parmlist_ myparms;
    AGGR_ID          aggr_id;
    char             keylabel[65];
};

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    struct parmstruct myparmstruct;
    char aggrname[45] = "PLEX.DCEIMGNJ.ENC";
    char key_label[65] = "PROTKEY.AES.SECURE.KEY.32BYTE";
    myparmstruct.myparms.opcode = AGOP_ENCRYPT_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = 1; /* request encrypt operation */
    myparmstruct.myparms.parms[2] = sizeof(key_label);
    myparmstruct.myparms.parms[3] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    /* Ensure reserved fields are 0 */
    memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID));
    memcpy(&myparmstruct.aggr_id, AID_EYE, 4);
    myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
    myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
    strncpy(myparmstruct.aggr_id.aid_name, aggrname);
    ```
strcpy(myparmstruct.keylabel, key_label);
BPX1PCT("ZFS     ",            /* must be blank padded to length 8 */
ZFCALC_AGGR,
    /* Aggregate operation */
sizeof(myparmstruct),
    /* Length of Argument */
(char *)&myparmstruct,
    /* Pointer to Argument */
&bpxrv,
    /* Pointer to Return_value */
&bpxrc,
    /* Pointer to Return_code */
&bpxrs);   /* Pointer to Reason_code */
printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
if (bpxrv < 0)
{
    printf("Error trying to encrypt aggregate %s\n", aggrname);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
    printf("Encrypt of aggregate %s successful.\n", aggrname);
return 0;
File Snapshot

**Purpose**

Creates a point-in-time snapshot (or copy) of a file in a zFS file system and allows subsequent read requests from that snapshot along with concurrent reads and writes to the actual file on-disk. When a snapshot is created, backup programs can also request information about the file, which will help determine whether the file was changed since the last backup.

The File Snapshot API is a `w_ioctl (BPX1IOC)` call that specifies a file descriptor rather than a `pfsctl (BPX1PCT)` call that specifies a file system.

**Format**

<table>
<thead>
<tr>
<th>BPX1IOC parameter list</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>File_descriptor</td>
<td>int</td>
<td></td>
</tr>
<tr>
<td>Command</td>
<td>int</td>
<td>0x0000A903</td>
</tr>
<tr>
<td>Argument_length</td>
<td>int</td>
<td>sizeof(BK_REQ)</td>
</tr>
<tr>
<td>Argument</td>
<td>ptr to BK_REQ</td>
<td></td>
</tr>
<tr>
<td>Return_value</td>
<td>ptr to int</td>
<td>0</td>
</tr>
<tr>
<td>Return_code</td>
<td>ptr to int</td>
<td>0</td>
</tr>
<tr>
<td>Reason_code</td>
<td>ptr to int</td>
<td>0</td>
</tr>
</tbody>
</table>

**BK_REQ**

- `bk_eye` char[4] "BKRQ"
- `bk_length` short sizeof(BK_REQ)
- `bk_flags` short 0 - Non-first call to the API, 1 - First call to the API
- `bk_sversion` char 1
- `bk_writers` char Output, 1 if file was opened for write at time of registration request
- `bk_eof` char Output, 1 if end-of-file is reached
- `bk_key` char Key for the memory buffers, in the format of 0xK0, where K is the key
- `bk_bufferSize` int Size of `bk_buffer`. Minimum buffer length is 64K (65536).
- `bk_filelength` long long int Output, length of the file at snapshot time
- `bk_nextReadOffset` long long int Output, next offset into the file to read from
- `bk_offset` long long int Offset in file to read from
- `bk_buffer` long long int In/Out - buffer to place data into
- `bk_outputLen` int Output, amount of bytes placed in buffer
- `bk_uncompressedLen` int Output, amount of bytes if the data were not compressed. If `outputLen` and `uncompressedLen` do not match then the returned data was compressed.
- `bk_attrBuffer` long long int In/Out - If nonzero, then caller is requesting file attributes, only valid on first call(registration)
- `bk_aclBuffer` long long int In/Out - If non-zero, then caller is requesting file ACLs, only valid on first call(registration)
- `bk_attrBufferLen` int Length of `bk_attrBuffer`
- `bk_aclBufferLen` int Length of `bk_aclBuffer`
- `bk_future` char[32] Reserved

Return_value: 0 if request is successful, -1 if it is not successful
Return_code:
- `EFAULT` - Buffer address was bad or a storage key error.
- `ENFILE` - Buffer address was bad or a storage key error.
- `EFBIG` - One of the provided buffer sizes is too small. The various buffer sizes will be updated with the required size and a reason code will indicate which buffer was too small.
- `EINVAL` - Invalid parameter list. zFS will provide reason codes to help explain...
what is wrong.
EIO - zFS had some sort of error accessing the disk or communicating with other sysplex members. This type of error would be preceded by many operator messages and other warnings.
EMVSERR - Internal error in zFS software.
ENOMEM - zFS ran out of memory (not likely and would likely be a zFS internal error).
EPERM - The caller did not have the proper security credentials.

Reason_code
0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes
1. If an input buffer is too small, the caller should obtain a buffer of the required size and retry the operation. The minimum buffer length is 64 K (655536).
2. You cannot back up files that are stored in compressed format.
3. For file systems that are mounted NORWSHARE, backups can only be initiated from the file system owner. For those that are mounted RWSHARE, backups can be initiated from any system in the sysplex with a local mount for the file system.
4. If the open-read count of a file that has an in-progress backup becomes zero for any reason, zFS will fail the in-progress backup. The caller must initiate a new backup request.
5. For fragmented files, if the data retrieved is written to a new file it will no longer be in fragmented format and might increase disk space usage.
6. For file systems that are mounted RWSHARE, you can get slightly better performance if you issue the backup request on the owning system.
7. If zFS goes down on the system performing the backup, or the owning system, errors will occur. Active backups in progress will fail and will need to be reinitiated by the caller once zFS is restarted.
8. You cannot back up files on a file system that is being shrunk, encrypted, decrypted, compressed, or decompressed.
9. While a file is undergoing backup, you cannot write to it from systems that do not have zFS File Snapshot support installed.
10. You cannot back up files on a version 1.4 file system.

Privilege required
The user must have lookup authority (x) to the directory and READ authority (r) to the file.
The caller must be an authorized program.

Related services
List File Information
List Detailed File System Information

Restrictions
File Snapshot cannot be used while the containing aggregate is encrypting, decrypting, compressing, decompressing, or shrinking. It also cannot be used while the containing aggregate is version 1.4, or on a file that is stored in compressed format.

Examples

```c
#pragma linkage(BPX1IOC, OS)
#pragma LANGLVL(EXTENDED)
```
extern void BPX1IOC(int, int, int, char *, int *, int *, int *, int *, int *);

#include <stdio.h>
#include <fcntl.h>

#define IOCTL_SNAPSHOT 0x0000A903

typedef struct bk_req_t {
  char bk_eye[4];  /* eye catcher */
  short bk_length;  /* Length of this structure. */
  short bk_flags;   /* Input flags. The following values: */
#define BK_FIRSTCALL 0x0001  /* 0x0001 - Signifies that this is the first */
               /* snapshot read call. */
  char bk_writers;  /* Output for registration call, value 1 if the */
               /* file was opened for write by other users at */
               /* time of snapshot registration; 0 otherwise. */
  char bk_eof;      /* Output parameter, 1 if the end-of-file is */
               /* reached, 0 otherwise. Valid even */
               /* after snapshot register because the file could be */
               /* empty. */
  char bk_key;      /* Key for the memory buffer, in the format of */
#define BK_MINBUF 65536 /* Minimum required buffer size. */
  long long int bk_fileLength; /* Output, Length of the file at snapshot time.*/
  long long int bk_nextReadOffset; /* Output, Next offset into the file to */
  long long int bk_offset;  /* Input for read request, ignored for */
               /* registration request - next place in file */
               /* to read from. */
  long long int bk_buffer;  /* In/Out for read request, ignored for */
               /* registration request - buffer for zFS to */
               /* place data into. */
  int bk_outputLen; /* Output for read request, ignored for */
               /* registration request - amount of bytes */
               /* placed in buffer. */
  int bk_uncompressedLen; /* Output for read request, ignored for */
               /* registration request - amount of bytes */
               /* if the data were not compressed. If */
               /* outputlen does not equal uncompressedLen, */
               /* the returned data is compressed; otherwise */
               /* the data was returned uncompressed. */
  long long int bk_attrBuffer; /* In/Out - If non-zero, then the caller is */
               /* requesting attributes, this parameter is */
               /* only valid on the first call for a file, */
               /* for subsequent reads of the file this will */
               /* be ignored. */
  long long int bk_aclBuffer; /* In/Out - If non-zero, then the caller is */
               /* requesting the ACL for the file. This */
               /* parameter is only valid on the first call */
               /* for a file, for subsequent reads of the file */
               /* this will be ignored. */
  int bk_attrBufferLen; /* Input - Length of the buffer used to */
               /* contain the output attributes, which will be */
               /* in the z/OS Unix ATTR format. If the ATTR is */
               /* requested then the buffer used to contain */
               /* the ATTR should have the ATTR version field */
               /* set so that zFS knows which version of the */
               /* ATTR the caller expects. */
  int bk_aclBufferLen; /* Input - Length of the buffer used to */
               /* contain the access ACL of the file. zFS */
               /* recommends that this buffer be 64K in size */
               /* since 64K is theoretically the largest */
               /* possible ACL. Of course ACLs could be */
               /* written in-between calls, so it's best to */
               /* simply pass a 64K buffer. */
#define BK_FUT_LEN 32
  char bk_future[BK_FUT_LEN]; /* Future use, must be zero on input */
} BK_REQ;

int main(int argc, char **argv)
{  
  int bpxrv = 0;
  int bpxrc = 0;
  int bpxrs = 0;
  int fd;
  BK_REQ myreq;
  char *bkbuf = NULL;
char *attrbuf = NULL;
char *aclbuf = NULL;

/* Open file for read. Assumed to be valid input. */
fd = open(argv[1], O_RDONLY);
/* Allocate a buffer to use in the read loop later. */
bkbuf = (char *)malloc(BK_MINBUF);
if (bkbuf == NULL)
{
    printf("Malloc of bkbuf failed.\n");
    bpxr = -1;
    goto error;
}
/**************************************************************************/
/* Optional - Snapshot API can return ACL and ATTR information for the     */
/* file if we choose to request it. To request this information, simply   */
/* create and pass in a buffer for bk_attrBuffer and bk_aclBuffer and */
/* their corresponding size fields bk_attrBufferLen and bk_aclBufferLen. */
/* The size only needs to be big enough to fit a standard ATTR structure  */
/* and ACL information respectively, but for this example we're making    */
/* them plenty large enough.                                            */
/**************************************************************************/
attrbuf = (char *)malloc(65536);
if (attrbuf == NULL)
{
    printf("Malloc of attrbuf failed.\n");
    bpxr = -1;
    goto error;
}
/* Ensure reserved fields and bk_offset are 0 */
memset(&myreq, 0, sizeof(BK_REQ));
/* Set up input values. */
memcpy(&myreq, BK_EYE, 4);
myreq.bk_length = sizeof(myreq);
myreq.bk_flags = BK_FIRSTCALL;   /* Initialize snapshot */
myreq.bk_sversion = 1;
myreq.bk_key = 0x80;
myreq.bk_attrBuffer = (long long int)attrbuf;
myreq.bk_aclBuffer  = (long long int)aclbuf;
myreq.bk_attrBufferLen = 65536;
myreq.bk_aclBufferLen  = 65536;
/**************************************************************************/
/* The first call with the BK_FIRSTCALL flag set will register a snapshot */
/* request. Future calls beyond that will be to read data, in up to 64K */
/* pieces, ideally in a loop. These calls won't use the BK_FIRSTCALL flag.*/
/**************************************************************************/
BPXIIOC(fd,
    IOCTL_SNAPSHOT,     /* IOCTL operation */
    sizeof(myreq),     /* Length of Argument */
    (char *)&myreq,     /* Pointer to Argument */
    &bpxr,             /* Pointer to Return_value*/
    &bpxrc,            /* Pointer to Return_code */
    &bpxrs);           /* Pointer to Reason_code */
printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxr, bpxrc, bpxrs);
if (bpxr < 0)
{
    printf("Error trying to register snapshot for file %s\n", argv[1]);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxr, bpxrc, bpxrs);
    goto error;
}
printf("Registered snapshot of file %s\n\n", argv[1]);
/* Set the appropriate BK_REQ fields for the next call. */
myreq.bk_flags = 0;
myreq.bk_buffer = (long long int)bkbuf;
myreq.bk_bufferSize = 65536;
while (myreq.bk_eof != 1)
```c
/* Set the read offset each time we call. */
myreq.bk_offset = myreq.bk_nextReadOffset;

BPX1IOC(fd,
    IOCTL_SNAPSHOT,        /* IOCTL operation        */
    sizeof(myreq),         /* Length of Argument     */
    (char *)&myreq,        /* Pointer to Argument */
    &bpxrv,                /* Pointer to Return_value*/
    &bxrc,                 /* Pointer to Return_code */
    &bpxrs);               /* Pointer to Reason_code */

printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bxrc, bpxrs);
if (bpxrv < 0)
{
    printf("Error reading snapshot data for file %s at offset %lld\n", 
        argv[1], myreq.bk_offset);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bxrc, bpxrs);
    goto error;
}
/* Some useful information to show about the progress. */
printf("Read %d bytes from offset %lld of the file.\n", 
    myreq.bk_outputLen, myreq.bk_offset);
printf("Next read offset is %lld\n", myreq.bk_nextReadOffset);
/* To create a backup file with this information, write the data */
/* in <bk_buffer> at offset <bk_offset> for size <bk_outputLen>. */
printf("Backup of file %s successful.\n", argv[1]);
}
error:
    if (bkbuf != NULL)
        free(bkbuf);
    if (attrbuf != NULL)
        free(attrbuf);
    if (aclbuf != NULL)
        free(aclbuf);
    close(fd);
    return bxrc;
```
Format Aggregate

Purpose

Format Aggregate is an aggregate operation that formats a VSAM linear data set as a zFS aggregate. It supports both version 1.4 aggregates and version 1.5 aggregates.

Format

syscall_parmlist

| opcode  | int       | 134 | AGOP_FORMAT_PARMDATA |
| parms[0] | int       | offset to AGGR_ID |
| parms[1] | int       | offset to AGGR_FORMAT |
| parms[2] | int       | offset to system name (optional) |
| parms[3] | int       | 0 |
| parms[4] | int       | 0 |
| parms[5] | int       | 0 |
| parms[6] | int       | 0 |

AGGR_ID

| aid_eye | char[4] | "AGID" |
| aid_len | char    | Sizeof(AGGR_ID) |
| aid_ver | char    | 1 |
| aid_name | char[45] | Aggregate name |
| aid_reserved | char[33] | 0 (Reserved for the future) |

AGGR_FORMAT

| af_eye | char[4] | "AGFM" |
| af_len | short   | Sizeof(AGGR_FORMAT) |
| af_ver | char    | 1 |
| af_aggrversion | char | 0 means honor format_aggrversion value |
| af_aggrversion | char | 4 means format a version 1.4 aggregate |
| af_aggrversion | char | 5 means format a version 1.5 aggregate |

| af_size | int   | Amount of aggregate to format |
| af_size | int   | Size of the aggregate log |
| af_initialempty | int | this is ignored - always use 1 |
| af_overwrite | int | Use caution if you specify 1 |
| af_overwrite | int | this is ignored - always compat |
| af_owner | int   | No uid specified |
| af_ownerSpecified | int | Use uid of issuer |
| af_group | int   | No guid specified |
| af_groupSpecified | int | Gid set to issuer default group |
| af_perms | int   | No perms specified |
| af_permsSpecified | int | Perms not specified |
| af_grow | int   | Grow amount, 0 means grow not specified |
| af_newauditfid | int | 0=old auditfid; 1=newauditfid |
| af_encrypt | char | encryption specification |
| af_encrypt | char | 0 – value is not set |
| af_encrypt | char | 1 – request an encrypted file system |
| af_encrypt | char | 2 – request the file system to be not encrypted |
| af_compress | char | compression specification |
| af_compress | char | 0 – value is not set |
| af_compress | char | 1 – request a compressed file system |
| af_compress | char | 2 – request the file system to be not compressed |

| af_reserved | char[54] |
| systemname | char[9] |

Return_value 0 if request is successful, -1 if it is not successful

Return_code

EBUSY    Aggregate is busy or otherwise unavailable
EINTR    ZFS is shutting down
EINVAL    Invalid parameters
EMVSERR   Internal error using an osi service
ENOENT    No aggregate by this name is found
EPERM    Permission denied to perform request

Reason_code

0xEFnnxxxx See z/OS Distributed File Service Messages and Codes
EINVAL    Invalid parameters
Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.
2. The af_compat bit is ignored. The VSAM linear data set is always formatted as a compatibility mode aggregate.
3. If af_encrypt is not specified or 0, the default value that is used for encryption will be the value specified in the IOEFSprm option format_encryption.
4. If af_compress is not specified or 0, the default value used for compression will be the value specified in the IOEFSprm option format_compression.
5. If af_perms is not specified or 0, and af_permsSpecified is not specified or 0, the default value for used for root directory permissions will be the value that is specified in the IOEFSprm option format_perms.

Privilege required

Before you can issue the Format Aggregate API, you must have UPDATE authority to the VSAM linear data set.

If you specified af_owner, af_group, or af_perms, with values that differ from the defaults, you must also be UID 0 or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIX UNIXPRIV class. The defaults for af_owner and af_group are determined from the credentials of the issuer. The default for af_perms is the value of the IOEFSprm FORMAT_PERMS option.

Related services

Define Aggregate

Restrictions

The VSAM linear data set to be formatted cannot be attached.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGlvl(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_FORMAT_PARMDATA 134
typedef struct syscall_parmlist_t {
   int   opcode;       /* Operation code to perform */
   int   parms[7];     /* Specific to type of operation, */
   /* provides access to the parms */
   /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;
#define ZFS_MAX_AGGRNAME 44
typedef struct aggr_id_t {
   char  aid_eye[4];                   /* Eye catcher */
   #define AID_EYE "AGID"
   char  aid_len;                      /* Length of this structure */
   char  aid_ver;                      /* Version */
   #define AID_VER_INITIAL 1             /* Initial version */
} aggr_id;
```
typedef struct aggr_format_t {
  char af_eye[4]; /* Eye catcher */
#define AF_EYE "AGFM"
  short af_len; /* Length of structure */
#define AF_VER_INITIAL 1
  char af_aggrversion; /* 0 means honor */
#define AF_VERSION4 4
#define AF_VERSION5 5
  int af_size; /* Amount to format of aggr */
#define AF_DEFAULT_SIZE 0 /* If set, we use default of entire */
  int af_logsize; /* Size of logfile in aggr */
#define AF_DEFAULT_LOGSIZE 0 /* If set, we use default of */
  int af_initialempty; /* Initial empty blocks */
#define AF_DEFAULT_INITIALEMD 1 /* This is the default & minimum too */
  int af_overwrite; /* Overwrite aggr if its not empty */
#define AF_OVERWRITE_OFF 0 /* Overwrite off, that means if aggr */
  int af_compat; /* HFS-compat aggr desired */
#define AF_MULT 0 /* HFS-compat aggr desired */
#define AF_HFSCOMP 1 /* HFS-compat aggr desired */
  int af_owner; /* Owner for HFS-compat */
#define AF_OWNER_USECALLER 0 /* Owner is set to pfsctl issuer uid */
#define AF_OWNER_SPECIFIED 1 /* Use owner uid set in af_owner */
  int af_group; /* Group for HFS-compat */
#define AF_GROUP_USECALLER 0 /* Group gets set to pfsctl */
#define AF_GROUP_SPECIFIED 1 /* Use group gid set in af_group */
  int af_perms; /* Perms for HFS-compat */
#define AF_PERMS_DEFAULT 0 /* Perms not specified, use default */
#define AF_PERMS_SPECIFIED 1 /* Use perms set in af_perms */
  int af_grow; /* Amount to extend each time until */
  /* we reach desired size */
  /* 0 means work the old way, just */
  /* extend to desired size once */
  int af_newauditfid; /* 0 = old format auditfid, */
  /* 1 = new format auditfid */
  /* 0 = not specified (default value)*/
  /* 1 = encrypted file system */
  /* 2 = unencrypted file system */
  /* 0 = not specified (default value)*/
  /* 1 = compressed file system */
  /* 2 = uncompressed file system */
  char af_encrypt; /* 0 = not specified (default value)*/
  /* 1 = compressed file system */
  /* 2 = uncompressed file system */
  char af_compress; /* 0 = not specified (default value)*/
  char af_reserved[54]; /* For future use */
} AGGR_FORMAT;

struct parmstruct {
  syscall_parmlist myparms;
  AGGR_ID aid;
  AGGR_FORMAT aggformat;
  char systemname[9];
} myparmstruct;

int main(int argc, char **argv) {
int bpxrv;
int bpxrc;
int bpxrs;
char aggrname[45] = "PLEX.DCEIMGQX.LDS"; /* aggregate name to format */
AGGR_FORMAT *aggptr = &(myparmstruct.aggformat);
AGGR_ID *idp = &(myparmstruct.aid);
/* This next field should only be set if parms[2] is non-zero */
/* strcpy(myparmstruct.systemname,"DCEIMGVN"); */
/* set system to change*/

myparmstruct.myparms.opcode = AGOP_FORMAT_PARMDATA;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
myparmstruct.myparms.parms[2] = 0;

/* Only specify a non-zero offset for the next field (parms[2]) if */
/* you are running z/OS 1.7 and above, and */
/* you want the format to be run on a different system than this one */
/* myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist) + */
/* sizeof(AGGR_ID) + sizeof(AGGR_FORMAT); */

myparmstruct.myparms.parms[3] = 0;
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;
memset(idp, 0, sizeof(AGGR_ID));
memcpy(idp->aid_eye, AID_EYE, 4);
idp->aid_ver = 1;
strcpy(idp->aid_name, aggrname);
memset(aggptr, 0, sizeof(myparmstruct.aggformat));
memcpy(aggptr->af_eye, AF_EYE, 4);

aggptr->af_len = sizeof(myparmstruct.aggformat);
aggptr->af_ver = AF_VER_INITIAL;
aggptr->af_size = AF_DEFAULT_SIZE;
aggptr->af_comp = AF_HFSCOMP; /* HFS compatibility mode aggregate */

/* aggptr->af_owner = owner; */
/* aggptr->af_groupSpecified = AF_OWNER_USECALLER; */
/* aggptr->af_ownerSpecified = AF_GROUP_USECALLER; */
/* aggptr->af_permsSpecified = AF_PERMS_DEFAULT; */

aggptr->af_grow = 0; /* no grow size */
aggptr->af_aggrversion = 0; /* format with default version defined by */
/* format_aggrversion */
aggptr->af_newauditfid = 1; /* generate a new auditfid */

BPX1PCT("ZFS
ZFS_APP AGGR,    /* Aggregate operation */
sizeof(myparmstruct), /* Length of Argument */
(char *)&myparmstruct, /* Pointer to Argument */
&bxrv, /* Pointer to Return_value */
&bxrc, /* Pointer to Return_code */
&bpxrs); /* Pointer to Reason_code */

if (bxrv < 0)
{
    printf("Error formatting, BPXRV = %d BPXRC = %d BPXRS = %x\n", bxrv, bxrc, bpxrs);
    return bxrv;
}
else
    printf("Formatted aggregate %s\n", aggrname);

return 0;
Grow Aggregate

Purpose

Extends the physical size of an attached aggregate. It supports both version 1.4 aggregates and version 1.5 aggregates.

Format

```c
syscall_parmlist
opcode          int        129       AGOP_GROW_PARMDATA
parms[0]        int        offset to AGGR_ID
parms[1]        int        new size of aggregate
parms[2]        int        0
parms[3]        int        0
parms[4]        int        0
parms[5]        int        0
parms[6]        int        0
AGGR_ID
aid_eye         char[4]    "AGID"
aid_len         char        sizeof(AGGR_ID)
aid_ver         char        1   (new size is 32 bits)
aid_name        char[45]    Name of aggregate
aid_reserved    char[33]    0   (Reserved for future use)
- OR -
syscall_parmlist
opcode          int         129       AGOP_GROW_PARMDATA
parms[0]        int         offset to AGGR_ID
parms[1]        int         high 32 bits of new 64 bit size of aggregate
parms[2]        int         low 32 bits of new 64 bit size of aggregate
parms[3]        int         0
parms[4]        int         0
parms[5]        int         0
parms[6]        int         0
AGGR_ID
aid_eye         char[4]     "AGID"
aid_len         char        sizeof(AGGR_ID)
aid_ver         char        3  (new size is 64 bits)
aid_name        char[45]    Name of aggregate
aid_reserved    char[33]    0  (Reserved for future use)
```

Return_value 0 if request is successful, -1 if it is not successful

Return_code

8        DFSMS did not extend the aggregate
EBUSY    Aggregate is busy or otherwise unavailable
EINTR    ZFS is shutting down
EINVAL   Invalid parameters
EMVSERR  Internal error using an osi service
ENOENT   No aggregate by this name is found
EPERM    Permission denied to perform request

Reason_code

0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes

1. The aggregate must be mounted or attached.
2. The size specified is the new total size (in 1 KB blocks) that is being requested. The size can be rounded up by DFSMS. If a zero is specified for the new size, the aggregate is grown by a secondary allocation. DFSMS determines whether to extend to another volume. Requests that write to files and need aggregate blocks that are not available yet and other requests that access those files will wait. Other requests will not wait during the grow.
3. For an AGGR_ID version 1, the new size cannot be larger than approximately 4 TB. For an AGGR_ID version 3, the new size is a 64-bit number, and cannot be larger than approximately 16 TB.
4. Reserved fields and undefined flags must be set to binary zeros.

Privilege required
The issuer must have ALTER authority on the VSAM linear data set to be formatted and must be logged in as root (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Related services
List Aggregate Status Version 2

Restrictions
The aggregate to be grown cannot already be quiesced or be attached as read-only. An aggregate cannot be made smaller.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANG_LVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_GROW_PARMDATA 129

typedef struct syscall_parmlist_t {
    int opcode;                /* Operation code to perform */
    int parms[7];              /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;
#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
    char aid_eye[4];                    /* Eye catcher */
    char aid_len;                       /* Length of this structure */
    char aid_ver;                       /* Version */
    #define AID_VER_INITIAL 1               /* Initial version */
    char aid_name[ZFS_MAX_AGGRNAME+1];  /* Name, null terminated */
    char aid_reserved[33];              /* Reserved for the future */
} AGGR_ID;

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID          aggr_id;
}:

int main(int argc, char **argv) {
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    char              aggrname[45]     = "PLEX.DCEIMGQX.FS";

    struct parmstruct myparmstruct;

    /* Ensure reserved fields are 0 */
    memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID));

    myparmstruct.myparms.opcode   = AGOP_GROW_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = 70000; /*New size of aggregate in K-bytes*/
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
```

zFS application programming interface information 271
myparmstruct.myparms.parms[6] = 0;
memcpy(&myparmstruct.aggr_id.aid_eye, AID_EYE, 4);
myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
strcpy(myparmstruct.aggr_id.aid_name, aggrname);

BPX1PCT("ZFS ",  /* Aggregate operation */
ZFSCALL_AGGR,   /* Length of Argument */
sizeof(myparmstruct), /* Pointer to Argument */
(char *)&myparmstruct, /* Pointer to Return_value */
&bpxrv,
&bpxrc,  /* Pointer to Return_code */
&bpxrs); /* Pointer to Reason_code */

if (bpxrv < 0)
{
    printf("Error growing aggregate %s\n", aggrname);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
{
    printf("Aggregate %s grown successfully\n", aggrname);
    return 0;
}
# List Aggregate Status (Version 1)

## Purpose
An aggregate operation that returns information about a specified attached aggregate on this system.

IBM recommends using the List Detailed File System Information API instead of List Aggregate Status or List File System Status.

## Format

```c
syscall parm list

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>opcodel</td>
<td>int</td>
<td>137  AGOP_GETSTATUS_PARMDATA</td>
</tr>
<tr>
<td>parms[0]</td>
<td>int</td>
<td>offset to AGGR_ID</td>
</tr>
<tr>
<td>parms[1]</td>
<td>int</td>
<td>offset to AGGR_STATUS</td>
</tr>
<tr>
<td>parms[2]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parms[3]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parms[4]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parms[5]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parms[6]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>AGGR_ID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aid_eye</td>
<td>char[4]</td>
<td>&quot;AGID&quot;</td>
</tr>
<tr>
<td>aid_len</td>
<td>char</td>
<td>sizeof(AGGR_ID)</td>
</tr>
<tr>
<td>aid_ver</td>
<td>char</td>
<td>1</td>
</tr>
<tr>
<td>aid_name</td>
<td>char[45]</td>
<td>&quot;OMVS.PRV.AGGR001.LDS0001&quot;</td>
</tr>
<tr>
<td>aid_reserved</td>
<td>char[33]</td>
<td>0</td>
</tr>
<tr>
<td>AGGR_STATUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>as_eye</td>
<td>char[4]</td>
<td>&quot;AGST&quot;</td>
</tr>
<tr>
<td>as_len</td>
<td>short</td>
<td>sizeof(AGGR_STATUS)</td>
</tr>
<tr>
<td>as_ver</td>
<td>char</td>
<td>1</td>
</tr>
<tr>
<td>as_aggrId</td>
<td>int</td>
<td>Aggregate ID</td>
</tr>
<tr>
<td>as_nFileSystems</td>
<td>int</td>
<td>Number of File Systems</td>
</tr>
<tr>
<td>as_threshold</td>
<td>char</td>
<td>Aggrfull threshold</td>
</tr>
<tr>
<td>as_increment</td>
<td>char</td>
<td>Aggrfull increment</td>
</tr>
<tr>
<td>as_flags</td>
<td>char</td>
<td></td>
</tr>
<tr>
<td>AS_MONITOR</td>
<td>char</td>
<td>0x80</td>
</tr>
<tr>
<td>AS_RDONLY</td>
<td>char</td>
<td>0x40</td>
</tr>
<tr>
<td>AS_NBS</td>
<td>char</td>
<td>0x20</td>
</tr>
<tr>
<td>AS_COMPAT</td>
<td>char</td>
<td>0x10</td>
</tr>
<tr>
<td>AS_GROW</td>
<td>char</td>
<td>0x08</td>
</tr>
<tr>
<td>as_res2</td>
<td>char</td>
<td>0</td>
</tr>
<tr>
<td>as_blocks</td>
<td>unsigned int</td>
<td></td>
</tr>
<tr>
<td>as_fragSize</td>
<td>int</td>
<td></td>
</tr>
<tr>
<td>as_blockSize</td>
<td>int</td>
<td></td>
</tr>
<tr>
<td>as_totalUsable</td>
<td>unsigned int</td>
<td></td>
</tr>
<tr>
<td>as_realFree</td>
<td>unsigned int</td>
<td></td>
</tr>
<tr>
<td>as_minFree</td>
<td>unsigned int</td>
<td></td>
</tr>
<tr>
<td>as_reserved</td>
<td>char[128]</td>
<td></td>
</tr>
</tbody>
</table>

Return_value   0 if request is successful, -1 if it is not successful

Return_code
- EINTR: ZFS is shutting down
- EINVAL: Invalid parameter list
- EMVSERR: Internal error using an osi service
- ENOENT: Aggregate is not attached

Reason_code
0xEFnnxxxx: See z/OS Distributed File Service Messages and Codes

## Usage notes
1. To grow an aggregate, you need to specify a number larger than the sum of `as_totalUsable` and `as_minFree`.

2. Reserved fields and undefined flags must be set to binary zeros.

## Privilege required
None.
Related services

List Attached Aggregate Names
List Detailed File System Information

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>

#define ZFS_MAX_AGGRNAME 44

typedef struct syscall_parmlist_t {
    int opcode;         /* Operation code to perform */
    int parms[7];       /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused */
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
    char aid_eye[4];                   /* Eye Catcher */
    char aid_len;                      /* Length of this structure */
    char aid_ver;                      /* Version */
    char aid_name[ZFS_MAX_AGGRNAME+1]; /* aggr name, null terminated */
    char aid_reserved[33];             /* Reserved for the future */
} AGGR_ID;

#define AS_MONITOR 0x80           /* Aggr monitored for aggr full */
#define AS_RO 0x40                /* Aggr attached Read-only */
#define AS_NBS 0x20               /* Aggr should guarantee NBS */
#define AS_COMPAT 0x10            /* Aggr is HFS compatible */
#define AS_GROW 0x08              /* Aggr can be dynamically grown */

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID          aggr_id;
    AGGR_STATUS      aggr_status;
};

int main(int argc, char **argv)
```
int bpxrv;
int bpxrc;
int bpxrs;

/* aggregate name to getstatus */
char aggrname[45] = "PLEX.DCEIMGQX.FS";
struct parmstruct myparmstruct;
AGGR_ID *idp = &(myparmstruct.aggr_id);
AGGR_STATUS *asp = &(myparmstruct.aggr_status);

myparmstruct.myparms.opcode = AGOP_GETSTATUS_PARMDATA;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
myparmstruct.myparms.parms[2] = 0;
myparmstruct.myparms.parms[3] = 0;
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;

memset(idp, 0, sizeof(AGGR_ID)); /* Ensure reserved fields are 0 */
memezer(asp, 0, sizeof(AGGR_STATUS)); /* Ensure reserved fields are 0 */
memcpy(&myparmstruct.aggr_status.as_eye[0], AS_EYE, 4);
mempcpy(&myparmstruct.aggr_status.as_aggrId, AID_EYE, 4);
myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
strcpy(myparmstruct.aggr_id.aid_name, aggrname);

BPX1PCT("ZFS",
ZFSCALL_AGGR,          /* Aggregate operation*/
sizeof(myparmstruct),  /* Length of Argument */
(char *)&myparmstruct, /* Pointer to Argument */
&bpxrv,                /* Pointer to Return_value */
&bpxrc,                /* Pointer to Return_code */
&bpxrs);               /* Pointer to Reason_code */

if (bpxrv < 0)
{
    printf("Error getstatus aggregate %s\n", aggrname);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
{
    /* Return from getstatus was successful */
    printf("Aggregate %s getstatus successful\n", aggrname);
    printf("getstatus: aggr_id=%d, no_of_filesystems=%d, aggr_flags=%x\n",
        myparmstruct.aggr_status.as_aggrId,
        myparmstruct.aggr_status.as_nFileSystems,
        myparmstruct.aggr_status.as_flags);
    printf("getstatus: threshold=%d, increment=%d\n",
        myparmstruct.aggr_status.as_threshold,
        myparmstruct.aggr_status.as_increment);
    printf("getstatus: blocks=%d, frag_size=%d, block_size=%d\n",
        myparmstruct.aggr_status.as_blocks,
        myparmstruct.aggr_status.as_fragSize,
        myparmstruct.aggr_status.as_blockSize);
    printf("getstatus: total_usable=%d, real_free=%d, min_free=%d\n",
        myparmstruct.aggr_status.as_totalUsable,
        myparmstruct.aggr_status.as_realFree,
        myparmstruct.aggr_status.as_minFree);
}
return 0;
List Aggregate Status (Version 2)

Purpose

Returns information about a specified attached aggregate on this system. Version 2 returns additional flags and fields.

IBM recommends that you use the List Detailed File System Information API instead of List Aggregate Status or List File System Status.

Format

syscall_parmlist
opcode                   int                146   AGOP_GETSTATUS2_PARMDATA
parms[0]                 int                Offset to AGGR_ID
parms[1]                 int                Offset to AGGR_STATUS2
parms[2]                 int                0
parms[3]                 int                0
parms[4]                 int                0
parms[5]                 int                0
parms[6]                 int                0
AGGR_ID
aid_eye                  char[4]            "AGID"
aid_len                  char               Sizeof(AGGR_ID)
aid_ver                  char               1
aid_name                 char[45]           Aggregate name
aid_reserved             char[33]           0
AGGR_STATUS2
as_eye                   char[4]            "AGST"
as_len                   short              Sizeof(AGGR_STATUS2)
as_ver                   char               2
as_res1                  char               0
as_aggrId                int                Aggregate ID
as_nFileSystems          int                Number of File Systems
as_threshold             char               Aggrfull threshold
as_increment             char               Aggrfull increment
as_flags                 char
AS_MONITOR                       0x80 Monitoring for aggrfull
AS_RO                              0x40 Attached Read-only
AS_NBS                         0x20 NBS being guaranteed
AS_COMPAT                      0x10 Formatted as HFS-compat
AS_GROW                        0x08 Can be dynamically grown
ASQUIESCED                   char               0x01 1 means aggr is quiesced
as_flags2                char
AS_DISABLED                  0x80 Aggr is disabled
AS_SYSPLEXAWARE             0x40 Aggr mounted RSHARE and is sysplex-aware
as_blocks                 unsigned int       Number of fragments in aggr
as_fragSize               int                Size of fragment in aggr (normally 1k)
as_blockSize              int                Size of blocks (8K normally)
as_totalUsable            unsigned int       Total available blocks
as_realFree               unsigned int       Total free 1K blocks
as_minFree                unsigned int       Minimum kilobytes free
as_reserved2              int[3]             Reserved
as_freeblocks             unsigned int       K available in free 8K blocks
as_freefrags              unsigned int       K available in free 1K frags
as_directLog              unsigned int       K used on the log
as_indirectLog            unsigned int       K used indirectly on the log
as_fstbl                  unsigned int       K used for file system table
as_bitmap                 unsigned int       K used for the bitmap
as_diskFormatMajorVersion unsigned int       Disk format major version
as_diskFormatMinorVersion unsigned int       Disk format minor version
s_auditfid                char[10]          Aggregate Audit Fid
as_bytes_reserved         char[2]            Reserved
as_reserved3              int                Reserved
as_quiesce_time           struct timeval   If quiesced, time quiesce
List Aggregate Status (Version 2)

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>posix_time_low</td>
<td>int</td>
<td>Seconds since epoch</td>
</tr>
<tr>
<td>posix_usecs</td>
<td>int</td>
<td>Micro-seconds</td>
</tr>
<tr>
<td>as_quiesce_jbname</td>
<td>char[9]</td>
<td>If quiesced, Job name requesting quiesce</td>
</tr>
<tr>
<td>as_quiesce_sysname</td>
<td>char[9]</td>
<td>If quiesced, system name quiesce request came from</td>
</tr>
<tr>
<td>as_reserved</td>
<td>char[42]</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

OR

syscall_parmlist

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>opcode</td>
<td>int</td>
<td>146 AGOP_GETSTATUS2_PARMDATA</td>
</tr>
<tr>
<td>parms[0]</td>
<td>int</td>
<td>Offset to AGGR_ID</td>
</tr>
<tr>
<td>parms[1]</td>
<td>int</td>
<td>Offset to AGGR_STATUS3</td>
</tr>
<tr>
<td>parms[2]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parms[3]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parms[4]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parms[5]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parms[6]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>AGGR_ID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aid_eye</td>
<td>char[4]</td>
<td>&quot;AGID&quot;</td>
</tr>
<tr>
<td>aid_len</td>
<td>char</td>
<td>Sizeof(AGGR_ID)</td>
</tr>
<tr>
<td>aid_name</td>
<td>char[45]</td>
<td>Aggregate name</td>
</tr>
<tr>
<td>aid_reserved</td>
<td>char[33]</td>
<td>0</td>
</tr>
<tr>
<td>AGGR_STATUS3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>as_eye</td>
<td>char[4]</td>
<td>&quot;AGST&quot;</td>
</tr>
<tr>
<td>as_len</td>
<td>short</td>
<td>sizeof(AGGR_STATUS2)</td>
</tr>
<tr>
<td>as_ver</td>
<td>char</td>
<td>3 (supports 64 bit sizes)</td>
</tr>
<tr>
<td>as_aggrId</td>
<td>int</td>
<td>Aggregate ID</td>
</tr>
<tr>
<td>as_threshold</td>
<td>char</td>
<td>Aggrfull threshold</td>
</tr>
<tr>
<td>as_increment</td>
<td>char</td>
<td>Aggrfull increment</td>
</tr>
<tr>
<td>as_flags</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS_MONITOR</td>
<td></td>
<td>0x80 Monitoring for aggrfull</td>
</tr>
<tr>
<td>AS_RO</td>
<td></td>
<td>0x40 Attached Read-only</td>
</tr>
<tr>
<td>AS_NBS</td>
<td></td>
<td>0x20 NBS being guaranteed</td>
</tr>
<tr>
<td>AS_COMPAT</td>
<td></td>
<td>0x10 Formatted as HFS-compat</td>
</tr>
<tr>
<td>AS_GROW</td>
<td></td>
<td>0x08 Can be dynamically grown</td>
</tr>
<tr>
<td>AS_QUIESCED</td>
<td></td>
<td>0x01 1 means aggr is quiesced</td>
</tr>
<tr>
<td>as_flags2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS_DISABLED</td>
<td></td>
<td>0x80 Aggr is disabled</td>
</tr>
<tr>
<td>AS_SYSPLEXAWARE</td>
<td></td>
<td>0x40 Aggr mounted RSHARE and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>is sysplex-aware</td>
</tr>
<tr>
<td>AS_CONVERTTOV5</td>
<td></td>
<td>0x20 Aggregate enabled for</td>
</tr>
<tr>
<td></td>
<td></td>
<td>automatic V5 conversion</td>
</tr>
<tr>
<td>as_blocks</td>
<td>unsigned int</td>
<td>Number of fragments in aggr</td>
</tr>
<tr>
<td>as_fragSize</td>
<td>int</td>
<td>Size of fragment in aggr (normally 1K)</td>
</tr>
<tr>
<td>as_blockSize</td>
<td>int</td>
<td>Size of blocks (8K normally)</td>
</tr>
<tr>
<td>as_totalUsable</td>
<td>unsigned int</td>
<td>Total available blocks</td>
</tr>
<tr>
<td>as_realFree</td>
<td>unsigned int</td>
<td>Total free 1K blocks</td>
</tr>
<tr>
<td>as_minFree</td>
<td>unsigned int</td>
<td>Minimum kilobytes free</td>
</tr>
<tr>
<td>as_reserved2</td>
<td>int[3]</td>
<td>Reserved</td>
</tr>
<tr>
<td>as_freeBlocks</td>
<td>unsigned int</td>
<td>K available in free 8K blocks</td>
</tr>
<tr>
<td>as_freefrags</td>
<td>unsigned int</td>
<td>K available in free 1K frags</td>
</tr>
<tr>
<td>as_directLog</td>
<td>unsigned int</td>
<td>K used on the log</td>
</tr>
<tr>
<td>as_indirectLog</td>
<td>unsigned int</td>
<td>K used indirectly on the log</td>
</tr>
<tr>
<td>as_fstbl</td>
<td>unsigned int</td>
<td>K used for file system table</td>
</tr>
<tr>
<td>as_bitmap</td>
<td>unsigned int</td>
<td>K used for the bitmap</td>
</tr>
<tr>
<td>as_diskFormatMajorVersion</td>
<td>unsigned int</td>
<td>Disk format major version</td>
</tr>
<tr>
<td>as_diskFormatMinorVersion</td>
<td>unsigned int</td>
<td>Disk format minor version</td>
</tr>
<tr>
<td>as_auditfid</td>
<td>char[10]</td>
<td>Aggregate Audit Fid</td>
</tr>
<tr>
<td>as_bytes_reserved</td>
<td>char[2]</td>
<td>Reserved</td>
</tr>
<tr>
<td>as_reserved3</td>
<td>int</td>
<td>Reserved</td>
</tr>
<tr>
<td>as_quiesce_time</td>
<td>struct timeval</td>
<td>If quiesced, time quiesce occurred. Low order part of seconds since epoch</td>
</tr>
<tr>
<td>posix_time_low</td>
<td>int</td>
<td>Seconds since epoch</td>
</tr>
</tbody>
</table>
### List Aggregate Status (Version 2)

**posix_usecs**  
**int**  
Micro-seconds

**as_quiesce_jbname**  
**char[9]**  
If quiesced, Job name requesting quiesce

**as_quiesce_sysname**  
**char[9]**  
If quiesced, system name quiesce request came from

**as_reserved2**  
**char[2]**  
Reserved

**as_quiece_time_hi**  
**int**  
If quiesced, high portion of seconds since epoch

**as_pad**  
**char[6]**  
Gets alignment

**as_blocks_hyper**  
**hyper**  
Number of fragments in aggr

**as_totalUsable_hyper**  
**hyper**  
Total available blocks

**as_realFree_hyper**  
**hyper**  
Total free 1k blocks

**as_minFree_hyper**  
**hyper**  
Minimum kilobytes free

**as_freeblocks_hyper**  
**hyper**  
K available in free 8K blocks

**as_freefrags_hyper**  
**hyper**  
K available in free 1K frags

**as_directLog_hyper**  
**hyper**  
K used on the log

**as_indirectLog_hyper**  
**hyper**  
K used indirectly on the log

**as_fstbl_hyper**  
**hyper**  
K used for file system table

**as_bitmap_hyper**  
**hyper**  
K used for the bitmap

**as_quiesce_time_high**  
**int**  
If quiesce, high portion of seconds since epoch

**as_reserved**  
**char[40]**  
Reserved for future use

Return_value 0 if request is successful, -1 if it is not successful

**Return_code**

- **EINVAL**        Invalid parameter list
- **EMVSERR**       Internal error using an osi service
- **ENOENT**        Aggregate is not attached

**Reason_code**

- **0xEFnnxxxx**    See z/OS Distributed File Service Messages and Codes

#### Usage notes

1. The aggregate must be mounted or attached.
2. To grow an aggregate, you need to specify a number larger than the sum of `as_totalUsable` and `as_minFree`.

3. For an AGGR_STATUS2, if a size is too large for 32 bits, 0xFFFFFFFF is returned. For an AGGR_STATUS3, sizes are returned in both the normal fields and the hyper fields.

4. Reserved fields and undefined flags must be set to binary zeros.

#### Privilege required

None.

#### Related services

- List Attached Aggregate Names
- List Detailed File System Information

#### Restrictions

None.

#### Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
```
#define AGOP_GETSTATUS2_PARMDATA 146

typedef struct syscall_parmlist_t {
    int opcode;      /* Operation code to perform */
    int *parms[7];   /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct timeval {
    int posix_time_low; /* seconds since epoch */
    int posix_usecs;   /* microseconds */
} TIMEVAL;

typedef struct hyper_t {    /* unsigned 64 bit integers */
    unsigned int high;
    unsigned int low;
} hyper;

#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
    char aid_eye[4];     /* Eye Catcher */
    char aid_len;        /* Length of this structure */
    char aid_ver;        /* Version */
    char aid_name[ZFS_MAX_AGGRNAME+1]; /* aggr name, null terminated */
    char aid_reserved[33]; /* Reserved for the future */
} AGGR_ID;

typedef struct aggr_status_t {
    char as_eye[4];      /* Eye catcher */
    short as_len;        /* Length of structure */
    char as_ver,
        as_res1;        /* Reserved. */
    int as_aggrId;       /* Internal identifier */
    int as_nFileSystems; /* Number of filesystems in aggregate */
    char as_threshold;   /* Threshold for aggrfull monitoring */
    char as_increment;   /* Increment for aggrfull monitoring */
    char as_flags;       /* Aggregate flags */
    char as_flags2;      /* Aggregate flags2 */
    unsigned int as_blocks; /* Number of fragments in aggregate */
    int as_fragSize;     /* Size of fragment in aggregate (normally 1K) */
    unsigned int as_totalUsable; /* Total available blocks on aggregate */
    unsigned int as_realFree; /* Total kilobytes free */
    unsigned int as_minFree; /* Minimum kilobytes free */
    int as_reserved2[3]; /* Minimum kilobytes free */
    unsigned int as_freeblocks; /*Number of k available in free 8k blocks*/
    unsigned int as_freefrags; /*Number of k available in free 1k fragments*/
    unsigned int as_directLog; /*Number of k used on the log*/
    unsigned int as_indirectLog; /*Number of k used indirectly on the log*/
    unsigned int as_freeblocks; /*Number of k used for the filesystem table*/
    unsigned int as_bitmap; /*Number of k used for the bitmap file*/
    unsigned int as_diskFormatMajorVersion; /* disk format major version */
    unsigned int as_diskFormatMinorVersion; /* disk format minor version */
    char as_auditfidi[18]; /* 6 byte volser followed by */
    /*4 byte CCHH */
    short as_bytes_reserved; /* reserved */
    int as_reserved3;
    struct timeval as_quiesce_time; /* time of last quiesce */
    char as_quiesce_jobname[9]; /* job name of last quiesce */
}
List Aggregate Status (Version 2)

```c
char as_quiesce_sysname[9]; /* system where last quiesce issued - null terminated */
char as_pad[6]; /* pad to double word boundary */

/* new hyper fields */
hyper as_blocks_hyper; /* Number of fragments in aggregate */
hyper as_totalUsable_hyper; /* Total avail 1K blks on aggregate */
hyper as_realFree_hyper; /* Total 1K blocks free */
hyper as_minFree_hyper; /* Minimum kilobytes free */
hyper as_freeblocks_hyper; /*Number of k available free 8k blocks*/
hyper as_freefrags_hyper; /*Number of k available free 1k frags*/
hyper as_directLog_hyper; /*Number of k used on the log*/
hyper as_indirectLog_hyper; /*Number of k used indirectly on log*/
hyper as_fstbl_hyper; /*Number of k used - filesystem table*/
hyper as_bitmap_hyper; /*Number of k used for the bitmap file*/
int as_quiesce_time_high; /* High piece of quiesce time */
char as_reserved[40]; /* Reserved for future */

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID         aggr_id;
    AGGR_STATUS3    aggr_status;
};

int main(int argc, char **argv) {
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    int               i;
    char              buf[33];
    char              aggrname[45];     /* aggregate name to getstatus */
    struct parmstruct myparmstruct;
    long long         ptl;
    AGGR_ID           *idp         = &(myparmstruct.aggr_id);
    AGGR_STATUS3      *asp         = &(myparmstruct.aggr_status);
    if (argc < 2) {
        printf("Please specify an aggregate name as a parameter\n");
        exit(1);
    }
    strncpy(aggrname, argv[1], sizeof(aggrname));
    myparmstruct.myparms.opcode = AGOP_GETSTATUS2_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    memset(idp, 0, sizeof(AGGR_ID)); /* Ensure reserved fields are 0 */
    memset(asp, 0, sizeof(AGGR_STATUS3)); /* Ensure reserved fields are 0 */
    memcpy(&myparmstruct.aggr_status.as_eye[0], AS_EYE, 4);
    myparmstruct.aggr_status.as_len = sizeof(AGGR_STATUS3);
    memcpy(&myparmstruct.aggr_status.as_ver = AS_VER_3;
    memcpy(&myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
    strpcy(myparmstruct.aggr_id.aid_name, aggrname);
    BPX1PCT("ZFS     ",
    ZFS_CALL_AGGR,    /* Aggregate operation */
    sizeof(myparmstruct), /* Length of Argument */
    (char *)&myparmstruct, /* Pointer to Argument */
    &bpxrv,    /* Pointer to Return_value */
    &bpxrc,    /* Pointer to Return_code */
    &bpxrs);    /* Pointer to Reason_code */
    if (bpxrv < 0) {
        printf("Error getstatus aggregate %s\n", aggrname);
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        return bpxrc;
    } else {
        /* Return from getstatus was successful */
    }
}
```
printf("Aggregate %s getstatus successful\n", aggrname);

printf("getstatus: aggr_id=%d, no_of_filesystems=%d, ",
"aggr_flags=%2.2x, aggr_flags2=%2.2x\n",
myparmstruct.aggr_status.as_aggrId,
myparmstruct.aggr_status.as_nFileSystems,
myparmstruct.aggr_status.as_flags,
myparmstruct.aggr_status.as_flags2);

printf("getstatus: threshold=%d, increment=%d\n",
myparmstruct.aggr_status.as_threshold,
myparmstruct.aggr_status.as_increment);

printf("getstatus: blocks=%d, frag_size=%d, block_size=%d\n",
myparmstruct.aggr_status.as_blocks,
myparmstruct.aggr_status.as_fragSize,
myparmstruct.aggr_status.asBlockSize);

printf("getstatus: total_usable=%d, real_free=%d, min_free=%d\n",
myparmstruct.aggr_status.as_totalUsable,
myparmstruct.aggr_status.as_realFree,
myparmstruct.aggr_status.as_minFree);

printf("getstatus: free_8K_blocks=%d, free_1K_fragments=%d\n",
myparmstruct.aggr_status.as_freeblocks / 8,
myparmstruct.aggr_status.as_freefrags);

printf("getstatus: direct_Log=%d, indirect_Log=%d\n",
myparmstruct.aggr_status.as_directLog,
myparmstruct.aggr_status.as_indirectLog);

printf("getstatus: filesystem_table=%d, bitmap=%d\n",
myparmstruct.aggr_status.as_fstbl,
myparmstruct.aggr_status.as_bitmap);

printf("getstatus: blocks=sh=%d, blocks1l=%d\n",
myparmstruct.aggr_status.as_blocks_hyper.high,
myparmstruct.aggr_status.as_blocks_hyper.low);

printf("getstatus: total_usableh=%d, total_usablel=%d, ",
"real_freeh=%d, real_freel=%d, ",
"min_freeh=%d, min_freel=%d\n",
myparmstruct.aggr_status.as_totalUsable_hyper.high,
myparmstruct.aggr_status.as_totalUsable_hyper.low,
myparmstruct.aggr_status.as_realFree_hyper.high,
myparmstruct.aggr_status.as_realFree_hyper.low,
myparmstruct.aggr_status.as_minFree_hyper.high,
myparmstruct.aggr_status.as_minFree_hyper.low);

printf("getstatus: free_8K_blocks=sh=%d, free_8K_fragmentsl=%d, ",
"free_1K_fragments=sh=%d, ",
"free_1K_fragmentsl=%d\n",
myparmstruct.aggr_status.as_freeblocks_hyper.high/8,
myparmstruct.aggr_status.as_freeblocks_hyper.low/8,
myparmstruct.aggr_status.as_freefrags_hyper.high,
myparmstruct.aggr_status.as_freefrags_hyper.low);

printf("getstatus: direct_Logh=%d, direct_Logl=%d, ",
"indirect_Logh = %d, ",
"indirect_Logl=%d\n",
myparmstruct.aggr_status.as_directLog_hyper.high,
myparmstruct.aggr_status.as_directLog_hyper.low,
myparmstruct.aggr_status.as_indirectLog_hyper.high,
myparmstruct.aggr_status.as_indirectLog_hyper.low);

printf("getstatus: filesystem_tableh=%d, filesystem_tablel=%d, ",
"bitmap = %d, bitmapl=%d\n",
myparmstruct.aggr_status.as_fstbl_hyper.high,
myparmstruct.aggr_status.as_fstbl_hyper.low,
myparmstruct.aggr_status.as_bitmap_hyper.high,
myparmstruct.aggr_status.as_bitmap_hyper.low);

printf("getstatus: version=%d.%d\n",
myparmstruct.aggr_status.as_disFormatMajorVersion,
myparmstruct.aggr_status.as_disFormatMinorVersion);

printf("getstatus: auditfid=");

for (i = 0; i < 10; i++)
printf("%2.2X", myparmstruct.aggr_status.asauditfid[i]);

printf("\n");
if (myparmstruct.aggr_status.as_flags & AS_QUIESCED)
if (myparmstruct.aggr_status.as_quiesce_jbname[0] != 0x00)
{
    memcpy(4 + (char *)&ptl, &myparmstruct.aggr_status.as_quiesce_time.posix_time_low, 4);
    memcpy(&ptl, &myparmstruct.aggr_status.as_quiesce_time_high, 4);
    if (0 == ctime64_r((const long long *)& ptl, buf))
    {
        printf("Could not get timestamp.\n");
    }
    else /* Insert the microseconds into the displayable time value */
    {
        strncpy(&buf[27]), &buf[20]), 6);
        sprintf(&buf[20]), "%06d",
            myparmstruct.aggr_status.as_quiesce_timeposix_usecs);
        buf[26] = ' '.
        buf[19] = '.';
        printf("Quiesced by job %s on system %s on %s",
            myparmstruct.aggr_status.as_quiesce_jbname,
            myparmstruct.aggr_status.as_quiesce_sysname,
            buf);
    }
}
printf("\n");
return 0;
List Attached Aggregate Names (Version 1)

Purpose
List Attached Aggregate Names (Version 1) is an aggregate operation that returns a list of the names of all attached aggregates on a system.

Format

```
syscall_parmlist
  opcode       int            135       AGOP_LISTAGGRNAMES_PARMDATA
  parms[0]     int            buffer length or 0
  parms[1]     int            offset to AGGR_ID or 0
  parms[2]     int            offset to size
  parms[3]     int            offset to system name (optional)
  parms[4]     int            0
  parms[5]     int            0
  parms[6]     int            0
  AGGR_ID[2]   int            Array of AGGR_IDs (n can be 0)
  aid_eye      char[4]        "AGID"
  aid_len      char            sizeof(AGGR_ID)
  aid_ver      char            1
  aid_name     char[45]       "OMVS.PRV.AGGR001.LDS0001"
  aid_reserved char[33]       0
  size needed  int            bytes returned or size needed
               if the return code is E2BIG
  systemname   char[9]

Return_value  0 if request is successful, -1 if it is not successful

Return_code
  EINVAL        Invalid parameter list
  E2BIG         List is too big for buffer supplied

Reason_code
  0xEFnnxxxxx   See z/OS Distributed File Service Messages and Codes
```

Usage notes
1. This call returns an array of AGGR_ID structures, one for each attached aggregate on the system. Each AGGR_ID structure is 84 bytes. You can specify a buffer that you think might hold all of them or you can specify a buffer length and offset to AGGR_ID of zero. If you get a return code of E2BIG, the required size for the buffer is contained in the size field.

2. Reserved fields and undefined flags must be set to binary zeros.

Privilege required
None.

Related services
List Aggregate Status
List File System Names

Restrictions
None.
Examples

```c
#pragma linkage(BPX1PCT, OS)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>

#define ZFSCALL_AGGR 0x40000005
#define AGOP_LISTAGGRNAMES_PARMDATA 135
#define E2BIG 145

typedef struct syscall_parmlist_t {
    int  opcode;        /* Operation code to perform */
    int  parms[7];      /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
    char aid_eye[4];                    /* Eye Catcher */
    char aid_len;                       /* Length of this structure */
    char aid_ver;                       /* Version */
    #define AID_VER_INITIAL 1            /* Initial version */
    char aid_name[ZFS_MAX_AGGRNAME+1];  /* aggr name, null terminated */
    char aid_reserved[33];              /* Reserved for the future */
} AGGR_ID;

struct parmstruct {
    syscall_parmlist myparms;
    /* Real malloc'd structure will have an array of AGGR_IDS here */
    int              size;
    char             systemname[9];
};

int main(int argc, char **argv)
{
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    struct parmstruct myparmstruct;
    AGGR_ID           *aggPtr;
    int               aggSize      = sizeof(AGGR_ID);
    int               buflen       = sizeof(AGGR_ID);
    struct parmstruct *myp         = &myparmstruct;
    int               mypsize;
    char              *systemp;
    int               count_aggrs,
    total_aggrs;
    myparmstruct.myparms.opcode   = AGOP_LISTAGGRNAMES_PARMDATA;
    myparmstruct.myparms.parms[0] = 0;
    myparmstruct.myparms.parms[1] = 0;
    myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    BPX1PCT("ZFS",
        ZFSCALL_AGGR,               /* Aggregate operation */
        sizeof(myparmstruct),      /* Length of Argument */
        (char *)&myparmstruct,      /* Pointer to Argument */
        &bpxrv,                     /* Pointer to Return_value */
        &bpxrc,                     /* Pointer to Return_code */
        &bpxrs);                    /* Pointer to Reason_code */
    if (bpxrv < 0)
    {
        if (bpxrc == E2BIG)
        {
            buflen = myp->size;         /* Get buffer size needed */
            mysize = buflen + sizeof(syscall_parmlist) + sizeof(int) + 9;
            myp = (struct parmstruct *)malloc((int)mysize);
            memset(myp, 0, mysize);
            /* This next field should only be set if parms[3] is non-zero */
        }
    }
}```
/* systemp = (char *)myp + buflen + sizeof(syscall_parmlist) */
/*           + sizeof(int); */
/* strcpy(systemp,"DCEIMGVN"); */ /* set system to get lsaggr info from*/

myp->myparms.opcode = AGOP_LISTAGGRNAMES_PARMDATA;
myp->myparms.parms[0] = buflen;
myp->myparms.parms[1] = sizeof(syscall_parmlist);
myp->myparms.parms[2] = sizeof(syscall_parmlist) + buflen;
myp->myparms.parms[3] = 0;

/* Only specify a non-zero offset for the next field (parms[3]) if */
/* you are running z/OS 1.7 and above, and */
/* you want lsaggr aggregates owned on a single system */
/* myp->myparms.parms[3] = sizeof(syscall_parmlist) + buflen */
/*                         + sizeof(int); */

myp->myparms.parms[4] = 0;
myp->myparms.parms[5] = 0;
myp->myparms.parms[6] = 0;

BPX1PCT("ZFS     
 ZFSCALL_AGGR,   /* Aggregate operation */
 mypsize,        /* Length of Argument */
 (char *)myp,    /* Pointer to Argument */
 &bpxrv,         /* Pointer to Return_value */
 &bpxrc,         /* Pointer to Return_code */
 &bpxrs);        /* Pointer to Reason_code */

if (bpxrv == 0)
{
    total_aggrs = buflen / aggSize;
    count_aggrs = 1;

    for (aggPtr = (AGGR_ID *) & (myp->size);
        count_aggrs <= total_aggrs;
        aggPtr++, count_aggrs++)
    {
        if (strlen(aggPtr->aid_name) != 0)
            printf("%-64.64s\n", aggPtr->aid_name);
    }

    free(myp);
}
else
{
    /* lsaggr names failed with large enough buffer */
    printf("Error on ls aggr with large enough buffer\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
}
else
{
    /* error was not E2BIG */
    printf("Error on ls aggr trying to get required size\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
}
else
{
    /* asking for buffer size gave rv = 0; maybe there are no aggregates */
    if (myparmstruct.size == 0)
        printf("No attached aggregates\n");
    else /* No, there was some other problem with getting the size needed */
        printf("Error getting size required\n");
}
return 0;
List Attached Aggregate Names (Version 2)

Purpose

The List Attached Aggregate Names (Version 2) subcommand call returns a list of the names of all attached aggregates on a system with the system name.

Format

syscall_parmlist
  opcode int 140 AGOP_LISTAGGRNAMES2_PARMDATA
  parms[0] int buffer length or 0
  parms[1] int offset to AGGR_ID2 or 0
  parms[2] int offset to size
  parms[3] int offset to system name (optional)
  parms[4] int 0
  parms[5] int 0
  parms[6] int 0
  AGGR_ID2[n] Array of AGGR_ID2s (n can be 0)
    aid_eye char[4] "AGID"
    aid_len char sizeof(AGGR_ID)
    aid_ver char 2
    aid_name char[45] "OMVS_PRV_AGGR001.LDS0001"
    aid_sysname char[9] "DCEIMGVN"
    aid_reserved char[24] 0
  size int bytes returned or size needed
  if the return code is E2BIG
  systemname char[9]

Return_value 0 if request is successful, -1 if it is not successful

Return_code
  EINTR ZFS is shutting down
  EINVAL Invalid parameter list
  EMVSERR Internal error using an osi service
  ENOENT Aggregate is not attached
  E2BIG List is too big for buffer supplied

Reason_code
  0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes

1. This call returns an array of AGGR_ID2 structures, one for each attached aggregate on the system. Each AGGR_ID2 structure is 84 bytes. You can specify a buffer that you think might hold all of them or you can specify a buffer length and offset to AGGR_ID2 of zero. If you get a return code of E2BIG, the required size for the buffer is contained in the size field.

2. Reserved fields and undefined flags must be set to binary zeros.

Privilege required

None.

Related services

List Aggregate Status
List File System Names

Restrictions

None.
Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>

#define ZFSCALL_AGGR 0x40000005
#define AGOP_LISTAGGRNAMES2_PARMDATA 140 /* list attached aggregates */
#define E2BIG 145

typedef struct syscall_parmlist_t {
    int  opcode;          /* Operation code to perform */
    int  parms[7];        /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44
#define SYS_MAX_NAMELEN 8 /* Max. z/OS system name length*/

typedef struct aggr_id2_t {
    char aid_eye[4];                     /* Eye Catcher */
    char aid_len;                        /* Length of this structure */
    char aid_ver;                        /* Version */
    char aid_name[ZFS_MAX_AGGRNAME+1];   /* aggr name, null terminated */
    char aid_sysname[SYS_MAX_NAMELEN+1]; /* system name, NULL terminated */
    char aid_reserved[24];               /* Reserved for the future */
} AGGR_ID2;

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID2          *aggPtr;
    int              aggSize      = sizeof(AGGR_ID2);
    int              buflen       = sizeof(AGGR_ID2);
    int              *t;
};

int main(int argc, char **argv)
{
    int               buffer_success = 0;
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    int               t;

    struct parmstruct myparmstruct;

    myparmstruct.myparms.opcode = AGOP_LISTAGGRNAMES2_PARMDATA;
    myparmstruct.myparms.parms[0] = 0;
    myparmstruct.myparms.parms[1] = 0;
    myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;

    BPX1PCT("ZFS",
             ZFSCALL_AGGR,      /* Aggregate operation */
             sizeof(myparmstruct), /* Length of Argument */
             (char *)&myparmstruct, /* Pointer to Argument */
             &bpxrv,       /* Pointer to Return_value */
             &bpxrc,       /* Pointer to Return_code */
             &bpxrs);     /* Pointer to Reason_code */

    for(t = 0; t < 1000 && buffer_success == 0; t++)
    {
```
```
if (bpxrv < 0) {
  if (bpxrc == E2BIG) {
    buflen = myp->size; /* Get buffer size needed */
    mypsize = buflen + sizeof(syscall_parmlist) + sizeof(int) + 9;
    free(myp);
    myp = (struct parmstruct *)malloc((int)mypsise);
    memset(myp, 0, mypsize);
    /* This next field should only be set if parms[3] is non-zero */
    /* sysemp = (char *)myp + buflen */
    /* + sizeof(syscall_parmlist) + sizeof(int); */
    /* strcpy(sysemp, "DCEIMGVN"); */
    /* set system to get lsaggr info from */
    myp->myparms.opcode = AGOP_LISTAGGRNAMES2_PARMDATA;
    myp->myparms.parms[0] = buflen;
    myp->myparms.parms[1] = sizeof(syscall_parmlist);
    myp->myparms.parms[2] = sizeof(syscall_parmlist) + buflen;
    myp->myparms.parms[3] = 0;
    /* Only specify a non-zero offset for the next field (parms[3]) if */
    /* you are running z/OS 1.7 and above, and */
    /* you want lsaggr aggregates owned on a single system */
    /* myp->myparms.parms[3] = sizeof(syscall_parmlist) */
    /* + buflen + sizeof(int); */
    myp->myparms.parms[4] = 0;
    myp->myparms.parms[5] = 0;
    myp->myparms.parms[6] = 0;
    BPX1PCT("ZFS ",
             ZPSCALL_AGGR, /* Aggregate operation */
             mypsize, /* Length of Argument */
             (char *)myp, /* Pointer to Argument */
             &bpxrv, /* Pointer to Return_value */
             &bpxrc, /* Pointer to Return_code */
             &bpxrs); /* Pointer to Reason_code */
  }
  else { /* error was not E2BIG */
    printf("Error on ls aggr trying to get required size\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
  }
}
else { /* asking for buffer size gave rv = 0; maybe there are no aggregates */
  if (myparmstruct.size == 0)
    printf("No attached aggregates\n");
  else { /* No, there was some other problem with getting the size needed */
    printf("Error getting size required\n");
    free(myp);
  }
}
return bpxrc;
}

if ( t == 1000 )
    printf("Number of failed buffer resizes exceeded.\n");
free(myp);
return 0;
}
List Detailed File System Information

Purpose

Returns detailed information for one or more file systems. You can obtain information for file systems that have common names, common attributes, or that have encountered similar unexpected conditions.

IBM recommends that you use the List Detailed File System Information API instead of List Aggregate Status, List File System Status, List File System Names (Version 1), or List File System Names (Version 2).

Format

| syscall_parmlist | opcode               | int     | 153    AGOP_FSINFO_PARMDATA |
|                 | parms[0]             | int     | 154    AGOP_FSINFO_RESET_PARMDATA |
|                 | parms[1]             | int     | 0      offset to FSINFO_REQUEST |
|                 | parms[2]             | int     | 0      |
|                 | parms[3]             | int     | 0      |
|                 | parms[4]             | int     | 0      |
|                 | parms[5]             | int     | 0      |
|                 | parms[6]             | int     | 0      |

FSINFO_REQUEST

| fr_eye          | char[4]              | "FIRQ"
| fr_length       | short                | Length of Structure
| fr_sversion     | char                 | Structure Version, must be 1
| fr_reqtype      | char                 | SingleQuery=0, NameCursor=1
| fr_version      | char                 | Version of input/output buffer
|                 | 1 for pre-z/OS V2R3  |
|                 | 2 for returning FSINFO_OWNER with long-running commands information introduced in z/OS V2R3 |
| fr_output       | char                 | Type of output/function selected, one of:
|                 | 0 - Local statistics only, use only local cache. |
|                 | 1 - Full sysplex-wide statistics(including owner statistics). |
|                 | 2 - Reset statistics. |
| fr_nameSelection| char                 | Selection of aggregates desired, one of:
|                 | 0 - When SingleQuery selected. |
|                 | Options for fr_reqtype=1 (NameCursor): |
|                 | 1 - All aggregates. fr_output can be 1 (full) or 2 (reset). |
|                 | 2 - Aggregates known on the local system. |
|                 | This is only allowed with fr_output 0 (local statistics). |
|                 | 3 - All aggregates matching a specific pattern provided in fr_patternName. fr_output can be 1 (full) or 2 (reset). |
| fr_eol          | char                 | Indicates if a multi-aggregate read has completed. |
|                 | 1 if yes, 0 if no. |
| fr_selection    | int                  | Selection mask for aggregates meeting certain state criteria. |
|                 | More than one bit can be set. zFS will use an OR-ing of the criteria so that aggregates that meet one or more criteria are returned. |
|                 | 0 - all aggregates desired. |
|                 | x1 - Show aggregates that have sysplex thrashing objects. |
|                 | x2 - Show aggregates that contain v5 directories with overflow pages. |
|                 | x4 - Show aggregates mounted R/W. |
|                 | x8 - Show aggregates mounted R/O. |
|                 | x10 - Show aggregates that are disabled. |
|                 | x20 - Show aggregates that are growing. |
|                 | x40 - Show aggregates that are quiesced. |
|                 | x80 - Show aggregates that had grow failures. |
|                 | x100 - Show aggregates that are low on space, as defined by the zFS bitmap manager. |
|                 | x200 - Show aggregates that are damaged. |
|                 | x400 - Show aggregates that are mounted RWSHARE. |
|                 | x800 - Show aggregates that are mounted NORMSHARE. |
|                 | x1000 - Show aggregates that had requests |
|                 | x2000 - Show aggregates that had write requests. |
|                 | x4000 - Show aggregates where applications saw ENOSPC errors. |
|                 | x8000 - Show aggregates that had disk I/O errors |
|                 | x10000 - Show aggregates that had XCF timeouts between client systems and owning systems (for RWSHARE aggregates). |
|                 | x20000 - Show aggregates that are version 1.4 aggregates. |
|                 | x40000 - Show aggregates that are version 1.5 aggregates. |
|                 | x80000 - Show aggregates that are disabled for dynamic grow.
List Detailed File System Information

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fr_entries</td>
<td>unsigned int</td>
<td>Number of aggregates returned in output.</td>
</tr>
<tr>
<td>fr_nonFatalRc</td>
<td>int</td>
<td>Non-fatal error code.</td>
</tr>
<tr>
<td>fr_nonFatalRsn</td>
<td>int</td>
<td>Reason code if fr_nonFatalRc is nonzero.</td>
</tr>
<tr>
<td>fr_resumeName</td>
<td>char[45]</td>
<td>Dataset name to resume with for NameCursor or the name of a single-aggregate query.</td>
</tr>
<tr>
<td>fr_patternName</td>
<td>char[45]</td>
<td>The aggregate name to be used. This can contain wildcards.</td>
</tr>
<tr>
<td>FSINFO_NAME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fn_eye</td>
<td>char[4]</td>
<td>&quot;FINA&quot;</td>
</tr>
<tr>
<td>fn_slength</td>
<td>short</td>
<td>Structure length.</td>
</tr>
<tr>
<td>fn_sversion</td>
<td>short</td>
<td>Structure version, must be 1.</td>
</tr>
<tr>
<td>fn_name</td>
<td>char[44]</td>
<td>Aggregate name.</td>
</tr>
<tr>
<td>fn_connected</td>
<td>unsigned int</td>
<td>Number of connected systems if owner output is requested; 0 otherwise.</td>
</tr>
<tr>
<td>fn_owner</td>
<td>char[8]</td>
<td>System name of the owner.</td>
</tr>
<tr>
<td>fn_length</td>
<td>unsigned int</td>
<td>Total length of all information for this aggregate.</td>
</tr>
<tr>
<td>fn_sysnames</td>
<td>char[8]</td>
<td>Names of connected systems (32 at most).</td>
</tr>
<tr>
<td>FSINFO_OWNER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fo_eye</td>
<td>char[4]</td>
<td>&quot;FIOW&quot;</td>
</tr>
<tr>
<td>fo_length</td>
<td>short</td>
<td>Length of structure</td>
</tr>
<tr>
<td>fo_sversion</td>
<td>short</td>
<td>Structure version: 1 for pre-z/OS V2R3 2 for returning FSINFO_OWNER with long-running commands introduced in z/OS V2R3</td>
</tr>
<tr>
<td>fo_size</td>
<td>unsigned int</td>
<td>Number of 8K blocks in the aggregate.</td>
</tr>
<tr>
<td>fo_free</td>
<td>unsigned int</td>
<td>Number of unused 8K blocks in the aggregate.</td>
</tr>
<tr>
<td>fo_frams</td>
<td>unsigned long</td>
<td>Number of free 1K fragments available in the aggregate.</td>
</tr>
<tr>
<td>fo_logsize</td>
<td>unsigned int</td>
<td>Number of 8K blocks allocated to the log file for transaction logging, including indirect blocks.</td>
</tr>
<tr>
<td>fo_bitmapsize</td>
<td>unsigned int</td>
<td>Number of 8K blocks allocated to the bitmap file, including indirect blocks.</td>
</tr>
<tr>
<td>fo_anodesize</td>
<td>unsigned int</td>
<td>Number of 8K blocks allocated to the anode table.</td>
</tr>
<tr>
<td>fo_objects</td>
<td>unsigned int</td>
<td>Number of objects in the file system.</td>
</tr>
<tr>
<td>fo_version</td>
<td>char</td>
<td>Aggregate version number.</td>
</tr>
<tr>
<td>fo_threshold</td>
<td>char</td>
<td>Space monitoring threshold.</td>
</tr>
<tr>
<td>fo_increment</td>
<td>char</td>
<td>Space monitoring increment.</td>
</tr>
<tr>
<td>fo_stop_longpct</td>
<td>char</td>
<td>If fr_version=2, percent completed for the stopped encrypt, decrypt, compress or decompress command.</td>
</tr>
<tr>
<td>fo_flags</td>
<td>int</td>
<td>Flag bits: x01 - Mounted in R/W mode. x02 - Disabled for access. x64 - Grow failure occurred since last reset. x88 - Aggregate is low on space zfs definition. x10 - Aggregate considered damaged by salvage verification and not repaired yet. x20 - Aggregate using zFS sysplex sharing (RWSHARE). x40 - Dynamic grow set at mount time. x80 - Aggregate is in the process of growing at time of query. x100 - converttov5 is set. x200 - Aggregate is not mounted. x400 - Aggregate is unowned. x800 - Dynamic grow allowed, no grow failures or since a grow failure an admin grow was done.</td>
</tr>
</tbody>
</table>

0xBFFFFFFF - Represents all valid bits if fr_version=2
### List Detailed File System Information

- **x1000** - The quiesce is done for chgowner.
- **x2000** - converttov5 disabled.
- **x4000** - Aggregate version 1.4.
- **x8000** - Aggregate version 1.5.

#### fo_overflow
- **unsigned int** Number of overflow pages used in v5 directories.

#### fo_overflowhiwater
- **unsigned int** Hi-water mark of fo_overflow for life of the file system.

#### reserved2
- **char[4]** Reserved. This field is only for fo_sversion=1.

#### or
- **fo_snappinned** **unsigned int** Number of free blocks pinned due to file backups. This field is only available if fo_sversion=2.

#### fo_thrashing
- **unsigned int** Number of objects using the thrash-resolution protocol.

#### fo_revocations
- **unsigned long long int** Number of revocations performed since last statistics reset.

#### fo_rewai
- **unsigned long long int** Average revocation wait time in microseconds.

#### fo_qsysname
- **char[8]** Name of system requesting quiesce, if the aggregate is quiesced, 0 otherwise.

#### fo_jobname
- **char[8]** Name of job requesting the quiesce, if the aggregate is quiesced, 0 otherwise.

#### fo_createtime
- **unsigned long long int** Creation time in seconds since last epoch.

#### fo_ownership
- **unsigned long long int** Ownershiip time in seconds since last epoch.

#### fo_reset
- **unsigned long long int** Time statistic counters reset in seconds since last epoch.

#### fo_quiesce
- **unsigned long long int** Quiesce time in seconds since epoch, 0 if not quiesced.

#### fo_devno
- **unsigned int** z/OS UNIX device number.

#### fo_auditfid
- **char[10]** Audit fid for file system.

#### fo_qasid
- **unsigned short** ASID which issued the quiesce.

#### fo_growcount
- **unsigned int** Number of grows since mount.

#### reserved3
- **char[4]** Reserved. This is only for fo_sversion=1.

#### or
- **fo_backups** **unsigned int** Number of in-progress backups. This field is only available if fo_sversion=2.

#### fo_growtime
- **unsigned long long int** Time of the last grow as known by the owner.

Field is only available if fo_sversion=2

#### fo_longtime
- **unsigned long int** Time that the long-running command was initiated on the aggregate.

Field is only available if fo_sversion=2

#### fo_edcFlag
- **char** Encryption and compression indicator flags:
  - 0x03 Encryption bits in fo_CEFlag
  - 0x06 Not-encrypted
  - 0x01 Decrypting
  - 0x02 Encrypting
  - 0x03 Encrypted
  - 0x20 Encrypt-scrubbing in progress or is required
  - 0x0C Compression bits in fo_CEFlag
  - 0x06 Not-compressed
  - 0x04 Decompressing
  - 0x08 Compressing
  - 0x0C Compressed

Field is only available if fo_sversion=2

#### fo_longstatus
- **char** Status indicator for long-running operations. This is only intended for IBM service information.

Field is only available if fo_sversion=2

#### fo_longpct
- **char** Percentage completion of the long-running command. This is only intended for IBM service information.

Field is only available if fo_sversion=2

#### fo_longtask
- **int** TCB address of the task performing the long-running operation, or 0.

### FSINFO_LOCAL

#### fl_eye
- **char[4]** "FILO"

#### fl_length
- **short** Structure Length.

#### fl_sversion
- **short** Structure version.

#### fl_vnodes
- **unsigned long long int** Number of vnodes cached in memory on the local system.

#### fl_ussheld
- **unsigned long long int** Number of vnodes held by z/OS UNIX.

#### fl_sysname
- **char[8]** System name stats are for.

#### fl_open
- **unsigned long long int** Number of open objects in the file system.

#### fl_tokens
- **unsigned long long int** Number of tokens held from the token manager.

#### fl_usercache
- **unsigned int** Number of 4K pages held in the user cache for file system.

#### fl_metacache
- **unsigned int** Number of 8K pages held in the metadata cache.

#### fl_appreads
- **unsigned long long int** Number of application reads done since last reset.

#### fl_appreadresp
- **unsigned long long int** Average read response time, in microseconds.

#### fl_appwrites
- **unsigned long long int** Number of application writes done since last reset.

#### fl_appwriteresp
- **unsigned long long int** Average write response time, in microseconds.

#### fl_xcfreads
- **unsigned long long int** Number of XCF read calls made to the owner since last reset.

#### fl_xcfrdresp
- **unsigned long long int** Average XCF read call response time, in microseconds.

#### fl_xcwrites
- **unsigned long long int** Number of XCF write calls made to the server since last reset.

#### fl_xcfwrtesp
- **unsigned long long int** Average XCF write call response time, in microseconds.

#### fl_enospc
- **unsigned long long int** Number of ENOSPC errors returned to applications since
List Detailed File System Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fl_ioerrs</td>
<td>unsigned long long int</td>
<td>Number of disk I/O errors since last reset.</td>
</tr>
<tr>
<td>fl_commerrs</td>
<td>unsigned long long int</td>
<td>Number of XCF communication timeouts or failures since last reset.</td>
</tr>
<tr>
<td>fl_cancels</td>
<td>unsigned long long int</td>
<td>Number of canceled operations since last reset by asynchronous abends, cancels, or forces.</td>
</tr>
<tr>
<td>fl_ddname</td>
<td>char[8]</td>
<td>DDNAME during allocation of aggregate dataset.</td>
</tr>
<tr>
<td>fl_mounttime</td>
<td>struct timeval64</td>
<td>Mount time in seconds since the last epoch.</td>
</tr>
<tr>
<td>fl_numdasd</td>
<td>unsigned int</td>
<td>Number of DASD volumes listed for aggregate in FSINFO_DASD array.</td>
</tr>
<tr>
<td>fl_flags</td>
<td>unsigned int</td>
<td>1 indicates this system has tasks waiting on a quiesced file system.</td>
</tr>
</tbody>
</table>

FSINFO_DASD

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fd_eye</td>
<td>char[4]</td>
<td>&quot;FIDA&quot;</td>
</tr>
<tr>
<td>fd_length</td>
<td>short</td>
<td>Structure Length.</td>
</tr>
<tr>
<td>fd_sversion</td>
<td>short</td>
<td>Structure version, must be 1.</td>
</tr>
<tr>
<td>fd_pavios</td>
<td>short</td>
<td>Number of I/Os zFS will issue at one time for non-critical I/Os.</td>
</tr>
<tr>
<td>fd_reads</td>
<td>unsigned long long int</td>
<td>Number of reads to this volume.</td>
</tr>
<tr>
<td>fd_readbytes</td>
<td>unsigned long long int</td>
<td>Number of kilobytes read.</td>
</tr>
<tr>
<td>fd_writes</td>
<td>unsigned long long int</td>
<td>Number of writes to this volume.</td>
</tr>
<tr>
<td>fd_writebytes</td>
<td>unsigned long long int</td>
<td>Number of kilobytes written.</td>
</tr>
<tr>
<td>fd_waits</td>
<td>unsigned long long int</td>
<td>Number of times a zFS task had to wait for an I/O to this volume.</td>
</tr>
<tr>
<td>fd_waitTime</td>
<td>unsigned long long int</td>
<td>(includes all time, queue wait, DASD response time etc.) since last reset.</td>
</tr>
<tr>
<td>fd_resptime</td>
<td>unsigned long long int</td>
<td>Avg. wait time in microseconds.</td>
</tr>
</tbody>
</table>

Return_value: 0 if request is successful, -1 if it is not successful.

Return_code:

- EINTR: zFS is shutting down
- EINVAL: Invalid parameter list
- EMVSERR: Internal error occurred
- E2BIG: Information too big for buffer supplied
- ENOENT: Specified data set is not found
- EPERM: Permission denied to perform request

Reason_code: 0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes:

1. Specifying fr_version=2 will cause any FSINFO_OWNER structures returned in the output buffer to be fo_sversion=2. fr_version=2 is not valid on systems running a release prior to z/OS V2R3. Specifying fr_version=1 will cause any FSINFO_OWNER structures returned in the output buffer to be fo_sversion=1.

2. The following fields in FSINFO_OWNER are only available if fo_sversion=2:
   - fo_longtime
   - fo_edcFlag
   - fo_longstatus
   - fo_longpct
   - fo_longtask
   - fo_snappinned
   - fo_backups

3. The following fr_selection fields in FSINFO_REQUEST are only available if fr_version=2:
   - x2000000 (shows aggregates that are encrypted).
   - x4000000 (shows aggregates that are not encrypted).
   - x8000000 (shows aggregates that are compressed).
   - x1000000 (shows aggregates that are not compressed).
   - x2000000 (shows aggregates that are being salvaged).
   - x4000000 (shows aggregates that are partially compressed or encrypted).
List Detailed File System Information

- x8000000 (shows aggregates that are being shrunk).
- x10000000 (shows aggregates that have in-progress backups).

4. Users of the API supply an input buffer that contains a syscall_parmlist followed by an FSINFO_REQUEST structure. Output will be placed in this buffer after the FSINFO_REQUEST.

5. A minimum length output buffer for a single-aggregate query is 10 K, and a minimum length output buffer for a multi-aggregate query is 64 K.

6. A single specific aggregate can be queried by putting its name in fr_resumeName. The name must be null-terminated. Also specify fr_reqtype 0 (SingleQuery). This aggregate does not need to be attached. fr_selection and fr_nameSelection must also be 0.

7. Multiple aggregate names can be specified by entering a string in fr_patternName that can contain a wildcard character ('*'). A wildcard can be specified at the beginning, at the end, or both at the beginning and the end of the string. The string must be null-terminated. The input string is converted to uppercase before it is processed. Use a fr_nameSelection value of 3 when specifying a wildcard, and a fr_reqtype of NameCursor (1).

8. All attached aggregates can be specified by using fr_nameSelection value of 1 and a fr_reqtype value of NameCursor (1).

9. If the output buffer cannot hold all of the returned information, fr_eol will be 0 and fr_resumeName will contain a value to be returned to zFS on the next query. Keep querying zFS until fr_eol is 1 to indicate that all information has been returned.

10. Use fr_selection to return only aggregates that match the specified criteria in a multiple aggregate query. The options are defined in the Format section.

11. fr_output determines the output of the request. Options are defined in the Format section.

12. There is no file system information returned when a reset is requested (fr_output=2). A reset can only be requested when the opcode is 154 (AGOP_FSINFO_RESET_PARMDATA) and fr_selection is 0.

13. Reserved fields and undefined flags must be set to binary zeros.

14. Any names returned that are less than the full length of the field are null terminated. If the length of the name is equal to the length of the field that contains it, then it is not null terminated.

15. Output consists of various structures following the FSINFO_REQUEST area in the buffer. For each aggregate that has information returned, first will be an FSINFO_NAME structure. This contains the name of an aggregate and the systems that are connected to it. Then, if present, will be the FSINFO_OWNER structure. This contains aggregate statistics and attributes as known by the owner. There can be no FSINFO_OWNER in some cases when the aggregate is unowned (fn_owner is *UNOWNED). This is followed by FSINFO_LOCAL structures. There are fn_connected FSINFO_LOCAL structures (if it is unowned), otherwise there are fn_connected+1 FSINFO_LOCAL structures. Each FSINFO_LOCAL structure is followed by fl_numdasd FSINFO_DASD structures to describe the DASD volumes that contain the zFS aggregate data set.

16. To move through the output buffer from one structure to the next, add the length field of each structure to the beginning of its containing structure.
   - For the FSINFO_REQUEST structure, the length field is fr_length.
   - For the FSINFO_NAME structure, the length field is fn_slength.
   - For the FSINFO_OWNER structure, the length field is fo_length.
   - For the FSINFO_LOCAL structure, the length field is fl_length.
   - For the FSINFO_DASD structure, the length field is fd_length.

**Privilege required**

If a reset of the statistics values is requested and the fr_output field of the FSINFO_REQUEST structure contains the value 2, the issuer must be UID 0 or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class. Otherwise, no privilege is required.
Related services

List Aggregate Status (Version 1)
List Aggregate Status (Version 2)
List Attached Aggregate Names (Version 1)
List Attached Aggregate Names (Version 2)
List File System Names (Version 1)
List File System Names (Version 2)
List File System Status

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>
#include <stddef.h>
#include <stdint.h>
#include <time.h>
#define ZFSCALL_FSINFO       0x40000013
#define ZFS_MAX_AGGNAME 44
#define AGOP_FSINFO_PARMDATA 153 /* Get status on aggr & fs */
#define BUFFER_SIZE 1024 * 64
#define FSINFO_XCF_ERR       0x1
#define FSINFO_IO_ERR        0x2
#define FSINFO_SPC_ERR       0x4

typedef struct syscall_parmlist_t {
    int opcode;                  /* Operation code to perform */
    int parms[7];                /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[1]-parms[6] are currently unused*/
} syscall_parmlist;

struct timeval64 {
    uint64_t tv_sec;
    int32_t  tv_usec_pad;
    uint32_t tv_usec;
};

typedef struct FSINFO_REQUEST_t {
    char  fr_eye[4];
    #define FR_EYE  "FIRQ"
    short fr_length;
    char fr_sversion;             /* Structure version. must be 1 */
    char fr_reqtype;              /*request type. BulkList=0, OffsetCursor=1*/
    #define FR_REQTYPE_SINGLEQUERY 0
    #define FR_REQTYPE_NAMECURSOR  1
    char fr_version;              /* Version of input/output buffer; must be */
    /* 1 or 2 (for long-running operations). */
    char fr_output;               /* Type of output */
    #define FR_OUT_LOCAL_STAT      0 /* Local stats from local system */
    #define FR_OUT_FULL_STAT       1 /* Full stats from all systems*/
    #define FR_OUT_RESET          2 /* reset statistics */
    char fr_nameSelection;        /* Selection of aggregates desired, one of: */
    #define FR_NM_ALLAGGR          1 /* All aggregates */
    #define FR_NM_LOCAL           2 /* Local aggregates */
    #define FR_NM_PATTERN         3 /* All aggregates matching pattern */
    char fr_eol;                  /* Indicates if a multi-aggregate */
    /* read has completed */
    int  fr_selection;            /* Selection criteria of aggregates desired */
    unsigned int  fr_entries;     /* Number of entries returned */
```
by zFS (for OffsetCursor) */

int fr_nonFatalRc; /* Non-fatal error code */
int fr_nonFatalRsn; /* Reason code if fr_nonFatalRc is non-0 */
char fr_resumeName[45]; /* Dataset name to resume with for NameCursor or */
/* the name for the single-aggregate query. */
char fr_patternName[45]; /* The pattern name to be used. */
char fr_future2[2];
} FSINFO_REQUEST;

typedef struct FSINFO_NAME_t {
  char fn_eye[4];
  #define FN_EYE "FINA"
  short fn_slength; /* Structure length */
  short fn_sversion;
  char fn_name[44]; /* aggregate name */
  unsigned int fn_connected; /* number of connected systems if owner 
  output is included; 0 otherwise*/
  char fn_owner[8]; /* system name of the owner */
  unsigned int fn_length; /* Total length of all information for this 
  aggregate, so programs can quickly find the 
  beginning of the next record 
  in the output buffer. */
  char fn_future[4];
  char fn_sysnames[8]; /* Names of connected systems (32 at most).Actual 
  number is defined fn_connected.*/
} FSINFO_NAME;

typedef struct FSINFO_OWNER_t {
  char fo_eye[4];
  #define FSO_EYE "FIOW"
  short fo_length;
  short fo_sversion;
  #define FO_VERSION  FR_CURRENT_VERSION
  unsigned int fo_size; /* Num of 8K blocks in the aggregate */
  unsigned int fo_free; /* Number of unused 8K blocks 
  in the aggregate.*/
  unsigned long long int fo_frags; /* Num of free 1K fragments 
  available in the aggregate.*/
  unsigned int fo_logsize; /* Num of 8K blocks allocated 
  to the log file for 
  transaction logging, 
  including indirect blocks.*/
  unsigned int fo_bitmapsize; /* Number of 8K blocks allocated to the 
  bitmap file including indirect blocks.*/
  unsigned int fo_anodesize; /* Number of 8K blocks allocated 
  to the anode table.*/
  unsigned int fo_objects; /* Number of objects in the file system. */
  char fo_version; /* Aggregate version number */
  char fo_threshold; /* Space monitoring threshold */
  char fo_increment; /* Space monitoring increment*/
  char fo_stop_longpct; /* Reserved for fo_sversion=1, otherwise 
  percent complete of an interrupted 
  compress, decompress, encrypt or decrypt 
  long-running operation. */
  int fo_flags;
  #define FO_OWNER_MNTRW 0x1 /* Mounted in RW mode */
  #define FO_OWNER_DISABLED 0x2 /* Disabled for access */
  #define FO_OWNER_GROWFAIL 0x4 /* Grow failure since last reset */
  #define FO_OWNER_LOW_ONSPC 0x8 /* Low on space (zfs definition)*/
  #define FO_OWNER_DAMAGED 0x10 /* Aggregate is damaged by salvage 
  verification & not repaired yet */
  #define FO_OWNER_RWSHARE 0x20 /*Aggregate using zfs sysplex 
  sharing (RWSHARE) */
  #define FO_OWNER_GROWSET 0x40 /* Dynamic grow set at mount time */
  #define FO_OWNER_GROWING 0x80 /* Aggregate is in the process 
  of growing at the time of query */
  #define FO_CONVERTTOV5 0x100 /* CONVERTTOV5 parm is set on mount. */
  #define FO_NOTMOUNT 0x200 /* Aggregate is not mounted */
  #define FO_NO_OWNER 0x400 /* Aggregate is un-owned */
  #define FO_OWNER_ALLOWGROW 0x800 /* Dynamic grow allowed , no 
  grow failures or since a grow 
  failure an admin grow was done. */
  #define FO_OWNER_CHGOWNER 0x1000 /* The quiesce is done for a 
  chowner instead of a backup */
  #define FO_CONVERTTOV5_DISABLED 0x2000 /* CONVERTTOV5 is disabled 
  due to quiesce or failed convert */
  #define FO_V4 0x4000 /* Aggregate with version 1.4 */
  #define FO_V5 0x8000 /* Aggregate with version 1.5 */

  unsigned int fo_overflow; /* Num of overflow pages used for v5 directories */
  unsigned int fo_overflowhiwater; /* Hiwater mark of fo_overflow */
} FSINFO_OWNER;
unsigned int fo_thrashing;  /* Current number of objects using
   the thrash-resolution protocol*/
char reserved2[4];
unsigned long long int fo_thrash_resolution; /* Number of thrash resolutions
   performed since last
   statistics reset.*/
unsigned long long int fo_revocations; /* Number of token revocations
   performed since last
   statistics reset*/
unsigned long int fo_revwait;  /* Average revocation wait time
   in microseconds.*/
char fo_qsysname[8]; /* Name of system requesting quiesce,
   if the aggregate is quiesced,
   0 otherwise.*/
char fo_jobname[8]; /* Name of job requesting quiesce,
   if the aggregate is quiesced,
   0 otherwise.*/
unsigned long long int fo_createetime;  /* Creation time in
   seconds since epoch*/
unsigned long long int fo_ownership;   /* Owership time in
   seconds since epoch*/
unsigned long long int fo_reset;       /* Time statistic counters reset in
   seconds since last epoch*/
unsigned long long int fo_quiesce;     /* Quiesce time in seconds since
   epoch, 0 if file system
   not quiesced.*/
unsigned int fo_devno;      /* Devno for the mount*/
char fo_auditfid[10];     /* Audit fid for file system*/
unsigned short fo_qasid;    /* ASID which issued the quiesce */
char reserved3[4];
unsigned long long int fo_growtime;    /* Time of the last grow
   as known by owner */

#if FR_CURRENT_VERSION >= FR_VERSION_LONG
/* Define fields only available when fr_version >= 2 and fo_sversion >= 2. */
/* They will only have values if a long-running operation is active. */
unsigned long int fo_longtime;  /* Time that a long-running operation
   was initiated on this aggregate. */
char fo_edcFlag; /* Current state of encryption or
   compression of the file system. */
char fo_longstatus; /* Current step of the operation.
   Intended for IBM service only. */
char fo_longpct; /* Percent completion of the current
   step of the long running command.*/
char fo_salvage_type; /* 1 = verify, 2 = verify and repair*/
int fo_longtask; /* TCB of the long running task. */
#endif

typedef struct FSINFO_LOCAL_t {
  char fl_eye[4];
#define FL_EYE  "FILO"
short fl_length;
short fl_sversion; /* Structure version */
unsigned long long int fl_vnodes; /* Number of vnodes cached in memory
   on the local system */
unsigned long long int fl_ussheld; /* Number of USS held vnodes*/
char fl_sysname[8]; /* System name these stats are for */
unsigned long long int fl_open; /* Number of open objects in
   the file system */
unsigned long long int fl_tokens; /* Number of tokens held from
   the token manager */
unsigned int fl_usercache; /* Number of 4K pages held in the
   user cache for the file system */
unsigned int fl_metacache; /* Number of 8k pages held in
   the metadata cache */
unsigned long long int fl_appreads; /* Number of application reads made
   since last reset */
unsigned long long int fl_appreadresp; /* Average read response
   time in microseconds*/
unsigned long long int fl_appwrites; /* Number of application writes
   made since last reset */
unsigned long long int fl_appwriteresp; /* Average write response
   time in microseconds*/
unsigned long int fl_xcfreads; /* Number of xcf read calls made
   to the owner since last reset */
unsigned long long int fl_xcfreadresp; /* Average xcf read call response
   time in microseconds*/
unsigned long int fl_xcfwrites; /* Number of xcf write calls made to
   the server since last reset */
unsigned long long int fl_xcfwriteresp; /* Average xcf write call response
   time in microseconds*/
} FSINFO_LOCAL_t;
unsigned long long int fl_enospc;  /* Number of ENOSPC errors returned to apps since last reset */
unsigned long long int fl_ioerrs;  /* Number of disk I/O errors since last reset*/
unsigned long long int fl_commerrs; /* Number of XCF communication timeouts or failures since last reset*/
unsigned long long int fl_cancels;  /* Number of cancelled operations since last reset by asynchronous abends, cancel, forces and EOMs */
char                   fl_ddname[8];    /* DDNAME of allocation of dataset */
struct timeval64       fl_mounttime;    /* Mount time, seconds since epoch */
unsigned int           fl_numdasd;      /* Number of DASD volumes listed for aggregate in FSINFO_DASD array */
unsigned int           fl_flags;        /* 1 indicates if this system has tasks waiting on a quiesced FS.*/
}
} FSINFO_LOCAL;

type struct FSINFO_DASD_t
{
    char  fd_eye[4];
#define FSD_EYE  "FIDA"
    short fd_length;
    short fd_sversion;
#define FSD_VER_INITIAL 1
    char  fd_volser[6];
    short fd_pavios;
    unsigned long long int fd_reads;
    unsigned long long int fd_readbytes;
    unsigned long long int fd_writes;
    unsigned long long int fd_writebytes;
    unsigned long long int fd_waits;
    unsigned long long int fd_waitTime;
    unsigned long long int fd_resptime;
} FSINFO_DASD;

void check_local_error(char *buffp, FSINFO_REQUEST *fs_req, int *lerr_stat);

int main(int argc, char **argv)
{
    char*             buffp          = NULL;
    syscall_parmlist* parmp          = NULL;
    FSINFO_REQUEST*   fs_req         = NULL;
    char              owner_sys[9];
    int               buff_fill_len  = 0;
    int               fs_ownerlen    = 0;
    int               fs_locallen    = 0;
    int               unowned        = 0;
    int               fr_nonFatalRc  = 0;
    int               fr_nonFatalRsn = 0;
    int               sperr          = 0;
    int               ioerr          = 0;
    int               xcferr         = 0;
    char              busiest_volume[7];
    int               locals         = 0;

    /* aggrname for fsinfo */
    char              aggrname[ZFS_MAX_AGGRNAME+1] = "PLEX.DCEIMGQY.FS";

    /* Output structure pointers */
    FSINFO_NAME*      fs_namep      = NULL;
    FSINFO_OWNER*     fs_ownerp     = NULL;
    FSINFO_LOCAL*     fs_localp     = NULL;
    FSINFO_DASD *     fs_dasdp      = NULL;
    char*             outputp       = NULL;

    /* Allocate buffer */
    buffp = (char*) malloc(BUFFER_SIZE);
    if( buffp == NULL )
    {
        printf("Malloc Error\n");
        return 0;
    }

    /* Set the parmlist */
    parmp = (syscall_parmlist*) &buffp[0];
    parmp->opcode   = AGOP_FSINFO_PARMDATA;
parmp->parms[0] = buff_fill_len = sizeof(syscall_parmlist);
parmp->parms[1] = 0;
parmp->parms[2] = 0;
parmp->parms[3] = 0;
parmp->parms[4] = 0;
parmp->parms[5] = 0;
parmp->parms[6] = 0;

fs_req = (FSINFO_REQUEST*) &buffp[buff_fill_len];
memset( fs_req, 0x00, sizeof(FSINFO_REQUEST) );

/* First obtain the statistics for all file systems. We will look
 * through them to find the DASD volume with the most write operations. */
memcpy( fs_req->fr_eye, FR_EYE, sizeof(fs_req->fr_eye) );
fs_req->fr_length = sizeof(FSINFO_REQUEST);
fs_req->fr_sversion = 1;
fs_req->fr_version = FR_CURRENT_VERSION;
fs_req->fr_reqtype = FR_REQTYPE_NAMECURSOR;
fs_req->fr_output = FR_OUT_FULL_STAT;
fs_req->fr_nameSelection = FR_NM_ALLAGGR;

buff_fill_len += sizeof(FSINFO_REQUEST);

/* Loop getting file system information from zFS until we have it all. */
do{
    /* Call zFS. */
    printf("call zfs\n");
    BPX1PCT("ZFS ",
            ZFSCALL_FSINFO,     /* Aggregate operation */
            BUFFER_SIZE,        /* Length of Argument */
            (char*) buffp,      /* Pointer to Argument */
            &bpxrv,             /* Pointer to Return_value */
            &bpxrc,             /* Pointer to Return_code */
            &bpxrs);            /* Pointer to Reason_code */

    if( bpxrv )
    {
        printf("Error getting fsinfo for aggregate %s\n", aggrname);
        printf("Return Value: %d Return Code: %d Reason Code: %x\n",
                bpxrv, bpxrc, bpxrs);
        goto done;
    }
    if( fs_req->fr_nonFatalRc )
    {
        fr_nonFatalRc = fs_req->fr_nonFatalRc;
        fr_nonFatalRsn = fs_req->fr_nonFatalRsn;
        goto print_non_fatals;
    }

    /* The first structure pointed by output buffer is FSINFO_NAME.*/
    fs_namep = (FSINFO_NAME*) &buffp[buff_fill_len];
    for (i=0; i<fs_req->fr_entries; i++)
    {
        fs_ownerp = (FSINFO_OWNER*)((char*)fs_namep+fs_namep->fn_slength);
        locals = fs_namep->fn_connected;

        /* If file system has an owner, there will be one more */
        /* FSINFO_LOCAL structure returned than this count. */
        if (memcmp(fs_namep->fn_owner, "\0") != 0)
            locals++;

        /* Determine if there is an FSINFO_OWNER or not. */
        if (memcmp(fs_ownerp->fo_eye, FS0_EYE, 4) == 0)
        {
            /* FSINFO_OWNER returned */
            fs_localp = (FSINFO_LOCAL*)((char*)fs_ownerp+fs_ownerp->fo_length);
        }
        else if (memcmp(fs_ownerp->fo_eye, FL_EYE, 4) == 0)
        {
            /* No FSINFO_OWNER returned. It’s FSINFO_LOCAL */
            fs_localp = (FSINFO_LOCAL*)fs_ownerp;
            fs_ownerp = NULL;
        }
        else
        {
            /* Should not get here!! */
            printf("Error exit: Incorrect structure sequence!!\n");
            goto done;
        }

    /* Loop through each FSINFO_LOCAL structure returned. */
for (j=0; j<locals; j++)
{
    fs_dasdp = (FSINFO_DASD *)((char *)fs_localp + fs_localp->fl_length);
    for (k=0; k<fs_localp->fl_numdasd; k++)
    {
        /* Determine if this DASD volume has more writes than the */
        /* previously higher one. Yes, remember DASD volume name. */
        if (fs_dasdp->fd_writes > most_writes)
        {
            strncpy(busiest_volume, fs_dasdp->fd_volser, 6);
            busiest_volume[6] = 0;
            most_writes = fs_dasdp->fd_writes;
        }
        /* Set up for next iteration. */
        fs_dasdp = (FSINFO_DASD *)((char *)fs_dasdp + fs_dasdp->fd_length);
    }
    /* After looping through all FSINFO_DASD structures, fs_dasdp */
    /* should be pointing at the next FSINFO_LOCAL structure. */
    fs_localp = (FSINFO_LOCAL *)fs_dasdp;
}
/* Get ready for next loop iteration. */
fs_namep = (FSINFO_NAME *)((char *)fs_namep+fs_namep->fn_length);
}
while (!fs_req->fr_eol);
printf("DASD volume %s has the most writes (%llu)\n", busiest_volume, most_writes);
/* Now do a single aggregate query for a specific file system. */
memset( fs_req, 0x00, sizeof(FSINFO_REQUEST));
memcpy( fs_req->fr_eye, FR_EYE, sizeof(fs_req->fr_eye) );
fs_req->fr_length = sizeof(FSINFO_REQUEST);
fs_req->fr_version = 1;
fs_req->fr_output = FR_OUT_FULL_STAT;
fs_req->fr_reqtype = FR_REQTYPE_SINGLEQUERY;
memcpy( fs_req->fr_resumeName, aggrname, ZFS_MAX_AGGRNAME+1 );
BPX1PCT("ZFS     ", /* Aggregate operation */
    ZFSCALL_FSINFO,  /* Length of Argument */
    BUFFER_SIZE,    /* Pointer to Argument */
    (char*) buffp,  /* Pointer to Return_value */
    &bpxrv,         /* Pointer to Return_code */
    &bpxrc,
    /* Pointer to Reason_code */
    &bpxrs);
if( bpxrv )
{
    printf("Error getting fsinfo for aggregate %s\n", aggrname);
    printf("Return Value: %d Return Code: %d Reason Code: %x\n", bpxrv, bpxrc, bpxrs);
    goto done;
}
if( fs_req->fr_nonFatalRc )
{
    fr_nonFatalRc  = fs_req->fr_nonFatalRc;
    fr_nonFatalRsn = fs_req->fr_nonFatalRsn;
    goto print_non_fatals;
}
buff_fill_len = sizeof(syscall_parmlist) + sizeof(FSINFO_REQUEST);
outputp = buffp + buff_fill_len;
check_local_error(outputp, fs_req, &lerr_stat);
/* The first structure pointed by output buffer would be FSINFO_NAME. */
fs_namep = (FSINFO_NAME *)buffp[buff_fill_len];
fs_ownerp = (FSINFO_OWNER *)((char*) fs_namep + fs_namep->fn_slength);
memcpy(owner_sys, fs_namep->fn_owner, 8);
owner_sys[8] = '\0';
if (memcmp(owner_sys[0], "UNOWNED", 8) == 0)
{
    unowned = 1;
    if (memcmp(fs_ownerp->fo_eye, FSO_EYE, 4) == 0)
    { /* FSINFO_OWNER returned */
        fs_localp = (FSINFO_LOCAL *)((char *)fs_ownerp + fs_ownerp->fo_length);
    }
    else if (memcmp(fs_ownerp->fo_eye, FL_EYE, 4) == 0)
    { /* No FSINFO_OWNER returned. It's FSINFO_LOCAL */
fs_localp = (FSINFO_LOCAL *)fs_ownerp;
fs_ownerp = NULL;
}
} else if (fs_ownerp->fo_flags & FO_NO_OWNER)
{
  unowned = 1;
  fs_localp = (FSINFO_LOCAL*)((char *)fs_ownerp + fs_ownerp->fo_length);
} else
  fs_localp = (FSINFO_LOCAL*)((char *)fs_ownerp + fs_ownerp->fo_length);

if ((lerr_stat & FSINFO_SPC_ERR) == FSINFO_SPC_ERR)
{
  fs_localp->fl_enospc = 1;
  sperr = 1;
}
if ((lerr_stat & FSINFO_IO_ERR) == FSINFO_IO_ERR)
{
  fs_localp->fl_ioerrs = 1;
  ioerr = 1;
}
if ((lerr_stat & FSINFO_XCF_ERR) == FSINFO_XCF_ERR)
{
  fs_localp->fl_commerrs = 1;
  xcferr = 1;
}
if( unowned && !fs_ownerp )
{
  if (!xcferr && !ioerr && !sperr)
    printf("%-44.44s %-8.8s n/a \n\n",
      aggrname, "*UNOWNED");
  else
    {
      printf("%-44.44s %-8.8s %s%s%s\n\n",
         aggrname, "*UNOWNED",
         (sperr)? "SE" :",
         (ioerr)?((sperr)?",IE":"IE"):"",
         (xcferr)?((sperr || ioerr)?",CE":"CE"):"");
      /* Define the flags in a legend */
      printf("Legend: %s%s%s\n\n",
         (sperr)? "SE = Space errors reported":",
         (ioerr)?((sperr)?",IE = IO errors reported":
         "IE = IO errors reported") : "",
         (xcferr)?((sperr || ioerr)?",CE = Communication errors reported":
         "CE = Communication errors reported") : "");
    }
}
else
{
  /* Print the aggregate info with flags */
  printf("%-44.44s %-8.8s %s%s%s%s%s%s%s%s%s\n\n",
     aggrname, fs_namep->fn_owner,
     (fs_ownerp->fo_flags & FO_NOTMOUNT) ? "NM" : "",
     /* Multiple Conditions */
     (fs_ownerp->fo_flags & FO_OWNER_MNTRW) ? "RW" : ((fs_ownerp->fo_flags & FO_OWNER_RWSHARE) ? ",RS" : ""),
     /* Multiple Conditions */
     (fs_ownerp->fo_flags & FO_OWNER_DISABLED) ? ",DI" : ",",
     (fs_ownerp->fo_flags & FO_OWNER_GROWFAIL) ? ",GF" : ",
     /* Multiple Conditions */
     (fs_ownerp->fo_flags & FO_OWNER_GROWFAIL) ? ",GD" : "",
     (fs_ownerp->fo_flags & FO_OWNER_GROWFAIL) ? ",GD" : "",
     (fs_ownerp->fo_flags & FO_OWNER_GROWFAIL) ? ",GR" : "",
     (fs_ownerp->fo_flags & FO_OWNER_DISMANTLE) ? ",DA" : "",
     (sperr) ? ",SE" : "",
     (ioerr) ? (sperr)?",IE":"IE") : ",IE",
     (xcferr) ? (sperr || ioerr)?",CE":"CE") : "");
/* Define the flags in a legend */
printf("Legend: %s%s%s%s%s%s%s
", 
(fs_ownerp->fo_flags & FO_NOTMOUNT) ? "NM = Not mounted" : "",
/* Multiple Conditions */
(!fs_ownerp->fo_flags & FO_NOTMOUNT) &&
((fs_ownerp->fo_flags & FO_OWNER_MNTRW)) ? "RW = Read-write" :
((fs_ownerp->fo_flags & FO_NOTMOUNT) ? "" : "RO = Read-only"),
/* Multiple Conditions */
(!fs_ownerp->fo_flags & FO_NOTMOUNT) &&
(fs_ownerp->fo_flags & FO_OWNER_RWSHARE)) ? ",RS = Mounted RWSHARE" : 
(fs_ownerp->fo_flags & FO_OWNER_DISABLED) ? ",DI = Disabled" :
(fs_ownerp->fo_flags & FO_OWNER_GROWFAIL) ? ",GF = Grow Failed" : "",
/* Multiple Conditions */
(!fs_ownerp->fo_flags & FO_NOTMOUNT) &&
(!fs_ownerp->fo_flags & FO_OWNER_ALLOWGROW) ? ",GD = AGGRGROW disabled" : "",
(fs_ownerp->fo_flags & FO_OWNER_GROW) ? ",GR = Growing" : "",
(fs_ownerp->fo_flags & FO_OWNER_LOW_ONSPC) ? ",L = Low on space" : "",
(sperr) ? ",SE = Space errors reported":"
(fs_ownerp->fo_flags & FO_OWNER_DAMAGED) ? ",DA = Damaged" : "",
(fs_ownerp->fo_flags & FO_OWNER_DISABLED) ? ",DI = Disabled" : ",",
(xcfeerr) ? ",CE = Communication errors reported":"");
} 
go to done;

print_non_fatals:
if(fr_nonFatalRc)
{
printf("Non-Fatal errors:\n");
printf("Return Code: %d Reason Code: %x\n", 
fr_nonFatalRc, fr_nonFatalRsn);
}
done:
free(buffp);
return 0;
}

void check_local_error(char *buffptr, FSINFO_REQUEST *fs_req, int *lerr_stat)
{
FSINFO_NAME * fs_namep;
FSINFO_OWNER * fs_ownerp = NULL;
FSINFO_LOCAL * fs_local;
FSINFO_DASD  * dasdp;
int dasd_space;
int i, j;
int total_sys = 0;
int unowned = 0;
if ((*lerr_stat) == (FSINFO_XCF_ERR | FSINFO_IO_ERR | FSINFO_SPC_ERR))
{
printf("FSINFO_CheckLocalErr: all 3 bits are set in *lerr_stat=%X\n", *
lerr_stat);
return ;
}
/* The first structure pointed by output buffer would be FSINFO_NAME. */
fs_namep = ((FSINFO_NAME *)((char *)buffptr));
fs_ownerp = (FSINFO_OWNER*)((char *)fs_namep + fs_namep->fn_slength);
/* if UNOWNED, make sure we are processing the right stats. */
if (memcmp(fs_namep->fn_owner, "*UNOWNED", 8) == 0)
{
unowned = 1;
if (memcmp(fs_ownerp->fo_eye, FSO_EYE, 4) == 0)
{ /* FSINFO_OWNER block */
    fs_local = (FSINFO_LOCAL*)((char *)fs_ownerp + fs_ownerp->fo_length);
}
else if (memcmp(fs_ownerp->fo_eye, FL_EYE, 4) == 0)
{ /* FSINFO_LOCAL block */
}
fs_local = (FSINFO_LOCAL *)((char *)fs_ownerp + fs_ownerp->fo_length);
fs_ownerp = NULL;
}
else
{ /* We should not get here!! */
return;
}
}
else
fs_local = (FSINFO_LOCAL *)((char *)fs_ownerp + fs_ownerp->fo_length);
/* If FSINFO_OWNER is not returned, we have 1 less FSINFO_LOCAL to process */
if (unowned & (fs_ownerp == NULL))
total_sys = fs_namep->fn_connected;
else
total_sys = fs_namep->fn_connected+1;
for (i=0; i < total_sys; i++)
{ if (fs_local->fl_commerrs)
   (*lerr_stat) |= FSINFO_XCF_ERR;
   if (fs_local->fl_enospc)
   (*lerr_stat) |= FSINFO_SPC_ERR;
   if (fs_local->fl_ioerrs)
   (*lerr_stat) |= FSINFO_IO_ERR;
   if (*lerr_stat) == (FSINFO_XCF_ERR | FSINFO_IO_ERR | FSINFO_SPC_ERR)
   return;
   /* Find the next FSINFO_LOCAL structure, which is after any FSINFO_DASD */
   /* structures that might be present. */
   if (fs_local->fl_numdasd > 0)
   {
   dasdp = (FSINFO_DASD *)((char *)fs_local + fs_local->fl_length);
   dasd_space = fs_local->fl_numdasd * dasdp->fd_length;
   }
   else
   dasd_space = 0;
   fs_local = (FSINFO_LOCAL *)((char *)fs_local + fs_local->fl_length +
   dasd_space);
}
return;
**List File Information**

**Purpose**
Lists detailed file or directory information. This API is a `w_pioctl` (BPX1PIO) call specifying a path name rather than a `pfsctl` (BPX1PCT) call specifying a file system name.

**Format**

<table>
<thead>
<tr>
<th>PX1PIO parameter list</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathname_length</td>
<td>int</td>
</tr>
<tr>
<td>Pathname</td>
<td>char[1025]</td>
</tr>
<tr>
<td>Command</td>
<td>int</td>
</tr>
<tr>
<td>Argument_length</td>
<td>int</td>
</tr>
<tr>
<td>Argument</td>
<td>ptr to FOBJ_INFO</td>
</tr>
<tr>
<td>Return_value</td>
<td>ptr to int</td>
</tr>
<tr>
<td>Return_code</td>
<td>ptr to int</td>
</tr>
<tr>
<td>Reason_code</td>
<td>ptr to int</td>
</tr>
</tbody>
</table>

**FOBJ_TIME**
- `fo_seconds` hyper: Second since last epoch
- `fo_mircoseconds` int: Micro seconds since last epoch
- `fo_unused` int: Reserved

**FOBJ_ACLINFO**
- `fo_index` int: Location of ACL
- `fo_length` int: Length of ACL

**FOBJ_AUDIT**
- `fo_read` char: Read information
- `fo_write` char: Write information
- `fo_exec` char: Exec information
- `fo_res1` char: 1 - No auditing, 2 - Success auditing, 3 - Failure auditing

**FOBJ_SYSINFO**
- `fo_vnode` hyper: Address of zFS vnode
- `fo_vntok` hyper: Address of z/OS UNIX vnode
- `fo_openwaiters` unsigned int: Number of tasks waiting to open a file blocked by deny-mode opens
- `fo_internalopens` unsigned int: Number of internal opens
- `fo_readopens` unsigned int: Number of opens for read
- `fo_writeopens` unsigned int: Number of opens for write
- `fo_denyreads` unsigned short: Number of deny-read opens
- `fo_denywrites` unsigned short: Number of deny-write opens
- `fo_advdenyreads` unsigned short: Number of advisory deny-read opens
- `fo_advdenywrites` unsigned short: Number of advisory deny-write opens
- `fo_sysflags` char: Miscellaneous information:
  - 0x01 - file being read sequentially
  - 0x02 - file written sequentially
  - 0x04 - security information cached
  - 0x08 - file location information cached
  - 0x10 - symlink information cached
  - 0x20 - metadata updates sent to server, can not directly read without a server sync
  - 0x40 - tokens are being revoked
  - 0x80 - file is undergoing thrashing
- `fo_sysflags2` char: More miscellaneous information
- `fo_unused` char[2]: Reserved
- `fo_unscheduled` int: Number of 4K pages in user file cache that need to be written
- `fo_pending` int: Number of 4K pages being written
- `fo_segments` int: Number of 64K segments in user cache
- `fo_dirtyssegment` int: Number of segments with pages that need to be written
- `fo_metaissued` int: Number of I/Os in progress that will require a metadata update
- `fo_metapending` int: Number of queued metadata updates
- `fo_rights` int: Token rights held by object
- `fo_xmits` short: Number of XCF messages client has
<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fo_fwd</td>
<td>short</td>
<td>Number of in-progress operations for object using thrashing protocol</td>
</tr>
<tr>
<td>fo_metabuffers</td>
<td>int</td>
<td>Number of buffers in metadata cache for this object, only client systems</td>
</tr>
<tr>
<td>fo_dirtybuffers</td>
<td>int</td>
<td>Number of metadata buffers updated for object that are on server and need writing</td>
</tr>
<tr>
<td>fo_owner</td>
<td>char[9]</td>
<td>Name of owning system</td>
</tr>
<tr>
<td>fo.localsys</td>
<td>char[9]</td>
<td>Name of local system</td>
</tr>
<tr>
<td>fo_pad</td>
<td>char[2]</td>
<td>Reserved</td>
</tr>
<tr>
<td>fo.sysres</td>
<td>int[9]</td>
<td>Reserved</td>
</tr>
<tr>
<td>FOBJ_INFO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fo_eye</td>
<td>char[4]</td>
<td>&quot;FOIN&quot;</td>
</tr>
<tr>
<td>fo_len</td>
<td>short</td>
<td>Size of (FOBJ_INFO)</td>
</tr>
<tr>
<td>fo_ver</td>
<td>char</td>
<td>1                              2 for returning information introduced in z/OS V2R3</td>
</tr>
<tr>
<td>fo_inflags</td>
<td>char</td>
<td>1- Only in-memory system information is being requested.</td>
</tr>
<tr>
<td>fo_inode</td>
<td>int</td>
<td>Object inode</td>
</tr>
<tr>
<td>fo_unique</td>
<td>int</td>
<td>Object unifier</td>
</tr>
<tr>
<td>fo_length</td>
<td>hyper</td>
<td>POSIX length of object (in bytes)</td>
</tr>
<tr>
<td>fo_time</td>
<td>FOBJ_TIME</td>
<td>Last modification time</td>
</tr>
<tr>
<td>fo_atime</td>
<td>FOBJ_TIME</td>
<td>Last access time</td>
</tr>
<tr>
<td>fo_ctime</td>
<td>FOBJ_TIME</td>
<td>Last change time</td>
</tr>
<tr>
<td>fo_reftime</td>
<td>FOBJ_TIME</td>
<td>Last reference time</td>
</tr>
<tr>
<td>fo_create</td>
<td>FOBJ_TIME</td>
<td>Create time</td>
</tr>
<tr>
<td>fo_allocation</td>
<td>char</td>
<td>How object stored on disk:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 - Object is stored inline</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 - Object is stored fragmented</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 - Object is stored blocked</td>
</tr>
<tr>
<td>fo_owner_perms</td>
<td>char</td>
<td>Permissions for owner of file:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x01 - Execute permission</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02 - Write permission</td>
</tr>
<tr>
<td>fo_group_perms</td>
<td>char</td>
<td>Permissions for the group: access to the file:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x01 - Execute permission</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02 - Write permission</td>
</tr>
<tr>
<td>fo_other_perms</td>
<td>char</td>
<td>Permissions of other users of file:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x01 - Execute permission</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02 - Write permission</td>
</tr>
<tr>
<td>fo_allocated</td>
<td>unsigned int</td>
<td>Number of allocated bytes</td>
</tr>
<tr>
<td>fo_locinfo</td>
<td>union</td>
<td>Location of object's data</td>
</tr>
<tr>
<td>fo_direct</td>
<td>unsigned int[8]</td>
<td>Location of first 8 logical blocks</td>
</tr>
<tr>
<td>fo_indirect</td>
<td>unsigned int[4]</td>
<td>Location of indirect tree roots</td>
</tr>
<tr>
<td>fo_block</td>
<td>unsigned int</td>
<td>Block with object's data</td>
</tr>
<tr>
<td>fo_start</td>
<td>unsigned short</td>
<td>Starting fragment in block</td>
</tr>
<tr>
<td>fo_len</td>
<td>unsigned short</td>
<td>Number of fragments</td>
</tr>
<tr>
<td>fo_uid</td>
<td>int</td>
<td>UID of owner</td>
</tr>
<tr>
<td>fo_gid</td>
<td>int</td>
<td>GID of owner</td>
</tr>
<tr>
<td>fo_access</td>
<td>FOBJ_ACLINFO</td>
<td>Access acl</td>
</tr>
<tr>
<td>fo_dmodel</td>
<td>FOBJ_ACLINFO</td>
<td>Directory model acl</td>
</tr>
<tr>
<td>fo_fmodel</td>
<td>FOBJ_ACLINFO</td>
<td>File model acl</td>
</tr>
<tr>
<td>fo_user</td>
<td>FOBJ_AUDIT</td>
<td>User audit information</td>
</tr>
<tr>
<td>fo_auditor</td>
<td>FOBJ_AUDIT</td>
<td>Auditor audit information</td>
</tr>
<tr>
<td>fo_permbits</td>
<td>char</td>
<td>Sticky bit and other bits:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x01 - setgid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02 - setuid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x04 - Sticky bit on</td>
</tr>
<tr>
<td>&lt;some bits&gt;</td>
<td>int</td>
<td>Miscellaneous bits in an integer</td>
</tr>
<tr>
<td>fo_txtflag</td>
<td>bit 0</td>
<td>Context are pure text</td>
</tr>
<tr>
<td>fo_deferflag</td>
<td>bit 1</td>
<td>Defer tag set until first write</td>
</tr>
<tr>
<td>fo_filefmt</td>
<td>bits 2-7</td>
<td>File format attribute:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0=NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1=BIN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2=NL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3=CR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4=LF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5=CRLF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6=LFCR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7=CRNL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8=REC</td>
</tr>
<tr>
<td>fo_cccsid</td>
<td>bits 8-31</td>
<td>Reserved</td>
</tr>
<tr>
<td>fo_seclabel</td>
<td>char[8]</td>
<td>Hex CCSID</td>
</tr>
<tr>
<td>fo_entrycount</td>
<td>unsigned int</td>
<td>If object a directory, the number</td>
</tr>
</tbody>
</table>
List File Information

- **fo_linkcount**: unsigned int - POSIX linkcount for object
- **fo_dataversion**: unsigned int - Data version for directory updates
- **fo_genvalue**: unsigned int - USS attribute flags of object
- **fo_cver**: char[8] - Creation verifier
- **fo_majorminor**: char[8] - If object a character special file, major/minor number.
- **fo_type**: char - Object type:
  - 0x01 - directory
  - 0x02 - regular file
  - 0x03 - symlink
  - 0x04 - FIFO
  - 0x05 - character special file
- **fo_flags**: char - Additional object flags:
  - 0x01 - object is a v5 directory
  - 0x02 - v5 directory tree structure is broken
  - 0x04 - automatic conversion to v5 failed
- **fo_offset**: short - Offset of anode
- **fo_anodeblock**: unsigned int - Physical block that contains anode
- **fo_status_level**: char - Directory status byte
  - 0x80 - directory is v5
  - 0x8F - max depth of v5 tree
- **fo_res**: char[3] - Reserved
- **fo_res3**: int[3] - Reserved
- **fo_CEprogress**: unsigned int - Next block to process for a blocked file that is undergoing encryption or decryption.
- **fo_compBlocks**: unsigned int - Number of 8k blocks that were saved based on compression of file data.
- **fo_CEFlag**: char - Encryption and compression indicator flags:
  - 0x03 - Encryption bits in fo_CEFlag
  - 0x00 - Not-encrypted
  - 0x01 - Decrypting
  - 0x02 - Encrypting
  - 0x03 - Encrypted
  - 0x0C - Compression bits in fo_CEFlag
  - 0x00 - Not-compressed
  - 0x04 - Decompressing
  - 0x08 - Compressing
  - 0x0C - Compressed
- **fo_res4**: char[3] - Reserved
- **fo_res5**: int[8] - Reserved
- **fo_info**: FOBJ_SYSINFO - System based transient information

Return value 0 if request is successful, -1 if it is not successful

Return code
- EBUSY - Aggregate containing file system is quiesced
- EINVAL - Invalid parameter list
- EMVSERR - Internal error using an osi service
- ENOENT - No such file or directory exists

Reason code
- 0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes
1. The aggregate must be mounted or attached.
2. If you set fo_inflags to 1, only local data is retrieved. If you set fo_inflags to 0, both global and local data are retrieved.
3. Reserved fields and undefined flags must be set to binary zeros.

Privilege required
The issuer must have lookup authority (x) to the directory and READ authority (r) to the file.

Related services
List Aggregate Status (Version 2)
Restrictions

None.

Examples

```
#pragma linkage(BPX1GCW, OS)
#pragma linkage(BPX1PIO, OS)
#pragma LANGLVL(EXTENDED)
extern void BPX1GCW(int, char *, int *, int *, int *, int *);
extern void BPX1PIO(int, char *, int, int, void *, int *, int *, int *);
#include <stdio.h>
#include <time.h>
#define ZFSIOCTL_FILEINFO 0x0000A901    /* zFS ioctl command to        */
/* return detailed fileinfo */
/* for a zFS file or directory */
#define hiszero(a) ((a).low == 0 && (a).high == 0)
#define hcmp(a,b)  ((a).high<(b).high? -1 : ((a).high > (b).high? 1 :    
#define u_int unsigned int
#define uint16_t unsigned short
typedef struct hyper {                  /* This is a 64 bit integer to zFS */
    unsigned int  high;
    unsigned int  low;
} hyper;
/******************************************************************************/
/* The FOBJ_INFO structure is used to contain the output of the fileinfo */
/* ioctl query to provide detailed information for a singular object in a */
/* zFS file system. */
/******************************************************************************/
typedef struct FOBJ_ACLINFO_t {
    int           fo_index;             /* Index into the anode table of */
    /* the location of the ACL */
    int           fo_length;            /* Length of the ACL */
} FOBJ_ACLINFO;

typedef struct FOBJ_AUDIT_t {
    char          fo_read;              /* read auditing information */
    char          fo_write;             /* write auditing information */
    char          fo_exec;              /* exec auditing information */
    char          fo_res1;              /* unused */
#define FO_NONE 0                       /* no auditing */
#define FO_SUCC 1                       /* success auditing */
#define FO_FAIL 2                       /* fail auditing */
} FOBJ_AUDIT;

typedef struct FOBJ_TIME_t {
    hyper         fo_seconds;           /* number of seconds since epoch */
    int           fo_microseconds;      /* number of microseconds since epoch*/
    int           fo_tres1;             /* unused */
} FOBJ_TIME;

typedef struct FOBJ_SYSINFO_t {         /* HEX displacement into FOBJ_INFO */
    hyper         fo_vnode;         /* 138 - Address of vnode in zFS */
    hyper         fo_vntok;         /* 140 - Address of USS vnode in */
    unsigned int  fo_openwaiters;   /* 148 - Number of tasks waiting to open */
    unsigned int  fo_internalopens; /* 14C - Number of internal */
    unsigned int  fo_readopens;     /* 150 - Number of opens for */
    unsigned int  fo_writeopens;    /* 154 - Number of write opens */
    unsigned short fo_denyreads;    /* 158 - Number of deny-read opens */
    unsigned short fo_denywrites;   /* 15A - Number of deny-write opens */
    unsigned short fo_advdenyreads; /* 15C - Number of adv. deny read opens */
    unsigned short fo_advdenywrites; /* 15E - Number of adv. deny write opens */
    char          fo_sysflags;      /* 160 - Misc. information */
```
#define FO_SEQREAD 1                /* Object is a file that zFS determined
    is being read sequentially */
#define FO_SEQWRITE 2               /* Object is a file that zFS is
    being written sequentially */
#define FO_FSPVALID 4               /* System has security information
    cached for anode */
#define FO_ANODEVALID 8             /* System has posix attribute and
    disk location information cached */
#define FO_SYMLINKVALID 16          /* Client has sent metadata updates to the
    server, and cannot directly read without
    a server sync */
#define FO_REVOKE 64                /* Revoke in progress */
#define FO_THRASH 128               /* Object is considered sysplex-thrashing
    and thrash resolution is in
    effect for file */
#define FO_OWNER 1                  /* This system is the owner of
    the file system */
#define FO_BACKUP 2                 /* There is an incremental backup in */
#define FO_SYSINFO_ONLY 1          /* Only the in-memory system information
    is being requested */
#define FO_INLINE 1                /* Object is stored inline */
#define FO_FRAGMENTED 2            /* Object is stored fragmented */
#define FO_BLOCKED 3               /* Object is stored in the blocked
    list */
#define FO_OWNER 1                  /* This system is the owner of
    the file system */
#define FO_BACKUP 2                 /* There is an incremental backup in */
#define FO_SYSRES_NUM 9

typedef struct fobj_info_t {        /* HEX displacement into FOBJ_INFO */
    char fo_eye[4];        /* 000 - Eye catcher */
    char fo_len;           /* 004 - Length of this structure */
    char fo_ver;           /* 006 - Version */
    char fo_inflags;      /* 007 - Input flag bits indicating
    requested function */
    char fo_sysflags2;     /* 161 - Misc. information 2 */
    char fo_unused[2];     /* 162 - reserved */
    int fo_unscheduled;   /* 164 - Number of dirty 4K pages in the
    user file cache that have not yet been
    written to disk */
    int fo_segments;       /* 16C - Number of 64K segment structures
    in the user file cache for the file */
    int fo_dirtysegments; /* 170 - Number of 64K segment structures
    that have dirty pages in the
    user file cache */
    int fo_metaissued;     /* 174 - Number of in-progress IOs to disk
    that will require a metadata
    update to reflect new data in the file*/
    int fo_metapending;    /* 178 - Number of queued metadata updates
    for file, for IOs completed to new data
    for the file */
    short fo_rights;       /* 17C - Token rights held for object */
    short fo_xmits;        /* 180 - Number of in-progress
    transmissions from client to
    server for this file */
    int fo_fwd;            /* 182 - Number of in-progress forwarded
    operations due to thrashing object */
    int fo_metabuffers;    /* 184 - Number of buffers for file in the
    metadata cache - client only */
    int fo_dirtybuffers;   /* 188 - Number of dirty metadata buffers
    in the metadata cache for
    object - server only */
    char fo_owner[9];      /* 18C - the name of the owner */
    char fo_localsys[9];   /* 195 - the name of the local system */
    short fo_backpct;      /* 19F - The percentage complete of an */
    int fo_sysres[FO_SYSRES_NUM]; /* 1A0 - Reserved for future use */
} FOBJSYSINFO;
List File Information

The code snippet provided is a C code fragment that defines various fields and structures for a file object in a file system. The fields and structures are as follows:

- `fo_owner_perms`: Permissions for the owner of this file
- `fo_group_perms`: Permissions for the group associated with this file
- `fo_other_perms`: Permissions for other objects
- `fo_allocated`: Number of allocated bytes to object, including internal control structures, in kilobyte units
- `fo_locinfo`: Location of objects data
- `fo_block`: Block that contains the object data
- `fo_start`: Start fragment in the block
- `fo_len`: Number of fragments in the block
- `fo_uid`: UID of the owner of object
- `fo_gid`: Group id of owner of object
- `fo_access`: ACL information for access
- `fo_dmodel`: ACL information for directory model acl
- `fo_fmodel`: ACL information for file model acl
- `fo_user`: User auditing information
- `fo_auditor`: Auditor auditing information
- `fo_permbits`: Sticky and other bits
- `fo_txtflag`: Contents are pure text indicator
- `fo_defertag`: Defer tag set until first write
- `fo_filefmt`: File format attribute
- `fo_ccsid`: Hex ccсид
- `fo_seclabel`: Seclabel of the object
- `fo_entrycount`: Number of names in the directory, if this is a directory
- `fo_linkcount`: Posix linkcount for object
- `fo_dataversion`: Data version for directory updates
- `fo_genvalue`: USS attribute flags of object
- `fo_cver`: Creation verifier
- `fo_majorminor`: Major/minor number if object is a char special file
- `fo_type`: Object type
- `fo_flags`: Additional flag bits of object
- `fo_offset`: Offset into the physical block that contains the anode for object

The code snippet also defines several macros and constants for permissions and flags:

- `FO_READ`, `FO_WRITE`, `FO_EXEC` for read, write, and execute permissions, respectively.
- `FO_OWNER_PERMS`, `FO_GROUP_PERMS`, `FO_OTHER_PERMS` for owner, group, and other permissions, respectively.
- `FO_UNALLOCATED` constant for an unallocated block.
- `FO_DIR`, `FO_FILE`, `FO_LINK`, `FO_FIFO`, `FO_CHARSPEC` for directory, regular file, symlink, fifo, and char special file, respectively.

These structures and fields are used to represent and manipulate file information in the zFS file system. The code is part of the application programming interface information for the zFS file system.
unsigned int fo_anodeblock; /* 0F8 - Physical block in aggregate that contains the anode */
char fo_statuslevel; /* 0FC - directory status byte */
char fo_res[3]; /* 0FD - reserved */
int fo_res3[3]; /* 100 - For future use */
unsigned int fo_CEprogress; /* 10C - Next logical block to process for encrypt/decrypt/compress/decompress */
unsigned int fo_compBlocks; /* 110 - Number of 8K blocks saved based on compressions of file data */
char fo_CEFlag; /* 114 - Encrypt/compress indicator flags */
#define FOBJ_ENC_BITS 0x03
#define FOBJ_NOT_ENC 0x00
#define FOBJ_DECRYPTING 0x01
#define FOBJ_ENCRYPTING 0x02
#define FOBJ_ENCRYPTED 0x03
#define FOBJ_COMP_BITS 0x0C
#define FOBJ_NOT_COMP 0x00
#define FOBJ_DECOMPRESSING 0x04
#define FOBJ_COMPRESSING 0x08
#define FOBJ_COMPRESSED 0x0C
char fo_res4[3]; /* 115 - For future use */
int fo_res5[8]; /* 118 - For future use */
FOBJ_SYSINFO fo_info; /* 138 - System based transient information */
} FOBJ_INFO;
/* 1C4 total length */

int main(int argc, char **argv)
{
  int bpxrv;
  int bpxrc;
  int bpxrs;
  char parm_pathname[1024];
  char pathname[1024];
  char *pathp = NULL;
  FOBJ_INFO fobj;
  FOBJ_INFO *fo = &fobj;
  void *arg = (void *)fo;
  int arglen = sizeof(fobj);
  char buffer1[80];
  char buffer2[80];
  hyper bogusSignedTime;
  char *p;
  char *timep;
  char time1_string[30];
  char time2_string[30];
  char seclabel[9];
  char temp;

  if (argc < 2)
  {
    printf("Please specify a file or directory path name as a parameter\n");
    exit(1);
  }

  strncpy(parm_pathname, argv[1], sizeof(pathname));
  if (parm_pathname[0] == '/') /* if absolute pathname */
    pathp = parm_pathname; /* put ptr to pathname in pathp */
  else
  {
    /* if relative pathname */
    pathname[0] = 0;
    bpxrc = 0;
    bpxrv = 0;
    bpxrs = 0;

    /* get current working directory path */
    BPX1GCW(sizeof(pathname), pathname, &bpxrv, &bpxrc, &bpxrs);
    if (bpxrv == -1)
    {
      printf("BPX1GCW call failed rc %u rsn %8.8X\n", bpxrc, bpxrs);
      return bpxrc;
    }
    if ((strlen(pathname) + strlen(parm_pathname) + 1) > sizeof(pathname))
    {
      /* if name longer than maximum pathname */
      printf("directory path name too long - input name len ",
             strlen(pathname), strlen(parm_pathname), sizeof(pathname));
      return 121; /* EINVAL */
    }

    /* take the current working directory and append slash */

    printf("Please specify a file or directory path name as a parameter\n");
    exit(1);
  }
strcat(pathname, "/");
/* then append the input relative path name */
strcat(pathname, parm_pathname);
/* put ptr to result in pathp */
pathp = pathname;
}
bpxrc = 0;
bpxrv = 0;
bpxrs = 0;
memset((char *)&fobj, 0x00, sizeof(fobj));
memcpy(&fobj.fo_eye, FO_EYE, 4);
fobj.fo_len = sizeof(fobj);
fo->fo_ver = FO_VER_INITIAL;
BPXIPIDO(strlen(pathp), pathp, ZFSIOCTL_FILEINFO,
arglen, arg, &bpxrv, &bpxrc, &bpxrs);
if (bpxrv < 0)
{
    printf("Error getting fileinfo for pathname %s\n", pathp);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
{
    /* Return from fileinfo was successful */
    printf(" Object path: %s\n", pathp);
    printf(" Inode is %lu\n", fo->fo_inode);
    printf(" Length is %llu\n", fo->fo_length);
    /* Some common object information */
    printf(" Object type is %s\n",
        fo->fo_type == FO_DIR ? "DIR":
        fo->fo_type == FO_FILE ? "FILE":
        fo->fo_type == FO_LINK ? "LINK":
        fo->fo_type == FO_CHARSPEC ? "CHARSPEC" : "??");
    /* Some directory object information */
    if (fo->fo_type == FO_DIR)
        printf(" Directory version %u\n",
            fo->fo_flags & FO_VER5 ? 5 : 4);
    printf("\n");
    return 0;
}
Purpose

Returns the names of the file systems contained in a specified aggregate on this system; the aggregate must be attached.

IBM recommends that you should use the List Detailed File System Information API instead of List Aggregate Status or List File System Status.

Format

```plaintext
syscall_parmlist
  opcode             int               138       AGOP_LISTFSNAMES_PARMDATA
  parms[0]          int               offset to AGGR_ID
  parms[1]          int               buffer length or 0
  parms[2]          int               offset to buffer or 0
  parms[3]          int               offset to size
  parms[4]          int               0
  parms[5]          int               0
  parms[6]          0

AGGR_ID
  aid_eye           char[4]           "AGID"
  aid_len           char              sizeof(AGGR_ID)
  aid_ver           char              1
  aid_name          char[45]          "OMVS.PRIV.AGGR001.LDS0001"
  aid_reserved      char[33]          0

FS_ID[n]
  fsid_eye          char[4]           "FSID"
  fsid_len          char              sizeof(FS_ID)
  fsid_ver          char              1
  fsid_res1         char              0
  fsid_res2         char              0
  fsid_id
    high            unsigned int
    low             unsigned int
  fsid_aggrname     char[45]
  fsid_name         char[45]
  fsid_reserved     char[32]
  fsid_reserved2    char[2]
  size              int

Return_value       0 if request is successful, -1 if it is not successful

Return_code
  EINVAL           Invalid parameter list
  EMVSERR          Internal error using an osi service
  ENOENT           Aggregate is not attached
  E2BIG            List is too big for buffer supplied

Reason_code
  0xEFnnxxxx       See z/OS Distributed File Service Messages and Codes
```

Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.

Privilege required

None.

Related services

List Attached Aggregate Names
List Detailed File System Information
List File System Status
Restrictions
None.

Examples

```c
#include <stdio.h>

#define ZFSCALL_AGGR 0x40000005
#define AGOP_LISTFSNAMES_PARMDATA 138
#define E2BIG 145

typedef struct syscall_parmlist_t {
  int opcode;       /* Operation code to perform */
  int parms[7];     /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44
#define ZFS_MAX_FSYSNAME 44

typedef struct aggr_id_t {
  char aid_eye[4];                   /* Eye Catcher */
  char aid_len;                      /* Length of this structure */
  char aid_ver;                      /* Version */
  char aid_name[ZFS_MAX_AGGRNAME+1]; /* aggr name, null terminated */
  char aid_reserved[33];             /* Reserved for the future */
} AGGR_ID;

typedef struct hyper {
  /* This is a 64 bit integer to zFS */
  unsigned int high;
  unsigned int low;
} hyper;

typedef struct fs_id_t {
  char fsid_eye[4];                  /* Eye catcher */
  char fsid_len;                     /* Length of this structure */
  char fsid_ver;                     /* Version */
  char fsid_res1;                    /* Reserved. */
  char fsid_res2;                    /* Reserved. */
  hyper fsid_id;                     /* Internal identifier */
  char fsid_aggrname[ZFS_MAX_AGGRNAME+1]; /*Aggregate name,can be NULL string*/
  char fsid_name[ZFS_MAX_FSYSNAME+1]; /* Name, null terminated */
  char fsid_reserved[32];            /* Reserved for the future */
  char fsid_reserved2[2];            /* Reserved for the future */
} FS_ID;

struct parmstruct {
  syscall_parmlist myparms;
  AGGR_ID          aggr_id;
  /* Real malloc'd structure will have an array of FS_IDs here */
  int              size;
};

int main(int argc, char **argv)
{
  int               bpxrv;
  int               bpxrc;
  int               bpxrs;
  struct parmstruct *myp         = &myparmstruct;
  int               fsSize       = sizeof(FS_ID);
  int               buflen       = sizeof(FS_ID);
  struct parmstruct *mpyp         = &myparmstruct;
  int               mypsize;
  int               count_fs;
  int               total_fs;
```
char aggrname[45] = "PLEX.DCEIMGQX.FS";

/* Ensure reserved fields are 0 */
memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID));
memcpy(&myparmstruct.aggr_id.aid_eye, AID_EYE, 4);
myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
strcpy(myparmstruct.aggr_id.aid_name, aggrname);

myparmstruct.myparms.opcode = AGOP_LISTFSNAMES_PARMDATA;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = 0;
myparmstruct.myparms.parms[2] = 0;
myparmstruct.myparms.parms[3] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;

BPX1PCT("ZFS     ",
ZFSCALL_AGGR,       /* Aggregate operation */
sizeof(myparmstruct), /* Length of Argument */
(char *)&myparmstruct, /* Pointer to Argument */
&bpxrv, /* Pointer to Return_value */
&bpxrc, /* Pointer to Return_code */
&bpxrs); /* Pointer to Reason_code */

if (bpxrv < 0)
{
    if (bpxrc == E2BIG)
    {
        buflen = myp->size; /* Get buffer size needed */
        mypsize = buflen +
                   sizeof(syscall_parmlist) +
                   sizeof(AGGR_ID) +
                   sizeof(int);

        myp = (struct parmstruct *)malloc((int)mypsise);
        memset(myp, 0, mypsize);
        memcpy(myp->aggr_id.aid_eye, AID_EYE, 4);
        myp->aggr_id.aid_len = sizeof(AGGR_ID);
        myp->aggr_id.aid_ver = AID_VER_INITIAL;
        strcpy(myp->aggr_id.aid_name, aggrname);

        myp->myparms.opcode = AGOP_LISTFSNAMES_PARMDATA;
        myp->myparms.parms[0] = sizeof(syscall_parmlist);
        myp->myparms.parms[1] = buflen;
        myp->myparms.parms[2] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
        myp->myparms.parms[3] = sizeof(syscall_parmlist) +
                                sizeof(AGGR_ID) +
                                buflen;
        myp->myparms.parms[4] = 0;
        myp->myparms.parms[5] = 0;
        myp->myparms.parms[6] = 0;

        BPX1PCT("ZFS     ",
                 ZFSCALL_AGGR, /* Aggregate operation */
                 mypsize, /* Length of Argument */
                 (char *)myp, /* Pointer to Argument */
                 &bpxrv, /* Pointer to Return_value */
                 &bpxrc, /* Pointer to Return_code */
                 &bpxrs); /* Pointer to Reason_code */

    if (bpxrv == 0)
    {
        total_fs = buflen / fsSize;
        printf("total file systems = %d\n", total_fs);
        count_fs = 1;
        for (fsPtr = (FS_ID *) & (myp->size);
             count_fs <= total_fs;
             fsPtr++, count_fs++)
            printf("%-64.64s\n", fsPtr->fsid_name);

        free(myp);
    }
    else
    {
        /* lsaggr names failed with large enough buffer */
        printf("Error on ls fs with large enough buffer\n");
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        free(myp);
        return bpxrc;
    }
}
else
    { /* error was not E2BIG */
        printf("Error on ls fs trying to get required size\n");
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        free(myp);
        return bpxrc;
    }
}
else
    { /* asking for buffer size gave rv = 0; maybe there are no file systems */
        if (myparmstruct.size == 0)
            printf("No file systems\n");
        else /* No, there was some other problem with getting the size needed */
            printf("Error getting size required\n");
    }
return 0;
}
Purpose

An aggregate operation that returns the names of the zFS file systems that are contained in a specified aggregate on this system and their corresponding z/OS UNIX file system names (if they are mounted). The specified aggregate must be attached.

IBM recommends using the List Detailed File System Information API instead of List Aggregate Status or List File System Status.

Format

syscall_parmlist
  opcode       int    144     AGOP_LISTFSNAMES_PARMDATA2
  parms[0]     int    offset to AGGR_ID
  parms[1]     int    buffer length or 0
  parms[2]     int    offset to buffer or 0
  parms[3]     int    offset to size
  parms[4]     int    0
  parms[5]     int    0
  parms[6]     int    0
AGGR_ID
  aid_eye      char[4]   "AGID"
  aid_len      char      sizeof(AGGR_ID)
  aid_ver      char      1
  aid_name     char[45]  "OMVS.PRV.AGGR001.LDS0001"
  aid_reserved char[33]  0
FS_ID2[n]
  fsid_eye     char[4]   "FSID"
  fsid_len     char      sizeof(FS_ID2)
  fsid_ver     char      2
  fsid_res1    char      0
  fsid_res2    char      0
  fsid_id
    high       unsigned int
    low        unsigned int
  fsid_aggrname char[45]
  fsid_name    char[45]
  fsid_mtname  char[45]
  fsid_reserved char[49]
  size         int

Return_value  0 if request is successful, -1 if it is not successful

Return_code
  EINTR        ZFS is shutting down
  EINVAL       Invalid parameter list
  EMVSERR      Internal error using an osi service
  ENOENT       Aggregate is not attached
  E2BIG        List is too big for buffer supplied

Reason_code
  0xEFnnxxxx   See z/OS Distributed File Service Messages and Codes

Usage notes

1. The version 2 List File System Names returns an array of FS_ID2s.
2. Reserved fields and undefined flags must be set to binary zeros.

Privilege required

None.

Related services

List Attached Aggregate Names
List Detailed File System Information
List File System Status

Restrictions

When FS_ID2 is used, if you specify the z/OS UNIX file system name (fsid_mtnname), you cannot specify the zFS file system name (fsid_name) nor the aggregate name (fsid_aggrname).

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_LISTFSNAMES_PARMDATA2 144
#define ZFS_MAX_AGGRNAME 44
#define ZFS_MAX_FSYSNAME 44

typedef struct syscall_parmlist_t {
  int opcode;         /* Operation code to perform */
  int *parms[7];       /* Specific to type of operation, */
                     /* provides access to the parms */
                     /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44
#define ZFS_MAX_FSYSNAME 44

typedef struct aggr_id_t {
  char aid_eye[4];                     /* Eye Catcher */
  char *AID_EYE "AGID"
  char aid_len;                        /* Length of this structure */
  char aid_ver;                        /* Version */
  char aid_name[ZFS_MAX_AGGRNAME+1];   /* aggr name,null terminated */
  char aid_reserved[33];               /* Reserved for the future */
} AGGR_ID;

typedef struct hyper {
  /* 64 bit integer to zFS */
  unsigned int high;
  unsigned int low;
} hyper;

typedef struct fs_id2_t {
  char fsid_eye[4];                    /* Eye catcher */
  char *FSID_EYE "FSID"
  char fsid_len;                       /* Length of this structure */
  char fsid_ver;                       /* Version */
  char fsid_res1;                      /* Reserved. */
  hyper fsid_id;                       /* Internal identifier */
  char *FSID_VER_2 2
  char fsid_aggrname[ZFS_MAX_AGGRNAME+1]; /* Aggregate name, */
  char *fsid_name[ZFS_MAX_FSYSNAME+1]; /* Name, null terminated */
  char fsid_mtnname[ZFS_MAX_FSYSNAME+1]; /* Mount name, */
                     /* null terminated */
  char fsid_reserved[49];              /* Reserved for the future */
} FS_ID2;

typedef struct parmstruct {
  syscall_parmlist myparms;
  AGGR_ID aggr_id;
  struct parmstruct { /* Real malloc'd structure will have an array of FS_ID2s here */
    int size;
  };
};

int main(int argc, char **argv) {
  int buffer_success = 0;
  int bpxrv;
```
int bpxrc;
int bpxrs;

struct parmstruct myparmstruct;
AGGR_ID *aggPtr;
FS_ID2 *fsPtr;
int fsSize = sizeof(FS_ID2);
int buflen = sizeof(FS_ID2);
struct parmstruct *myp = &myparmstruct;
int mypsize;
int count_fs, total_fs;

char aggrname[45] = "PLEX.DCEIMGQX.FS";
int *p;

memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID)); /* Ensure reserved */
/* fields are 0 */
memcpy(&myparmstruct.aggr_id.aid_eye, AID_EYE, 4);
myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
strcpy(myparmstruct.aggr_id.aid_name, aggrname);
myparmstruct.myparms.opcode = AGOP_LISTFSNAMES_PARMDATA2;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = 0;
myparmstruct.myparms.parms[2] = 0;
myparmstruct.myparms.parms[3] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;

BPX1PCT("ZFS
      ZFSCALL_AGGR,    /* Aggregate operation */
      sizeof(myparmstruct), /* Length of Argument */
      (char *)&myparmstruct, /* Pointer to Argument */
      &bpxrv,   /* Pointer to Return_value */
      &bpxrc,   /* Pointer to Return_code */
      &bpxrs); /* Pointer to Reason_code */

for(t = 0; t < 1000 && buffer_success == 0; t++)
{
  if (bpxrv < 0)
  {
    if (bpxrc == E2BIG)
    {
      buflen = myp->size; /* Get buffer size needed */
      mypsize = buflen +
      sizeof(syscall_parmlist) +
      sizeof(AGGR_ID) +
      sizeof(myparmstruct.size);

      free(myp);
      myp = (struct parmstruct *)malloc((int)mypszie);
      memset(myp, 0, mypsize);
      memcpy(myp->aggr_id.aid_eye, AID_EYE, 4);
      myp->aggr_id.aid_len = sizeof(AGGR_ID);
      myp->aggr_id.aid_ver = AID_VER_INITIAL;
      strcpy(myp->aggr_id.aid_name, aggrname);

      myp->myparms.opcode = AGOP_LISTFSNAMES_PARMDATA2;
      myp->myparms.parms[0] = sizeof(syscall_parmlist);
      myp->myparms.parms[1] = buflen;
      myp->myparms.parms[2] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
      myp->myparms.parms[3] = sizeof(syscall_parmlist) +
      sizeof(AGGR_ID) + buflen;
      myp->myparms.parms[4] = 0;
      myp->myparms.parms[5] = 0;
      myp->myparms.parms[6] = 0;

      BPX1PCT("ZFS
            ZFSCALL_AGGR,    /* Aggregate operation */
            mypsize,        /* Length of Argument */
            (char *)myp,    /* Pointer to Argument */
            &bpxrv,         /* Pointer to Return_value */
            &bpxrc,         /* Pointer to Return_code */
            &bpxrs);        /* Pointer to Reason_code */

      if( bpxrv != 0 && bpxrc == E2BIG )
        printf("E2BIG: %d times total\n", t++);
      else if( bpxrv == 0 )
        
      


List File System Names (Version 2)
buffer_success = 1;
total_fs = buflen / fsSize;
printf("total file systems = %d in aggregate %s\n", 
total_fs, aggrname);
count_fs = 1;
for (fsPtr = (FS_ID2*) & (myp->size);
     count_fs <= total_fs;
     fsPtr++, count_fs++)
{
    printf("\n");
    printf("zFS  file system name: [\%s]\n", fsPtr->fsid_name);
    printf("UNIX file system name: [\%s]\n", fsPtr->fsid_mtnname);
}
free(myp);
}
else
{   /* lsaggr names failed with large enough buffer */
    printf("Error on ls fs with large enough buffer\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
}
else
{   /* error was not E2BIG */
    printf("Error on ls fs trying to get required size\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
}
else
{   /* asking for buffer size gave rv = 0; maybe there are no file systems */
    if (myparmstruct.size == 0)
        printf("No file systems\n");
    else /* No, there was some other problem with getting the size needed */
        printf("Error getting size required\n");
    free(myp);
    return bpxrc;
}
}
if( t == 1000 )
    printf("Number of failed buffer resizes exceeded.\n");
free(myp);
return 0;
List File System Status

Purpose
List file system status information. As input, use an FS_ID or an FS_ID2, which specifies the z/OS UNIX file system name (the mount name). For an FS_ID2, the file system must be mounted using that z/OS UNIX file system name. The aggregate that contains the file system must be attached and the aggregate cannot be quiesced.

IBM recommends that you should use the List Detailed File System Information API instead of List Aggregate Status or List File System Status.

Format
```
syscall_parmlist
  opcode        int     142    FSOP_GETSTAT_PARMDATA
  parms[0]      int     Offset to FS_ID
  parms[1]      int     Offset to FS_STATUS
  parms[2]      int     0
  parms[3]      int     0
  parms[4]      int     0
  parms[5]      int     0
  parms[6]      int     0

FS_ID or FS_ID2
  fsid_eye      char[4] "FSID"
  fsid_len      char sizeof(FS_ID)
  fsid_ver      char 1
  fsid_res1     char Reserved
  fsid_res2     char Reserved
  fsid_aggrname char[45] Aggregate name
  fsid_name     char[45] File system name
  fsid_reserved char[32] Reserved
  fsid_reserved2 char[2] Reserved

FS_ID2 or FS_ID
  fsid_eye      char[4] "FSID"
  fsid_len      char sizeof(FS_ID2)
  fsid_ver      char 2
  fsid_res1     char Reserved
  fsid_res2     char Reserved
  fsid_id       high unsigned int High portion of generated ID
  low unsigned int Low portion of generated ID
  fsid_aggrname char[45] Aggregate name
  fsid_name     char[45] File system name
  fsid_mntname  char[45] Name used when mounted
  fsid_reserved char[49] Reserved

FS_STATUS
  fs_eye        char[4] "FSST"
  fs_len        short sizeof(FS_STATUS)
  fs_ver        char 1
  fs_res1       char Reserved
  fs_id         high unsigned int High portion of generated ID
  low unsigned int Low portion of generated ID
  fs_cloneTime  timeval Time file system cloned
  fs_createTime timeval Time file system created
  fs_updateTime timeval Time of last update
  fs_accessTime timeval Time of last access
  fs_allocLimit unsigned int Number of blocks available
  fs_usage      unsigned int Number of blocks in use
  fs_visQuotaLimit unsigned int Quota for file system
  fs_visQuotaUsage unsigned int Blocks used in file system
  fs_accError   unsigned int Error for invalid operation
  fs_accStatus  int Operations being performed
  fs_states     int File system state
  fs_nodeMax    int Maximum inode number
  fs_minQuota   int Minimum inode number
  fs_type       int Type of file system
  fs_threshold  char FSFULL threshold monitoring
  fs_increment  char FSFULL monitoring increment
```
<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fs_mountstate</td>
<td>char</td>
<td>Mount status</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>Not mounted</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Mounted R/W</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Mounted readonly</td>
</tr>
<tr>
<td>fs_msglen</td>
<td>char</td>
<td>Length of status message</td>
</tr>
<tr>
<td>fs_msg</td>
<td>[128] char</td>
<td>Status message</td>
</tr>
<tr>
<td>fs_aggrname</td>
<td>[45] char</td>
<td>Aggregate name</td>
</tr>
<tr>
<td>fs_reserved1</td>
<td>[3] char</td>
<td>Reserved</td>
</tr>
<tr>
<td>fs_reserved2</td>
<td>unsigned int[3]</td>
<td>Reserved</td>
</tr>
<tr>
<td>fs_inodeTbl</td>
<td>unsigned int</td>
<td>Size of Inode table</td>
</tr>
<tr>
<td>fs_requests</td>
<td>high</td>
<td>High portion of number of file system requests by applications</td>
</tr>
<tr>
<td>low</td>
<td></td>
<td>Low portion of number of file system requests by applications</td>
</tr>
<tr>
<td>fs_reserved3</td>
<td>unsigned int</td>
<td>Reserved</td>
</tr>
<tr>
<td>fs_reserved4</td>
<td>unsigned int</td>
<td>Reserved</td>
</tr>
<tr>
<td>fs_reserved5</td>
<td>unsigned int</td>
<td>Reserved</td>
</tr>
<tr>
<td>fs_diskFormatMajorVersion</td>
<td>unsigned int</td>
<td>Major version of disk format</td>
</tr>
<tr>
<td>fs_diskFormatMinorVersion</td>
<td>unsigned int</td>
<td>Minor version of disk format</td>
</tr>
<tr>
<td>fs_create64</td>
<td>long long</td>
<td>Time file system created</td>
</tr>
<tr>
<td>fs_update64</td>
<td>long long</td>
<td>Time of last update</td>
</tr>
<tr>
<td>fs_access64</td>
<td>long long</td>
<td>Time of last access</td>
</tr>
<tr>
<td>fs_reserved</td>
<td>[56] char</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

Return value 0 if request is successful, -1 if it is not successful

List File System Status

zFS application programming interface information 321
List File System Status

Usage notes

1. The aggregate must be mounted or attached.
2. For an FS_STATUS, if a size is too large for 32 bits, 0xFFFFFFFF is returned. For an FS_STATUS2, sizes are returned in both the normal fields and the hyper fields.
3. Reserved fields and undefined flags must be set to binary zeros.

Privilege required

None.

Related services

List Attached Aggregate Names
List Detailed File System Information

Restrictions

When FS_ID2 is used, if you specify the z/OS UNIX file system name (fsid_mntname), you cannot specify the zFS file system name (fsid_name) nor the aggregate name (fsid_aggrname).

The following fields are internal use only and not intended for application use:

• fs_accError
• fs_accStatus
• fs_type

The fs_states field contains flag 0x00010000, indicating a read/write file system, and flag 0x00030000, indicating a backup file system. All other flags in this field are internal use only and are not intended for application usage.

Examples

Example 1 uses an FS_ID; see Example 2 for an example that uses FS_ID2.

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#include <time.h> /* ctime */
#define ZFSCALL_FILESYS 0x40000004
#define FSOP_GETSTAT_PARMDATA 142
typedef struct syscall_parmlist_t {
    int           opcode;       /* Operation code to perform */
    int           parms[7];     /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;
typedef struct hyper {
    unsigned int  high;
    unsigned int  low;
} hyper;
```
#define ZFS_MAX_AGGRNAME 44
#define ZFS_MAX_FSYSNAME 44

typedef struct fs_id_t {
char fsid_eye[4];                          /* Eye catcher */
#define FSID_EYE "FSID"
char fsid_len;                             /* Length of this structure */
char fsid_ver;                             /* Version */
char fsid_res1;                            /* Reserved. */
char fsid_res2;                            /* Reserved. */
hyper fsid_id;                              /* Internal identifier */
#define FSID_VER_INITIAL 1                    /* Initial version */
char fsid_aggrname[ZFS_MAX_AGGRNAME+1];    /* Aggregate name, can be NULL string */
char fsid_name[ZFS_MAX_FSYSNAME+1];        /* Name, null terminated */
char fsid_reserved[32];                    /* Reserved for the future */
char fsid_reserved2[2];                    /* Reserved for the future */
} FS_ID;

struct timeval {
int tv_sec; /* seconds */
int tv_usec; /* microseconds */
};

typedef _Packed struct fs_status_t {
char fs_eye[4];        /* Eye catcher */
#define FS_EYE "FSST"
short fs_len;           /* Length of structure */
char fs_ver;            /* Flags */
#define FS_VER_INITIAL 1  /* Initial version */
char fs_flags;          /* Flags */
#define FS_PERFINFO 0x80  /*Performance information in output status*/
hyper fs_id;            /*Internal identifier */
struct timeval fs_cloneTime; /*Time when this filesystem was made via clone or last cloned*/
struct timeval fs_createTime; /*Time when this filesys was created*/
struct timeval fs_updateTime; /*Time when this filesystem was last updated*/
unsigned int fs_allocLimit; /*Allocation limit in kilobytes*/
unsigned int fs_allocUsage; /*Amount of allocation used in kilobytes*/
unsigned int fs_visQuotaLimit; /*Visible filesystem quota in kilobytes*/
unsigned int fs_visQuotaUsage; /*How much quota is used in kilobytes*/
unsigned int fs_accError; /*error to return for incompatible vnode ops*/
int fs_accStatus; /*Operations currently being performed on file system*/
int fs_states; /*State bits*/
#define FS_TYPE_RW 0x10000 /* read/write (ordinary) */
#define FS_TYPE_BK 0x30000 /* ``.backup */
int fs_nodeMax; /* Maximum inode number used */
int fs_minQuota;
char fs_type; /* Type */
char fs_threshold; /* Threshold for fsfull monitoring */
char fs_increment; /* Increment for fsfull monitoring */
char fs_mountstate; /* Aggregate flags */
#define FS_NOT_MOUNTED 0 /* Filesyst not mounted */
#define FS_MOUNTED_RW 1 /* Filesyst mounted RW */
#define FS_MOUNTED_RDONLY 2 /* Filesyst mounted RO */
char fs_msglen; /* Length of status message */
char fs_msg[128]; /* Status message for filesystem */
char fs_aggrname[ZFS_MAX_AGGRNAME+1]; /* Name of aggregate I reside on */
char fs_reserved[3]; /* Reserved for future use/alignment */
unsigned int fs_reserved2[3]; /* reserved */
unsigned int fs_inodeTbl; /*Amount of k used for the Filesystem Inode table*/
/* fs_inodeTbl is zero for all releases prior*/
/* to r7 and non zero in r7 and above*/
hyper fs_requests; /* Number of filesystem requests by users/applications */
unsigned int fs_reserved3;
unsigned int fs_reserved4;
unsigned int fs_reserved5;
int fs_pad1;
unsigned int fs_diskFormatMajorVersion; /* disk format major version */
unsigned int fs_diskFormatMinorVersion; /* disk format minor version */
long long fs_create64; /*time since epoch file system created*/
long long fs_update64; /*time since epoch file system last updated*/
long long fs_access64; /*time since epoch file system last accessed*/
char fs_reserved[56]; /* Reserved for future use */
} _Packed FS_STATUS;

struct parmstruct {

}

zFS application programming interface information 323
```c
syscall_parmlist myparms;
FS_ID            fs_id;
FS_STATUS        fs_status;
};

int main(int argc, char **argv)
{
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    /* file system name to getstatus */
    char              filesystemname[45] = "PLEX.DCEIMGQX.FS";

    struct parmstruct myparmstruct;
    FS_ID             *idp           = &(myparmstruct.fs_id);
    FS_STATUS         *fsp           = &(myparmstruct.fs_status);

    myparmstruct.myparms.opcode = FSOP_GETSTAT_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(FS_ID);
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;

    memset(idp, 0, sizeof(FS_ID));     /* Ensure reserved fields are 0 */
    memset(fsp, 0, sizeof(FS_STATUS)); /* Ensure reserved fields are 0 */
    memcpy(&myparmstruct.fs_status.fs_eye[0], FS_EYE, 4);
    myparmstruct.fs_status.fs_len = sizeof(FS_STATUS);
    myparmstruct.fs_status.fs_ver = FS_VER_INITIAL;
    memcpy(&myparmstruct.fs_id.fsid_eye, FSID_EYE, 4);
    myparmstruct.fs_id.fsid_len = sizeof(FS_ID);
    strcpy(myparmstruct.fs_id.fsid_name, filesystemname);

    BPX1PCT("ZFS     ",
              ZFSCALL_FILESYS,            /* File system operation */
              sizeof(myparmstruct),       /* Length of Argument */
              (char *)&myparmstruct,      /* Pointer to Argument */
              &bpxrv,                     /* Pointer to Return_value */
              &bpxrc,                     /* Pointer to Return_code */
              &bpxrs);                    /* Pointer to Reason_code */

    if (bpxrv < 0)
    {  
        printf("Error getstatus file system %s
", filesystemname);
        printf("BPXRV = %d BPXRC = %d BPXRS = %x
", bpxrv, bpxrc, bpxrs);
        return bpxrc;
    }
    else  
    { /* Return from getstatus was successful */
        printf("File system %s getstatus successful\n", filesystemname);
        printf("getstatus: fs_id=%d,,%d, clone_time=%s, "
               "create_time=%s, update_time=%s, access_time=%s\n",
               myparmstruct.fs_status.fs_id.high,
               myparmstruct.fs_status.fs_id.low,
               ctime((const long*) &myparmstruct.fs_status.fs_cloneTime.tv_sec),
               ctime64((const long long*) &myparmstruct.fs_status.fs_create64),
               ctime64((const long long*) &myparmstruct.fs_status.fs_update64),
               ctime64((const long long*) &myparmstruct.fs_status.fs_access64));

        printf("getstatus: alloc_limit=%u, alloc_usage=%u, quota_limit=%u\n",
               myparmstruct.fs_status.fs_allocLimit,
               myparmstruct.fs_status.fs_allocUsage,
               myparmstruct.fs_status.fs_visQuotaLimit);

        printf("getstatus: quota_usage=%u, accErrors=%u, accStatus=%x, states=%x\n",
               myparmstruct.fs_status.fs_visQuotaUsage,
               myparmstruct.fs_status.fs_accError,
               myparmstruct.fs_status.fs_accStatus,
               myparmstruct.fs_status.fs_states);

        printf("getstatus: max_inode=%d, min_quota=%d, "
               "type=%d, fsfull_threshold=%d\n",
               myparmstruct.fs_status.fs_nodeMax,
               myparmstruct.fs_status.fs_minQuota,
               myparmstruct.fs_status.fs_type,
               myparmstruct.fs_status.fs_threshold);

        printf("getstatus: fsfull_increment=%d, mount_state=%d, "
               "List File System Status
               "
```

324 z/OS: Distributed File Service zFS Administration
"msg_len=%d, msg=%s
",
myparmstruct.fs_status.fs_increment,
myparmstruct.fs_status.fs_mountstate,
myparmstruct.fs_status.fs_msglen,
myparmstruct.fs_status.fs_msg);

printf("getstatus: aggrname=%s\n", myparmstruct.fs_status.fs_aggrname);
printf("getstatus: inode_table_k=%d, fs_requests=%d,,%d
",
myparmstruct.fs_status.fs_InodeTbl,
myparmstruct.fs_status.fs_requests.high,
myparmstruct.fs_status.fs_requests.low);

printf("getstatus: version=%d.%d\n",
myparmstruct.fs_status.fs_diskFormatMajorVersion,
myparmstruct.fs_status.fs_diskFormatMinorVersion);
}
return 0;
}

The following example uses FS_ID2; see Example 1 for an example that uses FS_ID.

#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>
#include <time.h> /* ctime */
#define ZFSCALL_FILESYS 0x40000004
#define FSOP_GETSTAT_PARMDATA 142

typedef struct syscall_parmlist_t {
    int          opcode;         /* Operation code to perform */
    int          parms[7];       /* Specific to type of operation, */
                             /* provides access to the parms */
                             /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct hyper {
    /* This is a 64 bit integer to zFS */
    unsigned int  high;
    unsigned int  low;
} hyper;
#define ZFS_MAX_AGGRNAME 44
#define ZFS_MAX_FSYSNAME 44

typedef struct fs_id2_t {
    char fsid_eye[4];                        /* Eye catcher */
#define  FSID_EYE "FSID"
    char fsid_len;                          /* Length of this structure */
    char fsid_ver;                          /* Version */
    char fsid_res1;                         /* Reserved. */
    char fsid_res2;                         /* Reserved. */
    hyper fsid_id;                           /* Internal identifier */
#define   FSID_VER_2 2                       /* version for FS_ID2 */
    char fsid_aggrname[ZFS_MAX_AGGRNAME+1]; /* Aggregate name, can */
                             /* be NULL string */
    char fsid_name[ZFS_MAX_FSYSNAME+1];     /* Name, null terminated */
    char fsid_mntname[ZFS_MAX_FSYSNAME+1];   /* Mount name, null terminated */
    char fsid_reserved[49];                 /* Reserved for the future*/
} FS_ID2;

struct timeval {
    int          tv_sec;  /* seconds */
    int          tv_usec; /* microseconds */
};

typedef _Packed struct fs_status_t {
    char           fs_eye[4];          /* Eye catcher */
#define            FS_EYE "FSST"
    short          fs_len;             /* Length of structure */
    char           fs_ver;             /* Initial version */
#define            FS_VER_INITIAL 1    /* Version */
    char           fs_flags;           /* Flags */
#define            FS_PERFINFO 0x80    /* Performance information in */
                             /* output status */
    hyper          fs_id;              /* Internal identifier */
    struct timeval fs_cloneTime;       /* Time when this filesystem made via */
                             /* clone or when last recloned */
}
List File System Status

struct timeval fs_createTime; /* Time when this filesystem was created */
struct timeval fs_updateTime; /* Time when this filesystem was last updated */
struct timeval fs_accessTime; /* Time when this filesystem was last accessed */
unsigned int fs_allocLimit; /* Allocation limit for filesystem in kilobytes*/
unsigned int fs_allocUsage; /* Amount of allocation used in kilobytes*/
unsigned int fs_visQuotaLimit; /* Visible filesystem quota in kilobytes*/
unsigned int fs_visQuotaUsage; /* How much quota is used in kilobytes*/
int fs_accError; /* error to return for incompatible vnode ops */
int fs_accStatus; /* Operations currently being performed on file system */
int fs_states; /* State bits */
#define FS_TYPE_RW 0x10000 /* read/write (ordinary) */
#define FS_TYPE_BK 0x30000 /* `.backup' */
int fs_nodeMax; /* Maximum inode number used */
int fs_minQuota;
int fs_type;
char fs_threshold; /* Threshold for fsfull monitoring */
char fs_increment; /* Increment for fsfull monitoring */
char fs_mountstate; /* Aggregate flags */
#define FS_NOT_MOUNTED 0 /* Filesys not mounted */
#define FS_MOUNTED_RW 1 /* Filesys mounted RW */
#define FS_MOUNTED_RO 2 /* Filesys mounted RO */
char fs_msglen; /* Length of status message */
char fs_msg[128]; /* Status message for filesystem */
char fs_aggrname[ZFS_MAX_AGGRNAME+1]; /* Name of aggregate I reside on */
char fs_reserved1[3]; /* Reserved for future use/alignment */
unsigned int fs_reserved2[3]; /* reserved */
unsigned int fs_InodeTbl; /* Amount of k used for the Filesystem Inode table*/
/* fs_InodeTbl is zero for all releases prior to * /
/* r7 and non zero in r7 and above */
hyper fs_requests; /* Number of filesystem requests by users/applications */
unsigned int fs_reserved3;
unsigned int fs_reserved4;
unsigned int fs_reserved5;
int fs_pad1;
unsigned int fs_diskFormatMajorVersion; /* disk format major version */
unsigned int fs_diskFormatMinorVersion; /* disk format minor version */
long long fs_create64; /*time since epoch file system created*/
long long fs_update64; /*time since epoch file system last updated*/
long long fs_access64; /*time since epoch file system last accessed*/
char fs_reserved[56]; /* Reserved for future use */
}_Packed FS_STATUS;

struct parmstruct {
syscall_parmlist myparms;
FS_ID2           fs_id2;
FS_STATUS        fs_status;
};

int main(int argc, char **argv)
{
int bpxrv;
int bpxrc;
int bpxrs;

/* file system name to getstatus */
char filesystemname[45] = "PLEX.DCEIMGQX.FS";

struct parmstruct myparmstruct;
FS_ID2           *idp           = &(myparmstruct.fs_id2);
FS_STATUS        *fsp           = &(myparmstruct.fs_status);

myparmstruct.myparms.opcode = FSOP_GETSTAT_PARMDATA;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(FS_ID2);
myparmstruct.myparms.parms[2] = 0;
myparmstruct.myparms.parms[3] = 0;
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;
memset(idp, 0, sizeof(FS_ID2));  /* Ensure reserved fields are 0 */
memset(fsp, 0, sizeof(FS_STATUS)); /* Ensure reserved fields are 0 */
memcpy(&myparmstruct.fs_status.fs_eye[0], FS_EYE, 4);

myparmstruct.fs_status.fs_len = sizeof(FS_STATUS);
myparmstruct.fs_status.fs_ver = FS_VER_INITIAL;
memcpy(&myparmstruct.fs_id2.fsid_eye, FSID_EYE, 4);
myparmstruct.fs_id2.fsid_len = sizeof(FS_ID2);
myparmstruct.fs_id2.fsid_ver = FSID_VER_2;
strcpy(myparmstruct.fs_id2.fsid_mtnname, filesystemname);

BPX1PCT("ZFS ",
  ZFSIZEL_FILESYS,     /* File system operation */
  sizeof(myparmstruct),  /* Length of Argument */
  (char *)&myparmstruct,     /* Pointer to Argument */
  &bpxrv,                    /* Pointer to Return_value */
  &bpxrc,                    /* Pointer to Return_code */
  &bpxrs);                   /* Pointer to Reason_code */

if (bpxrv < 0)
{
  printf("Error getstatus file system %s\n", filesystemname);
  printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
  return bpxrc;
}
else
{ /* Return from getstatus was successful */
  printf("File system getstatus successful\n", filesystemname);
  printf("getstatus: fs_id=%d,,%d, clone_time=%s, create_time=%s, 
    "update_time=%s, access_time=%s\n",
      myparmstruct.fs_status.fs_id.high,
      myparmstruct.fs_status.fs_id.low,
      ctime((const long*) &myparmstruct.fs_status.fs_cloneTime.tv_sec),
      ctime64((const long long*) &myparmstruct.fs_status.fs_create64),
      ctime64((const long long*) &myparmstruct.fs_status.fs_update64),
      ctime64((const long long*) &myparmstruct.fs_status.fs_access64));

  printf("getstatus: alloc_limit=%u, alloc_usage=%u, quota_limit=%u\n",
    myparmstruct.fs_status.fs_allocLimit,
    myparmstruct.fs_status.fs_allocUsage,
    myparmstruct.fs_status.fs_visQuotaLimit);

  printf("getstatus: quota_usage=%u, accError=%u, accStatus=%x, states=%x\n",
    myparmstruct.fs_status.fs_visQuotaUsage,
    myparmstruct.fs_status.fs_accError,
    myparmstruct.fs_status.fs_accStatus,
    myparmstruct.fs_status.fs_states);

  printf("getstatus: max_inode=%d, min_quota=%d, type=%d, 
    "fsfull_threshold=%d\n",
    myparmstruct.fs_status.fs_nodeMax,
    myparmstruct.fs_status.fs_minQuota,
    myparmstruct.fs_status.fs_type,
    myparmstruct.fs_status.fs_threshold);

  printf("getstatus: fsfull_increment=%d, mount_state=%d, 
    "msg_len=%d, msg=%s\n",
    myparmstruct.fs_status.fs_increment,
    myparmstruct.fs_status.fs_mntstate,
    myparmstruct.fs_status.fs_msglen,
    myparmstruct.fs_status.fs_msg);

  printf("getstatus: aggrname=%s\n", myparmstruct.fs_status.fs_aggrname);
  printf("getstatus: inode_table_k=%d, fs_requests=%d,,%d\n",
    myparmstruct.fs_status.fs_InodeTbl,
    myparmstruct.fs_status.fs_requests.high,
    myparmstruct.fs_status.fs_requests.low);

  printf("getstatus: version=%d,,%d\n",
    myparmstruct.fs_status.fs_diskFormatMajorVersion,
    myparmstruct.fs_status.fs_diskFormatMinorVersion);
}
return 0;
List Systems

**Purpose**
Retrieves the system names that are part of the zFS XCF group.

**Format**

```plaintext
syscall_parmlist
  opcode    int    174     CFGOP_LSSYS
  parms[0]  int    size of buffer
  parms[1]  int    offset to buffer
  parms[2]  int    offset to bytes returned
  parms[3]  int    0
  parms[4]  int    0
  parms[5]  int    0
  parms[6]  int    0
  buffer    char[]
  bytes_returned    int

Return_value     0 if request successful, -1 if it is not successful

Return_code
  E2BIG 0     Data to return is too large for buffer supplied
  EINTR     ZFS is shutting down
  EMVSERR   Internal error
  ERANGE    No systems to return

Reason_code
  0xEFnnxxx   See z/OS Distributed File Service Messages and Codes
```

**Usage notes**

1. Reserved fields and undefined flags must be set to binary zeros.
3. Bytes_returned / 9 is the number of elements in the array.

**Privilege required**

None.

**Related services**

Query sysplex_state

**Restrictions**

None.

**Examples**

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *, int *);
#include <stdio.h>

#define ZFSCALL_CONFIG 0x40000006
#define CFGOP_LSSYS 174 /* List names of systems in the sysplex */
#define E2BIG 145 /* data to return is too big for buffer */
#define ERANGE 2 /* there were no systems to return */
```
typedef struct system_name_t {
    char sys_name[9]; /* 8 byte name, null terminated */
} SYSTEM_NAME;

typedef struct syscall_parmlist_t {
    int  opcode;        /* Operation code to perform */
    int  parms[7];      /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

struct parmstruct {
    syscall_parmlist myparms;
    /* SYSTEM_NAME buffer[32]; */
    /* output buffer for sysnames */
    int              size;
} myparmstruct;

int main(int argc, char **argv) {
    int               buffer_success = 0;
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    int               i,t;
    struct parmstruct *myp    = &myparmstruct;
    int               mypsize,
    buflen;

    myparmstruct.myparms.opcode = CFGOP_LSSYS;
    myparmstruct.myparms.parms[0] = 0; /* size of buffer */
    myparmstruct.myparms.parms[1] = 0; /* offset to buffer */
    myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist); /* offset to size*/
    /*(required size)*/
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;

    BPX1PCT("ZFS ",
        ZFSCALL_CONFIG,           /* Config query operation */
        sizeof(myparmstruct),     /* Length of Argument */
        (char *)&myparmstruct,    /* Pointer to Argument */
        &bpxrv,                   /* Pointer to Return_value */
        &bpxrc,                   /* Pointer to Return_code */
        &bpxrs);                  /* Pointer to Reason_code */
    for(t = 0; t < 1000 && buffer_success == 0; t++)
    {
        if (bpxrv < 0)
        {
            if (bpxrc == E2BIG)
            {
                buflen = myparmstruct.size; /* Get buffer size needed */
                mypsize = sizeof(syscall_parmlist) +
                buflen +
                sizeof(myparmstruct.size);

                free(myp);

                myp = (struct parmstruct *)malloc((int)mypsize);
                memset(myp, 0, mypsize);

                myp->myparms.opcode = CFGOP_LSSYS;
                myp->myparms.parms[0] = buflen;
                myp->myparms.parms[1] = sizeof(syscall_parmlist);
                myp->myparms.parms[2] = sizeof(syscall_parmlist) + buflen;
                myp->myparms.parms[3] = 0;
                myp->myparms.parms[4] = 0;
                myp->myparms.parms[5] = 0;
                myp->myparms.parms[6] = 0;

                BPX1PCT("ZFS ",
                    ZFSCALL_CONFIG,           /* Config query operation */
                    mypsize,                /* Length of Argument */
                    (char *)myp,             /* Pointer to Argument */
                    &bpxrv,                 /* Pointer to Return_value */
                    &bpxrc,                 /* Pointer to Return_code */
                    &bpxrs);                /* Pointer to Reason_code */
    }
if( bpxrv != 0 && bpxrc == E2BIG )
  printf("E2BIG: %d times total\n", t++);
else if( bpxrv == 0 )
  { buffer_success = 1;
    int     j, syscount;
    SYSTEM_NAME *syslist;
    int     *sizep;
    sizep   = (int *)((int)myp + sizeof(syscall_parmlist) + buflen);
    syslist = (SYSTEM_NAME *)((int)myp + sizeof(syscall_parmlist));
    syscount = (*sizep) / sizeof(SYSTEM_NAME);
    for (j = 1; j <= syscount; j++)
      {
        printf("%-8.8s\n", syslist->sys_name);
        syslist++;
      }
    free(myp);
  }
else /* lssys failed with large enough buffer */
  { /* lssys failed with large enough buffer */
    if (bpxrc == ERANGE)
      printf("No systems to display\n");
    else
      { printf("Error on lssys with large enough buffer\n");
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        free(myp);
        return bpxrc;
      }
  }
else /* erro was not E2BIG on the original BPX1PCT */
  { /* erro was not E2BIG on the original BPX1PCT */
    if (bpxrc == ERANGE)
      printf("No systems to display from original BPX1PCT\n");
    else
      { printf("Error on lssys trying to get required size\n");
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        free(myp);
        return bpxrc;
      }
  }
else /* asking for buffer size gave rv = 0; maybe there is no data */
  { /* asking for buffer size gave rv = 0; maybe there is no data */
    if (myparmstruct.size == 0)
      { printf("No data\n");
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
      }
    else
      { /* No, there was some other problem with getting the size needed */
        printf("Error getting size required\n");
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        free(myp);
        return bpxrc;
      }
  }
if( t == 1000 )
  printf("Number of failed buffer resizes exceeded.\n");
free(myp);
return 0; 
}
Query Config Option

Purpose
A set of subcommand calls (configuration operations) that retrieve the current value for a particular configuration setting. Each one returns the configuration setting as a character string in the co_string field.

The Format section and Example 1 use the CFGOP_QUERY_ADM_THREADS subcommand. Example 2 shows an example to query the syslevel. The other query subcommands (see Table 19 on page 242) operate in a similar manner.

Format

```c
syscall_parm_list
  opcode           int      180    CFGOP_QUERY_ADM_THREADS
  parms[0]         int      offset to CFG_OPTION
  parms[1]         int      offset to system name (optional)
  parms[2]         int      0
  parms[3]         int      0
  parms[4]         int      0
  parms[5]         int      0
  parms[6]         int      0

CFG_OPTION
  co_eye           char[4]  "CFOP"
  co_len           short    sizeof(CFG_OPTION)
  co_VER           char      1
  co_string        char[81] 0
  co_value_reserved int[4]  reserved
  co_reserved      char[24] 0
  systemname       char[9]
```

Return_value: 0 if request is successful, -1 if it is not successful
Return_code:
- EBUSY Aggregate could not be quiesced
- EINTR ZFS is shutting down
- EMVSERR Internal error using an osi service
- ENOTATT Aggregate is not attached
- EPERM Permission denied to perform request
Reason_code:
- 0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes
1. Reserved fields and undefined flags must be set to binary zeros.
2. The output is the null-terminated string that is returned in co_string.

Privilege required
None.

Related services
Set Config Option

Restrictions
None.

Examples
Example 1: The following example shows an API to query admin threads.

```c
#pragma linkage(BPX1PCT, OS)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
```
`#include <stdio.h>

#define ZFSCALL_CONFIG 0x40000006
#define CFGOP_QUERY_ADM_THREADS 180 /* query number of admin threads */

typedef struct syscall_parmlist_t {
    int   opcode;         /* Operation code to perform */
    int   parms[7];       /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused */
} syscall_parmlist;

typedef struct config_option_t {
    char  co_eye[4];              /* Eye catcher */
    #define CFGO_EYE "CFOP"
    short co_len;                 /* Length of structure */
    char co_ver;                  /* Version of structure */
    #define CO_VER_INITIAL 1        /* Initial version */
    #define CO_SLEN 80              /* Size of string */
    char co_string[CO_SLEN+1];    /* String value for option */
    /* must be 0 terminated */
    int   co_value[4];            /* Place for integer values */
    char co_reserved[24];        /* Reserved for future use */
} CFG_OPTION;

struct parmstruct {
    syscall_parmlist myparms;
    CFG_OPTION co;
    char system[9];
} myparmstruct;

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    CFG_OPTION *coptr = &(myparmstruct.co);
    /* This next field should only be set if parms[1] is non-zero */
    /* strcpy(myparmstruct.system,"DCEIMGVN"); */ /* set system to query */
    myparmstruct.myparms.opcode = CFGOP_QUERY_ADM_THREADS;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = 0;
    /* Only specify a non-zero offset for the next field (parms[1]) if you are */
    /* z/OS 1.7 and above, and you want to configquery to a different system */
    /* myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + */
    /* sizeof(CFG_OPTION); */
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;

    memset(coptr, 0, sizeof(CFG_OPTION));
    memcpy(coptr->co_eye, CFGO_EYE, 4);
    coptr->co_ver = CO_VER_INITIAL;
    coptr->co_len = (int)sizeof(CFG_OPTION);
    BPX1PCT("ZFS     ",
             ZFSCALL_CONFIG,        /* Config operation */
             sizeof(myparmstruct), /* Length of Argument */
             (char *)&myparmstruct, /* Pointer to Argument */
             &bpxrv, /* Pointer to Return_value */
             &bpxrc, /* Pointer to Return_code */
             &bpxrs); /* Pointer to Reason_code */
    if (bpxrv < 0)
    {
        printf("Error querying config -adm_threads, "
               "BPXRV = %d BPXRC = %d BPXRS = %x\n",
               bpxrv, bpxrc, bpxrs);
        return bpxrc;
    }
    else
    {
        printf("Config query -adm_threads = %s\n", myparmstruct.co.co_string);
    }
}`
Example 2: The following example shows an API to query the syslevel.

```c
#include <stdio.h>
#include <string.h>

#define ZFSCALL_CONFIG 0x40000006
#define CFGOP_QUERY_SYSLEVEL 238 /* Query Config option - syslevel */

typedef struct syscall_parmlist_t {
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
              /* provides access to the parms */
              /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct config_option_t {
    char co_eye[4]; /* Eye catcher */
    short co_len; /* Length of structure */
    char co_ver; /* Version of structure */
    char co_string[CO_SLEN+1]; /* String value for option must */
                                         /* be 0 terminated */
    int co_value[4]; /* Place for integer values */
    char co_reserved[24]; /* Reserved for future use */
} CFG_OPTION;

struct parmstruct {
    syscall_parmlist myparms;
    CFG_OPTION co;
    char system[9];
} myparmstruct;

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    CFG_OPTION *coptr = &(myparmstruct.co);

    char *version,
         *service,
         *created,
         *sysplex,
         *interface,
         *rwshare_default,
         *rest;

    int sysplex_level;

    /* strcpy(myparmstruct.system,"DCEIMGVN"); */ /* set system to query */
    myparmstruct.myparms.opcode = CFGOP_QUERY_SYSLEVEL;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = 0;
    myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist) + *
                                         /* sizeof(CFG_OPTION) */
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    ...
memset(coptr, 0, sizeof(CFG_OPTION));
memcpy(coptr->co_eye, CFGO_EYE, 4);
coptr->co_ver = CO_VER_INITIAL;
coptr->co_len = (int)sizeof(CFG_OPTION);

BPX1PCT("ZFS ",
    ZFSCALL_CONFIG,    /* Config operation */
    sizeof(myparmstruct),    /* Length of Argument */
    (char *)&myparmstruct,    /* Pointer to Argument */
    &bpxrv,    /* Pointer to Return_value */
    &bpxrc,    /* Pointer to Return_code */
    &bpxrs);    /* Pointer to Reason_code */

if (bpxrv < 0)
{
    printf("Error querying config -syslevel, ",
    "BPXRV = %d BPXRC = %d BPXRS = %x\n",
    bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
{
    /* Parse our configquery string */
    /* format is */
    /* "OSlevel
    Servicelevel
    createtimestamp" +                  
    "nsysplex_state
    interface_level
    rwshare_default\0"         */

    version = myparmstruct.co.co_string;
    service = strchr(version, '\n');    /* find the end of the */
    *service = '\0';    /* ensure end of string for version string */
    service++;    /* increment to next field (service) */

    created = strchr(service, '\n');    /* find the end of the */
    *created = '\0';    /* ensure end of string for service string */
    created++;    /* increment to next field (creation) */

    sysplex = strchr(created, '\n');    /* find the end of the */
    *sysplex = '\0';    /* ensure end of string for creation string */
    sysplex++;    /* increment to next field (sysplex_state) */

    interface = strchr(sysplex, '\n');    /* find end of the sysplex_state */
    *interface = '\0';    /* ensure end of string for sysplex_state */
    interface++;    /* increment to next field (interface level) */

    sysplex_level = atoi(sysplex);
    if (sysplex_level == NO_SYSPLEX_SUPPORT)
    {
        printf("zFS kernel: z/OS File System\nVersion %s 
Service Level %s.
Created on %s.",
        version, service, created);
    }
    else
    {
        char buffer[80];
        /* find the end of the interface */
        rwshare_default = strchr(interface, '\n');
        if (rwshare_default != NULL)
        {
            *rwshare_default = '\0';
            rwshare_default++;
        }
        if (sysplex_level == SYSPLEX_ADMIN_LEVEL)
            sprintf(buffer, "sysplex(admin-only) interface(%)", interface);
        else /* if sysplex_level is SYSPLEX_FILE_LEVEL */
            if (sysplex_level == SYSPLEX_FILE_LEVEL)
                sprintf(buffer, "sysplex(file) interface(%)", interface);
            else
                sprintf(buffer, "sysplex(filesys,%) interface(%)",
                    rwshare_default, interface);
        }
else
    sprintf(buffer, "sysplex(%s) interface(%s)", sysplex, interface);
}
}
printf("zFS kernel: z/OS File System
Version 
%<s Service Level %s
Created on %s.
%s
", version, service, created, buffer);
}
return 0;
Quiesce Aggregate

**Purpose**
An aggregate operation that quiesces a compatibility mode aggregate. It quiesces activity on the aggregate and its file system.

**Format**

```c
syscall_parmlist
    opcode    132             AGOP_QUIESCE_PARMDATA
    parms[0]  int             offset to AGGR_ID
    parms[1]  int             offset to handle returned by quiesce
    parms[2]  int             0
    parms[3]  int             0
    parms[4]  int             0
    parms[5]  int             0
    parms[6]  int             0

AGGR_ID
aid_eye     char[4]         "AGID"
aid_len     char             sizeof(AGGR_ID)
aid_ver     char             1
aid_name    char[45]        "OMVS.PRV.AGGR001.LDS0001"
aid_reserved char[33]       0
quiesce_handle int
```

**Return_value**
0 if request is successful, -1 if it is not successful

**Return_code**
- EBUSY: Aggregate could not be quiesced
- EINTR: ZFS is shutting down
- EMVSERR: Internal error using an osi service
- ENOTATTACHED: Aggregate is not attached
- EPERM: Permission denied to perform request

**Reason_code**
0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

**Usage notes**
1. Quiesce Aggregate is used to suspend activity on an aggregate. All activity on the file system contained in the aggregate that is mounted is also suspended. This subcommand is typically used before backing up an aggregate. The aggregate must be attached to be quiesced. The quiesce operation returns a quiesce handle that must be supplied on the unquiesce call.
2. Reserved fields and undefined flags must be set to binary zeros.

**Privilege required**
The issuer must be logged in as root or must have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Related services**
- Unquiesce Aggregate

**Restrictions**
None.

**Examples**

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)
```
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_QUIESCE_PARMDATA 132

typedef struct syscall_parmlist_t {
    int opcode;        /* Operation code to perform */
    int parms[7];      /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
    char aid_eye[4];                    /* Eye catcher */
    char aid_len;                       /* Length of this structure */
    char aid_ver;                       /* Version */
    char aid_name[ZFS_MAX_AGGRNAME+1];  /* Name, null terminated */
    char aid_reserved[33];              /* Reserved for the future */
} AGGR_ID;

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID          aggr_id;
    int              quiesce_handle;
};

int main(int argc, char **argv) {
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    char              aggrname[45] = "PLEX.DCEIMGQX.FS";
    int               save_quiesce_handle;
    struct parmstruct myparmstruct;
    AGGR_ID           *idp        = &(myparmstruct.aggr_id);
    myparmstruct.myparms.opcode = AGOP_QUIESCE_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(AGGR_ID);
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    /* Ensure reserved fields are 0 */
    memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID));
    memcpy(&myparmstruct.aggr_id, AID_EYE, 4);
    myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
    myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
    strcpy(myparmstruct.aggr_id.aid_name, aggrname);
    BPX1PCT("ZFS     ",
    ZFSCALL_AGGR,          /* Aggregate operation */
    sizeof(myparmstruct),  /* Length of Argument */
    (char *)&myparmstruct, /* Pointer to Argument */
    &bpxrv,                /* Pointer to Return_value */
    &bpxrc,                /* Pointer to Return_code */
    &bpxrs);               /* Pointer to Reason_code */
    if (bpxrv < 0)
    {
        printf("Error quiescing aggregate %s\n", aggrname);
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        return bpxrc;
    }
    /* Return from quiesce was successful */
    printf("Aggregate %s quiesced successfully, quiescehandle=%d\n", 
            aggrname, myparmstruct.quiesce_handle);
    save_quiesce_handle = myparmstruct.quiesce_handle;
}
return 0;
}
Reset Backup Flag

Purpose

Used by backup programs to reset the backup bit after completion of a backup. The backup program is expected to quiesce the aggregate and save the quiesce handle before beginning the backup. After completing the backup, the backup bit should be reset before unquiescing the aggregate.

Format

```
syscall_parmlist
opcode                  int             157 AGOP_RESETFLAG_PARMDATA
parms[0]                int             offset to AGGR_ID
parms[1]                int             quiesce handle
parms[2]                int             0
parms[3]                int             0
parms[4]                int             0
parms[5]                int             0
parms[6]                int             0
AGGR_ID
   aid_eye                 char[4]         "AGID"
   aid_len                 char            sizeof(AGGR_ID)
   aid_ver                 char 1
   aid_name                char[45]        "OMVS.PRV.AGGR001.LDS0001"
   aid_reserved            char[33]        0
```

Return_value 0 if request is successful, -1 if it is not successful

Return_code

EINVAL   Invalid input parameters
ENOENT   Aggregate not found
ENOSYS   Aggregate not locally owned
EBUSY    Aggregate is growing
EMVSERR  Internal error using an osi service

Reason_code

0xEFnnxxxx  See z/OS Distributed File Service Messages and Codes
EINVAL     Invalid parameters

Usage notes

1. The backup bit must be reset while the aggregate is still quiesced for backup.
2. Reserved fields and undefined flags must be set to binary zeros.

Privilege required

The issuer must be logged in as root or must have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Related services

Quiesce Aggregate
Unquiesce Aggregate

Restrictions

None.
Examples

```c
#pragma linkage(BPX1PCT, OS)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_RESETFLAG_PARMDATA 157

typedef struct syscall_parmlist_t
{
    int opcode;  /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[2]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t
{
    char aid_eye[4]; /* Eye Catcher */
#define AID_EYE "AGID"
    char aid_len;
#define AID_LEN 1 /* Length of this structure */
    char aid_ver; /* Version */
#define AID_VER_INITIAL 1 /* Initial version */
    char aid_name[ZFS_MAX_AGGRNAME+1]; /* aggr name, null terminated */
    char aid_reserved[33]; /* Reserved for the future */
} AGGR_ID;

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID aggr_id;
};

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;

    /*Aggregate name to attach, aggregate must
     * be quiesced for this API to run successfully */
    char aggrname[45] = "PLEX.DCEIMGQX.FS";

    struct parmstruct myparmstruct;
    AGGR_ID *idp = &(myparmstruct.aggr_id);

    /* This is the handle returned by zFS on a quiesce aggregate */
    /* Ensure that the quiesce_handle is set to the value returned */
    /* by the quiesce */
    int quiesce_handle = 1;

    myparmstruct.myparms.opcode = AGOP_RESETFLAG_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = quiesce_handle;
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    memset(idp, 0, sizeof(AGGR_ID)); /* Ensure reserved fields are 0 */
    memcpy(&myparmstruct.aggr_id.aid_eye, AID_EYE, 4);
    myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
    myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
    strcpy(myparmstruct.aggr_id.aid_name, aggrname);

    BPX1PCT("ZFS",
        ZFSCALL_AGGR, /* Aggregate operation */
        sizeof(myparmstruct), /* Length of Argument */
        (char *)&myparmstruct, /* Pointer to Argument */
        &bpxrv, /* Pointer to Return_value */
        &bpxrc, /* Pointer to Return_code */
        &bpxrs); /* Pointer to Reason_code */

    if (bpxrv < 0)
    {
    }
```
printf("Error resetting backup flag for aggregate %s\n", aggrname);
printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
return bpxrc;
}
else /* Return from reset was successful */
{
    printf("Successfully reset backup flag for aggregate %s\n", aggrname);
    return 0;
}
Salvage Aggregate

Purpose
An aggregate operation that verifies or repairs a compatibility mode aggregate.

Format

<table>
<thead>
<tr>
<th>syscall_parmlist</th>
<th>int</th>
<th>155</th>
<th>AGOP_SALVAGE_PARMDATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>opcode</td>
<td>int</td>
<td></td>
<td></td>
</tr>
<tr>
<td>parm[0]</td>
<td>int</td>
<td></td>
<td>offset to AGGR_ID</td>
</tr>
<tr>
<td>parm[1]</td>
<td>int</td>
<td>1</td>
<td>verify only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>verify and repair</td>
</tr>
<tr>
<td>parm[2]</td>
<td>int</td>
<td>3</td>
<td>cancel</td>
</tr>
<tr>
<td>parm[3]</td>
<td>int</td>
<td></td>
<td></td>
</tr>
<tr>
<td>parm[4]</td>
<td>int</td>
<td></td>
<td></td>
</tr>
<tr>
<td>parm[5]</td>
<td>int</td>
<td></td>
<td></td>
</tr>
<tr>
<td>parm[6]</td>
<td>int</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGGR_ID</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>aid_eye</td>
<td>char[4]</td>
<td>&quot;AGID&quot;</td>
<td></td>
</tr>
<tr>
<td>aid_len</td>
<td>char</td>
<td>sizeof(AGGR_ID)</td>
<td></td>
</tr>
<tr>
<td>aid_ver</td>
<td>char</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>aid_name</td>
<td>char[45]</td>
<td>&quot;OMVS.PRIV.AGGR001.LDS0001&quot;</td>
<td></td>
</tr>
<tr>
<td>aid_reserved</td>
<td>char[33]</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Return value</td>
<td>0</td>
<td>if request is successful</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1</td>
<td>if request is not successful</td>
<td></td>
</tr>
<tr>
<td>Return code</td>
<td></td>
<td>Aggregate not available or no long running thread available</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation interrupted</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Internal error</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aggregate is not mounted</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Permission denied to perform request</td>
<td></td>
</tr>
<tr>
<td>Reason code</td>
<td></td>
<td>0xEFnnxxxxx       See z/OS Distributed File Service Messages and Codes</td>
<td></td>
</tr>
</tbody>
</table>

Usage notes for Salvage Aggregate
1. The aggregate can be mounted read-only if -verifyonly is specified. It must be mounted read/write if -verifyonly is not specified and a repair is required. Before it can be repaired, it must be mounted read/write.
2. Reserved fields and undefined flags must be set to binary zeros.
3. A long-running command foreground thread must be available.
4. A salvage operation can be interrupted by a shutdown, unmount with the force option, or a zfsadm salvage command with the -cancel option specified or a Salvage Aggregate API call with parm[1]=3.
5. Both the FSINFO command and the List Detailed File System Information service have progress indicators that show the current step of the salvage operation. The progress indicators can be seen when owner information is requested.

Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Related services
List Detailed File System Information
Restrictions
None.

Examples

```
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>

#define ZFSCALL_AGGR 0x40000005
#define AGOP_SALVAGE_PARMDATA 155 /* salvage aggregate */

typedef struct syscall_parmlist_
{
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t
{
    char aid_eye[4];                   /* Eye Catcher */
    char aid_len;                      /* Length of this structure */
    char aid_ver;                      /* Version */
    char aid_name[ZFS_MAX_AGGRNAME+1]; /* aggr name, null terminated */
    char aid_reserved[33];             /* Reserved for the future */
} AGGR_ID;

struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID aggr_id;
};

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    struct parmstruct myparmstruct;
    char aggrname[45] = "PLEX.DCEIMGQX.FS"; /* aggregate name to salvage */
    AGGR_ID *aidp = &(myparmstruct.aggr_id);
    myparmstruct.myparms.opcode = AGOP_SALVAGE_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = 1; /* verify only */
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    /* Ensure reserved fields are 0 */
    memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID));
    /* Specify the name of the aggregate to salvage. */
    memcpy(&myparmstruct.aggr_id.aid_eye, "AGID", 4);
    myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
    myparmstruct.aggr_id.aid_ver = 1;
    strcpy(myparmstruct.aggr_id.aid_name, aggrname);
    BPX1PCT("ZFS     ", /* must be blank padded to length 8 */
        ZFSCALL_AGGR, /* Aggregate operation */
        sizeof(myparmstruct), /* Length of Argument */
        (char *)&myparmstruct, /* Pointer to Argument */
        &bpxrv, /* Pointer to Return_value */
        &bpxrc, /* Pointer to Return_code */
        &bpxrs); /* Pointer to Reason_code */
    if (bpxrv < 0)
    {
        printf("Errors found during salvage of aggregate %s.\n", aggrname);
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        return bpxrc;
    }
    printf("Success during salvage of aggregate %s.\n", aggrname);
    return 0;
}
```
Set Auditfid

Purpose
An aggregate operation that sets the current value of the auditfid. The aggregate whose auditfid is to be changed must be attached.

Format

```c
syscall_parmlist
opcode          int          149       AGOP_SETAUDITFID_PARMDATA
parms[0]        int          offset to AGGR_ID
parms[1]        int          0=set new auditfid if current auditfid is 0
                        1=set new auditfid regardless of current value
                        (force)
                        2=set new auditfid to 0 (old)
parms[2]        int          0
parms[3]        int          0
parms[4]        int          0
parms[5]        int          0
parms[6]        int          0
AGGR_ID
aid_eye         char[4]      "AGID"
aid_len         char         sizeof(AGGR_ID)
aid_ver         char         1
aid_name        char[45]     "OMVS.PRV.AGGR001.LDS0001"
aid_reserved    char[33]     0
```

Return_value  0 if request is successful, -1 if it is not successful

Return_code
EBUSY         auditfid could not be set
EINTR         ZFS is shutting down
EMVSERR       Internal error using an osi service
ENOENT        Aggregate is not attached
EPERM         Permission denied to perform request

Reason_code
0xEFnnxxxx    See z/OS Distributed File Service Messages and Codes

Usage notes
1. Reserved fields and undefined flags must be set to binary zeros.

Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Related services
List Aggregate Status (Version 2)

Restrictions
The aggregate cannot be attached as read-only. The aggregate cannot be quiesced. The aggregate cannot be in the process of being moved by zFS.
Examples

```c
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_SETAUDITFID_PARMDATA 149  /* Set or reset auditfid */
typedef struct syscall_parmlist_t {
    int opcode;                    /* Operation code to perform */
    int parms[7];                  /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;
#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
    char aid_eye[4];                   /* Eye catcher */
    char aid_len;                      /* Length of this structure */
    char aid_ver;                      /* Version */
    char aid_name[ZFS_MAX_AGGRNAME+1]; /* Name, null terminated */
    char aid_reserved[33];             /* Reserved for the future */
} AGGR_ID;

typedef struct parmstruct {
    syscall_parmlist myparms;
    AGGR_ID          aggr_id;
};

int main(int argc, char **argv)
{
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    struct parmstruct myparmstruct;
    char aggrname[45] = "PLEX.DCEIMGQX.FS"; /* aggregate name to set auditfid*/
    AGGR_ID *idp      = &(myparmstruct.aggr_id);
    myparmstruct.myparms.opcode = AGOP_SETAUDITFID_PARMDATA;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = 1;
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    /* Ensure reserved fields are 0 */
    memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID));
    memcpy(&myparmstruct.aggr_id, AID_EYE, 4);
    myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
    myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
    strcpy(myparmstruct.aggr_id.aid_name, aggrname);

    BPX1PCT("ZFS     ",
            ZFSCALL_AGGR,               /* Aggregate operation */
            sizeof(myparmstruct),       /* Length of Argument */
            (char *)&myparmstruct,       /* Pointer to Argument */
            &bpxrv,                       /* Pointer to Return_value */
            &bpxrc,                       /* Pointer to Return_code */
            &bpxrs);                      /* Pointer to Reason_code */

    if (bpxrv < 0)
        printf("Error setting auditfid for aggregate %s\n", aggrname);
    return 0;
}
```

Set Auditfid

344 z/OS: Distributed File Service zFS Administration
printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
  }
else /* Return from set auditfid was successful */
  {
    printf("Aggregate %s set auditfid successfully\n", aggrname);
    return 0;
  }
}
Set Config Option

**Purpose**

A set of subcommand calls (that are configuration operations) that set the current value for a particular configuration setting. Each one sets the configuration setting from input specified as a character string.

The following Format and Example use the CFGOP_ADM_THREADS subcommand. The other set subcommands (see Table 19 on page 242) operate similarly. That is, each sets the configuration setting from the character string in the **co_string** field.

**Format**

```
syscall_parmlist
    opcode int 150 CFGOP_ADM_THREADS
    parms[0] int offset to CFG_OPTION
    parms[1] int offset to system name (optional)
    parms[2] int 0
    parms[3] int 0
    parms[4] int 0
    parms[5] int 0
    parms[6] int 0
    CFG_OPTION
        co_eye char[4] "CFOP"
        co_len short sizeof(CFG_OPTION)
        co_ver char 1
        co_string char[81] "15" (New value for adm_threads)
        co_value_reserved int 4 (reserved)
        co_reserved char[24] 0
        systemname char[9]
```

**Return_value**

0 if request is successful, -1 if it is not successful

**Return_code**

- **EBUSY** Aggregate could not be quiesced
- **EINVAL** ZFS is shutting down
- **EMVSERR** Internal error using an osi service
- **ENOENT** Aggregate is not attached
- **EPERM** Permission denied to perform request

**Reason_code**

- **0xEFnnxxxx** See z/OS Distributed File Service Messages and Codes

**Usage notes**

1. Reserved fields and undefined flags must be set to binary zeros.
2. Specify the new value as a null terminated string in **co_string**.

**Privilege required**

The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

**Related services**

- Query Config Option

**Restrictions**

None.
Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLEVEL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>

#define ZFSCALL_CONFIG 0x40000006
#define CFGOP_ADM_THREADS 150  /* Set number of admin threads */

typedef struct syscall_parmlist_t {
  int   opcode;        /* Operation code to perform */
  int   parms[7];      /* Specific to type of operation, */
                    /* provides access to the parms */
                    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct config_option_t {
  char  co_eye[4];    /* Eye catcher */
  short co_len;       /* Length of structure */
  char  co_ver;       /* Version of structure */
  #define   CFGO_EYE "CFOP"
  #define   CO_VER_INITIAL 1    /* Initial version */
  #define   CO_SLEN 80         /* Sizeof string */
  char  co_string[CO_SLEN+1]; /* String value for option must be 0 terminated*/
  int   co_value[4];      /* Place for integer values */
  char  co_reserved[24]; /* Reserved for future use */
} CFG_OPTION;

struct parmstruct {
  syscall_parmlist myparms;
  CFG_OPTION       co;
  char             system[9];
} myparmstruct;

char new_adm_threads[CO_SLEN+1] = "20"; /* New adm_threads value */

int main(int argc, char **argv)
{
  int        bpxrv;
  int        bpxrc;
  int        bpxrs;
  CFG_OPTION *coptr = &(myparmstruct.co);

  /* This next field should only be set if parms[1] is non-zero */
  /* strcpy(myparmstruct.system,"DCEIMGVN"); */ /* set system to change */
  myparmstruct.myparms.opcode = CFGOP_ADM_THREADS;
  myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
  myparmstruct.myparms.parms[1] = 0;

  /* Only specify a non-zero offset for the next field (parms[1]) if */
  /* you are running z/OS 1.7 and above, and */
  /* you want to configquery to a different system */
  /* myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) */
  /* + sizeof(CFG_OPTION); */

  myparmstruct.myparms.parms[2] = 0;
  myparmstruct.myparms.parms[3] = 0;
  myparmstruct.myparms.parms[4] = 0;
  myparmstruct.myparms.parms[5] = 0;
  myparmstruct.myparms.parms[6] = 0;

  memset(coptr, 0, sizeof(CFG_OPTION));
  memcpy(coptr->co_eye, CFGO_EYE, 4);
  coptr->co_ver = CO_VER_INITIAL;
  coptr->co_len = (int)sizeof(CFG_OPTION);
  strcpy(coptr->co_string, new_adm_threads); /*set new adm_thread value*/
  BPX1PCT("ZFS     ",
           ZFSCALL_CONFIG,             /* Config operation */
           sizeof(myparmstruct),       /* Length of Argument */
           (char *)&myparmstruct,       /* Pointer to Argument */
           &bpxrv,                      /* Pointer to Return_value */
           &bpxrc,                      /* Pointer to Return_code */
           &bpxrs);                     /* Pointer to Reason_code */
```

zFS application programming interface information 347
if (bpxrv < 0)
{
    printf("Error setting config -adm_threads, ",
            "BPXRV = %d BPXRC = %d BPXRS = %x\n",
            bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
    printf("Config -adm_threads = %s\n", myparmstruct.co.co_string);
return 0;
**Purpose**

Reduces the physical size of a zFS aggregate.

**Format**

```plaintext
syscall_parmlist
  opcode  int       266   AGOP_SHRINK_PARMDATA
  parms[0] int       offset to SH_REQ
  parms[1] int       0
  parms[2] int       0
  parms[3] int       0
  parms[4] int       0
  parms[5] int       0
  parms[6] int       0

SH_REQ
  sh_eye  char[4]        "SHRQ"
  sh_len  short          sizeof(SH_REQ)
  sh_ver  char           1
  sh_flags char  
    Shrink flags with values:
    0 - No options specified.
    1 - Active increase not allowed.
    2 - Do not wait for shrink completion.
  sh_length unsigned long long int  New total size (in 1K units)
  sh_name  char[45]      Name of aggregate to shrink.
  sh_command char  
    Shrink operation to perform:
    1 - Start a shrink.
    2 - Cancel an active shrink.
  sh_reserved char[66]  Reserved.
```

Shrink API return codes:

- EPERM  User does not have permission to perform shrink
- ENOENT No aggregate by this name is found
- EROFS  Aggregate is mounted readonly
- EIO    General errors processing the shrink operation
- EFBIG  Aggregate size request does not make sense (bigger than existing aggregate or active increase gets back to original aggregate size)
- EMVSERR Internal error
- EBUSY  Aggregate is busy or otherwise unavailable, or no long running threads available
- EINVAL Invalid parameters
- ENFILE Error releasing space from the data set
- ENOSYS zFS owner goes down before a shrink command completes
- EINTR  Shrink command canceled

**Usage notes for Shrink Aggregate**

1. The aggregate must be mounted.
2. Reserved fields and undefined flags must be set to binary zeros.
3. A long-running command foreground thread must be available.
4. A shrink operation can be interrupted by a shutdown, unmount with the force option, or a zfsadm shrink command with the -cancel option specified.
5. The difference between the new total size of the aggregate and the current size of the aggregate cannot be larger than the free space in the aggregate.
6. Most of the shrink operation will allow other applications to access file and directory blocks during the shrink operation, which might cause additional blocks to be allocated. If this allocation causes more space to be needed in the aggregate than the new total size specified in -size, zFS will actively increase the new total size by adding 1 M to the new total size. The shrink command will end with an error if the size is actively increased back to the original size of the aggregate. You can prevent active increase
by specifying -noai. If -noai is specified, and an active increase is needed, the shrink command will end with an error.

7. Both the FSINFO command and the List Detailed File System Information service have progress indicators that show the current step of the shrink operation. The progress indicators can be seen when owner information is requested.

Privilege required
The user must have UPDATE authority to the VSAM linear data set.

Related services
Grow Aggregate
List Detailed File System Information

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_AGGR 0x40000005
#define AGOP_SHRINK_PARMDATA 266 /* shrink specified aggregate */

typedef struct syscall_parmlist_
{
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
} syscall_parmlist;
#define ZF_MAX_AGGRNAME 44
#define SHR_EYE "SHRQ"
#define SHR_VER_INITIAL 1
#define SHR_NO_ACTIVE_INCREASE 0x01 /* active increase should not be used */
#define SHR_ASYNC              0x02   /* do not wait for shrink to complete */
#define SHR_START_SHRINK       1      /* start a shrink operation if one */
#define SHR_STOP_SHRINK        2      /* stop a shrink operation that is */
#define SHR_RESERVED_LEN       66

typedef struct shrink_req_t
{
    char sh_eye[4]; /* eyecatcher "SHRQ" */
    short sh_len; /* size of SH_REQ */
    char sh_ver; /* 1 */
    char sh_flags; /* 1=no active increase, 2=async */
    unsigned long long int sh_length; /* New length of aggregate */
    /* (in 1K units) */
    char sh_name[ZF_MAX_AGGRNAME+1]; /* NULL terminated aggregate name */
    char sh_command; /* 1=start shrink 2=stop shrink */
    char sh_reserved[SHR_RESERVED_LEN]; /* reserved must be 0 */
} SH_REQ;

struct parmstruct {
    syscall_parmlist myparms;
    SH_REQ shreq;
};

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
```
struct parmstruct myparmstruct;
char aggrname[45] = "ZFSAGGR.BIGZFS.DHH.FS1.EXTATTR";
SH_REQ *reqp = &(myparmstruct.shreq);
myparmstruct.myparms.opcode = AGOP_SHRINK_PARMDATA;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = 0;
myparmstruct.myparms.parms[2] = 0;
myparmstruct.myparms.parms[3] = 0;
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;
/* Ensure reserved fields are 0 */
memset(&myparmstruct.shreq, 0, sizeof(SH_REQ));
/* Set fields to shrink aggregate, and not wait for it to complete. */
/* Since the aggregate is being used, we will allow active increase */
/* so that running tasks will not run out of space if they need more */
/* than originally anticipated. */
memcpy(&myparmstruct.shreq.sh_eye, SHR_EYE, 4);
myparmstruct.shreq.sh_len = sizeof(SH_REQ);
myparmstruct.shreq.sh_ver = SHR_VER_INITIAL;
strcpy(myparmstruct.shreq.sh_name, aggrname);
myparmstruct.shreq.sh_flags = SHR_ASYNC;
myparmstruct.shreq.sh_command = SHR_START_SHRINK;
/* Using 1K units, 8388704 is just over an 8G aggregate as a new length. */
myparmstruct.shreq.sh_length = 8388704;
BPX1PCT("ZFS     ", /* must be blank padded to length 8 */
ZFSCALL_AGGR, /* Aggregate operation */
sizeof(myparmstruct), /* Length of Argument */
(char *)&myparmstruct, /* Pointer to Argument */
&bpxrv, /* Pointer to Return_value */
&bpxrc, /* Pointer to Return_code */
&bpxrs); /* Pointer to Reason_code */
if (bpxrv < 0)
{
    printf("Error trying to shrink aggregate %s\n", aggrname);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else /* Return from change aggregate attributes was successful */
    printf("Shrink of aggregate %s started.\n", aggrname);
return 0;
Statistics Compression Information

Purpose
Displays compression statistics in order to monitor compression effectiveness and performance of zEDC systems.

Format

```plaintext
syscall_parmlist
  opcode          int                      256 STATOP_COMPRESSION
  parms[0]        int                      Offset of output following STAT_API
  parms[1]        int                      Offset to system name (optional)
  parms[2]        int                      0
  parms[3]        int                      0
  parms[4]        int                      0
  parms[5]        int                      0
  parms[6]        int                      0

STAT_API
  sa_eye          char[4]                  "STAP"
  sa_len          int                      Length of buffer that follows STAT_API
  sa_ver          int                      1
  sa_flags        char[1]                  0x80 for reset; 0x00 otherwise
  sa_fill         char[3]                  Reserved
  sa_support_ver  int                      Version of data returned
  sa_reserve      int[3]                   Reserved
  posix_time_high unsigned int             High order 32 bits since epoch
  posix_time_low  unsigned int             Low order 32 bits since epoch
  posix_seconds   unsigned int             Microseconds
  pad1            int                      Reserved

API_COMPRESSION_STATS
  comp_eye        char[4]                  "COMP"
  comp_size       short                    Size of the output structure
  comp_version    char                     1
  future1         char                     For future use
  comp_calls      unsigned long long int   Number of compression calls made
  comp_kbytesin   unsigned long long int   Number of kilobytes sent to the zEDC
  comp_kbytesout  unsigned long long int   Number of kilobytes returned by the zEDC
  comp_calltime   unsigned long long int   Average number of microseconds per
  decompress calls
  decompress kbytesout unsigned long long int   Number of kilobytes returned from zEDC
  decompress kbytesout unsigned long long int   Average number of microseconds per
  decompress kbytesout unsigned long long int   Number of kilobytes returned from zEDC
  decompress kbytesout unsigned long long int   Average number of microseconds per
  decompress kbytesout unsigned long long int   For future use
  future2         int[16]                  For future use

Return_value     0 if request is successful, -1 if it is not successful

Return_code
  EINTR         zFS is shutting down
  EINVAL        Invalid parameter list
  EMVSERR       Internal error occurred
  E2BIG         Information too big for buffer supplied
```

z/OS: Distributed File Service zFS Administration
Reason_code
0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes for Statistics Compression Information
1. Reserved fields and undefined flags must be set to binary zeros.

Privilege required
None.

Related services
Encrypt (Decrypt, Compress, Decompress) Aggregate

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>
#include <errno.h>
#define ZFSCALL_STATS 0x40000007
#define STATOP_COMPRESSION   256
#define BUFFER_SIZE   1024 * 64
#define CONVERT_RATIO_TO_INTS(RATIO, INTEGER, DECIMAL)                   
   {                                                                      
      INTEGER = (int)RATIO;                                                
      DECIMAL = (int)((RATIO - (double)INTEGER) * (double)1000.0);         
   }
#define zCOUNT_FIELD(COUNT, COUNT_STRING)                                
   zCOUNT_FIELD_MAX(COUNT, COUNT_STRING, 10)

/* This macro takes a unsigned long long int, a pointer to an output */
/* string pointer and the max len of the output string. */
/* This macro assumes the format field for the string is %%(MAXLEN)s */
#define zCOUNT_FIELD_MAX(COUNT, COUNT_STRING, MAXLEN)                       
   {                                                                           
      unsigned long long int tcount = COUNT;                                    
      char suffixp[3] = {0, 0, 0};                                              
      unsigned long long int max_val[11] = {0LL, 9LL, 99LL, 999LL, 9999LL,      
         99999LL, 999999LL, 9999999LL, 99999999LL, 999999999LL, 9999999999LL};  
      unsigned long long int MAXVAL = max_val[MAXLEN-1];                       
      unsigned long long int maxval = MAXVAL;                                  
      unsigned long long int maxval2 = MAXVAL/10;                             
      unsigned long long int maxval3 = maxval2/10;                            
      if (tcount > maxval)
      {
         if (tcount > maxval1)
         {
            tcount /= 1000ll;
            suffixp[0] = 't';
            if (tcount > maxval2)
            {
                tcount /= 1000ll;
                suffixp[0] = 'm';
                if (tcount > maxval3)
                {
                    tcount /= 1000ll;
                    suffixp[0] = 'b';
                }
            }
        }
      }
```

zFS application programming interface information 353
typedef struct syscall_parmlist_t {
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation */
} syscall_parmlist;

typedef struct reset_time {
    unsigned int posix_time_high;
    unsigned int posix_time_low;
    unsigned int posix_usecs;
    int padi;
} RESET_TIME;

typedef struct stat_api_t {
    #define SA_EYE "STAP"
    char sa_eye[4]; /* 4 byte identifier must be */
    int sa_len; /* length of the buffer to put data into */
    int sa_ver; /* the version number currently always 1 */
    #define SA_VER_INIT 0x01
    char sa_flags; /* command field must be x00 or x80, */
    #define SA_RESET 0x80
    char sa_fill[3]; /* spare bytes */
    int sa_reserve[4]; /* Reserved */
    struct reset_time reset_time_info;
} STAT_API;

typedef struct API_COMPRESSION_STATS_t {
    char comp_eye[4]; /* Eye catcher */
    #define COMP_EYE "COMP"
    short comp_size; /* Size of output structure */
    char comp_version; /* Version of statistics returned */
    char comp_future; /* Future use */
    unsigned long long int comp_calls;
    unsigned long long int comp_kbytesin;
    unsigned long long int comp_kbytesout;
    unsigned long long int comp_calltime;
    unsigned long long int decomp_calls;
    unsigned long long int decomp_kbytesin;
    unsigned long long int decomp_kbytesout;
    unsigned long long int decomp_calltime;
    int comp_future2[16];
} API_COMPRESSION_STATS;

int main(int argc, char** argv) {
    int buff_fill_len = 0;
    int bpxrv, bpxrc, bpxrs;
    char sysname[9];
    STAT_API local_req;
    STAT_API *st_req = NULL;
    syscall_parmlist *parmp = NULL;
    API_COMPRESSION_STATS *statsp = NULL;
    char *buffp = NULL;
    double temp_ratio;
    int whole, decimal;
    char string1[16];
    char string2[16];
    char *p;
    unsigned long long int *temp;

    /* Initialize the local_req to 0s */
    st_req = &local_req;
    memset( st_req, 0x00, sizeof(STAT_API) );

    strncpy( local_req.sa_eye, SA_EYE, sizeof(local_req.sa_eye) );
    local_req.sa_len = sizeof(API_COMPRESSION_STATS);
    local_req.sa_ver = SA_VER_INIT;

    /* Allocate Buffer */
    buffp = (char*) malloc(BUFFER_SIZE);
if( buffp == NULL )
{
    printf("Malloc Error\n");
    return ENOMEM;
}
memset( buffp, 0x00, sizeof(syscall_parmlist) + sizeof(STAT_API));

/* Set the run parms */
parmp = (syscall_parmlist*) &buffp[0];
parmp->opcode   = STATOP_COMPRESSION;
parmp->parms[0] = buff_fill_len = sizeof(syscall_parmlist);
parmp->parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
parmp->parms[2] = 0;
parmp->parms[3] = 0;
parmp->parms[4] = 0;
parmp->parms[5] = 0;
parmp->parms[6] = 0;

st_req = (STAT_API*) &buffp[buff_fill_len];
memcpy( st_req, &local_req, sizeof(STAT_API) );
buff_fill_len += sizeof(STAT_API);

BPX1PCT("ZFS     
ZFCALL_STATS,     /* Aggregate operation */
BUFFER_SIZE,     /* Length of Argument */
(char*) buffp,     /* Pointer to Argument */
&bpxrv,         /* Pointer to Return_value */
&bpxrc,         /* Pointer to Return_code */
&bpxrs);        /* Pointer to Reason_code */

if( bpxrv )
{
    /* Bad Return code */
    printf("Error requesting info for compression stats\n");
    printf("Return Value: %d Return Code: %d Reason Code: %x\n", 
bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
{
    /* Success. Print the information in a table */
    stastp = (API_COMPRESSION_STATS *) &buffp[buff_fill_len];
    
zCOUNT_FIELD(stastp->comp_calls, string1);
    temp_ratio = ((double)stastp->comp_calltime)/1000;
    temp = (unsigned long long int *)&stastp->comp_calltime;
    CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
    printf("-%18s %10s %18s %10s %13.3u \n", 
            "Compression calls:", string1,
            "Avg. call time: ", whole, decimal);
    
zCOUNT_FIELD(stastp->comp_kbytesin, string1);
zCOUNT_FIELD(stastp->comp_kbytesout, string2);
    printf("-%18s %10s %18s %10s \n", 
            "KB input", string1,
            "KB output", string2);
    
zCOUNT_FIELD(stastp->decomp_calls, string1);
    temp_ratio = ((double)stastp->decomp_calltime)/1000;
    temp = (unsigned long long int *)&stastp->decomp_calltime;
    CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
    printf("-%18s %10s %18s %10s %13.3u \n", 
            "Decompression calls:", string1,
            "Avg. call time: ", whole, decimal);
    
zCOUNT_FIELD(stastp->decomp_kbytesin, string1);
zCOUNT_FIELD(stastp->decomp_kbytesout, string2);
    printf("-%18s %10s %18s %10s \n", 
            "KB input", string1,
            "KB output", string2);
    
    printf("\n");
    return 0;
}
}
Purpose

Returns directory cache counters, including the number of requests, hits and discards from the directory cache.

Note: As of z/OS V1R13, this subcommand is no longer used. All output from a call to statistics directory cache information will be zeros.

Format

syscall_parmlist
  opcode                int              249              STATOP_DIR_CACHE
  parms[0]              int              offset to STAT_API
  parms[1]              int              offset of output following STAT_API
  parms[2]              int              offset to system name (optional)
  parms[3]              int              0
  parms[4]              int              0
  parms[5]              int              0
  parms[6]              int              0

STAT_API
  sa_eye                char[4]          "STAP"
  sa_len                int              length of buffer that follows STAT_API
  sa_ver                int              1
  sa_flags              char[1]          0x00
    SA_RESET            0x80             Reset statistics
  sa_fill               char[3]          0
  sa_reserve            int[4]           0
  posix_time_high       unsigned int     high order 32 bits since epoch
  posix_time_low        unsigned int     low order 32 bits since epoch
  posix_useconds        unsigned int     microseconds
  pad1                  int

API_DIR_STATS
  ad_eye                char[4]          "ADIR"
  ad_size               short            size of output
  ad_version            char             version
  ad_reserved1          char             reserved byte
  ad_reserved           int[4]           always zero
  ad_buffers            int              number of buffers in the cache
  ad_buffersize         int              size of each buffer in K bytes
  ad_res1               int              reserved
  ad_reserved           int              reserved
  ad_requests           int              requests to the cache
  ad_res2               int              reserved
  ad_hits               int              hits in the cache
  ad_reserves           int              reserved
  ad_discards           int              discards of data from the cache
  ad_reserved2          int[10]          reserved
  system_name           char[9]          

Return_value     0 if request is successful, -1 if it is not successful
Return_code
  EINVAL         Invalid parameter list
  EMVSERR        Internal error occurred
  E2BIG          Information too big for buffer supplied
Reason_code
  0xEFnnxxxx     See z/OS Distributed File Service Messages and Codes

Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.

Privilege required

None.
Related services
Statistics Vnode Cache Information
Statistics Metadata Cache Information

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLEVEL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>
#include <string.h>
#include <time.h>

#define ZFSCALL_STATS 0x40000007
#define STATOP_DIR_CACHE 249 /* Directory cache stats */
#define CONVERT_RATIO_TO_INTS(RATIO, INTEGER, DECIMAL)                  
{                                                                     
    INTEGER = (int)RATIO;                                               
    DECIMAL = (int)((RATIO - (double)INTEGER) * (double)1000.0);        
}

typedef struct syscall_parmlist_t
{                           
    int          opcode; /* Operation code to perform */
    int          *parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct hyper {
    unsigned int high; /* unsigned int reserved */
    unsigned int low;
} hyper;

typedef struct API_DIR_STATS_t {
    char          ad_eye[4];        /* Eye catcher = ADIR */
#define DS_EYE "ADIR"
    short         ad_size;          /* Size of output structure */
    char          ad_version;       /* Version of stats */
#define DS_VER_INITIAL 1 /* First version of log stats */
    char          ad_reserved1;     /* Reserved byte, 0 in version 1 */
    hyper         ad_buffers;       /* Number of buffers in cache */
    int           ad_buffsize;      /* Size of each buffer in K bytes */
    int           ad_res1;          /* Reserved for future use, zero in version 1 */
    hyper         ad_requests;      /* Requests to the cache */
    hyper         ad_hits;          /* Hits in the cache */
    hyper         ad_discards;      /* Discards of data from cache */
    int           ad_reserved2[10]; /* Reserved for future use */
} API_DIR_STATS;

/* reset timestamp */
typedef struct reset_time {
    unsigned int posix_time_high; /* high order 32 bits since epoch */
    unsigned int posix_time_low;  /* low order 32 bits since epoch */
    unsigned int posix_usecs;     /* microseconds */
    int          pad1;
} RESET_TIME;

/**************************************************************************
* The following structure is the api query control block */
* It is used for all api query commands */
**************************************************************************
typedef struct stat_api_t {
#define SA_EYE "STAP"
    char          sa_eye[4];     /* 4 byte identifier must be */
    int           sa_len;        /* length of the buffer to put data into*/
/* this buffer area follows this struct*/
```
```c
int sa_ver; /* the version number currently always 1*/
#define SA_VER_INITIAL 0x01
char sa_flags; /* flags field must be x00 or x80, x80 means reset statistics*/
#define SA_RESET 0x80
char sa_fill[3]; /* spare bytes */
int sa_reserve[4]; /* Reserved */
struct reset_time reset_time_info;
} STAT_API;

struct parmstruct {
    syscall_parmlist myparms;
    STAT_API myapi;
    API_DIR_STATS mystats;
    char systemname[9];
} myparmstruct;

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    int i;
    double temp_ratio;
    int whole;
    int decimal;
    STAT_API *stapptr = &(myparmstruct.myapi);
    char buf[33];

    myparmstruct.myparms.opcode = STATOP_DIR_CACHE;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
    myparmstruct.myparms.parms[2] = 0;
    /* Only specify a non-zero offset for the next field (parms[2]) if */
    /* you are running z/OS 1.7 and above, and you want to query the directory */
    /* cache statistics of a different system than this one */
    /* myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist) + */
    /*     sizeof(STAT_API) + sizeof(API_DIR_STATS); */
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    memset(stapptr, 0, sizeof(STAT_API));
    memcpy(stapptr->sa_eye, SA_EYE, 4);
    stapptr->sa_ver = SA_VER_INITIAL;
    stapptr->sa_len = (int)sizeof(API_DIR_STATS);
    /* This next field should only be set if parms[2] is non-zero */
    /* strcpy(myparmstruct.systemname,"DCEIMGVQ"); */
    BPX1PCT("ZFS     
    ZFSCALL_STATS,           /* Perf statistics operation */
    sizeof(myparmstruct),    /* Length of Argument */
    &myparmstruct,     /* Pointer to Argument */
    &bpxrv,          /* Pointer to Return_value */
    &bpxrc,          /* Pointer to Return_code */
    &bpxrs);         /* Pointer to Reason_code */

    if (bpxrv < 0)
    {
        printf("Error querying directory cache, ",
    "BPXRV = %d' BPXRC = %d BPXRS = %x\n",
        bpxrv, bpxrc, bpxrs);
        return bpxrc;
    }
    else
    {
        printf("\n%50s\n", "Directory Backing Caching Statistics");
        printf("\n");
        printf("Buffers (K bytes) Requests Hits Ratio Discards \n");
        printf("---------- --------- ---------- ---------- ------ ---------- \
");
        if( myparmstruct.mystats.ad_requests.low == 0 )
            temp_ratio = 0;
        else
            temp_ratio = ((double)myparmstruct.mystats.ad_hits.low) /
                myparmstruct.mystats.ad_requests.low;
        temp_ratio *= 100.0;
```
CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);

decimal = decimal / 100; /* Just want tenths */
printf("%10u %9u %10u %10u %3u.%1.1u%% %10u\n",
    myparmstruct.mystats.ad_buffers.low,
    myparmstruct.mystats.ad_buffers.low * myparmstruct.mystats.ad_buffsize,
    myparmstruct.mystats.ad_requests.low, myparmstruct.mystats.ad_hits.low,
    whole, decimal, myparmstruct.mystats.ad_discards.low);
printf(" \n");

if (0 == ctime_r((time_t*) & stapptr->reset_time_info.posix_time_low, buf))
    printf("Could not get timestamp.\n");
else
    /* Insert the microseconds into the displayable time value */
    strncpy(&(buf[27]), &(buf[20]), 6);
    sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usecs);
    buf[26] = ' ';
    buf[19] = '.';
    printf("Last Reset Time: %s", buf);
}
return 0;
Statistics Iobyaggr Information

Purpose
Displays information about the number of reads and writes (I/Os) and the amount of data in bytes that are transferred for each aggregate.

Format

syscall_parmlist

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Offset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>opcode</td>
<td>int</td>
<td>244</td>
<td>STATOP_IOPYAGGR</td>
</tr>
<tr>
<td>parms[0]</td>
<td>int</td>
<td>offset</td>
<td>offset to STAT_API</td>
</tr>
<tr>
<td>parms[1]</td>
<td>int</td>
<td></td>
<td>offset of output following STAT_API</td>
</tr>
<tr>
<td>parms[2]</td>
<td>int</td>
<td></td>
<td>offset to system name (optional)</td>
</tr>
<tr>
<td>parms[3]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parms[4]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parms[5]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parms[6]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

STAT_API

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sa_eye</td>
<td>char[4]</td>
<td>&quot;STAP&quot;</td>
</tr>
<tr>
<td>sa_len</td>
<td>int</td>
<td>Length of buffer that follows STAT_API</td>
</tr>
<tr>
<td>sa_ver</td>
<td>int</td>
<td>1</td>
</tr>
<tr>
<td>sa_flags</td>
<td>char[1]</td>
<td>$80 - Reset statistics</td>
</tr>
<tr>
<td>sa_reserve</td>
<td>int[3]</td>
<td>Reserved</td>
</tr>
<tr>
<td>posix_time_high</td>
<td>unsigned int</td>
<td>High order 32 bits since epoch</td>
</tr>
<tr>
<td>posix_time_low</td>
<td>unsigned int</td>
<td>Low order 32 bits since epoch</td>
</tr>
<tr>
<td>posix_useconds</td>
<td>unsigned int</td>
<td>Microseconds</td>
</tr>
</tbody>
</table>

IO_REPORT2_2_GRAND_TOTALS

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>io_count</td>
<td>int</td>
<td>Count of IO_REPORT2 lines</td>
</tr>
<tr>
<td>grand_total_reads</td>
<td>unsigned int</td>
<td>Total reads</td>
</tr>
<tr>
<td>grand_total_writes</td>
<td>unsigned int</td>
<td>Total writes</td>
</tr>
<tr>
<td>grand_total_read_bytes</td>
<td>unsigned int</td>
<td>Total bytes read (in kilobytes)</td>
</tr>
<tr>
<td>grand_total_write_bytes</td>
<td>unsigned int</td>
<td>Total bytes written (in kilobytes)</td>
</tr>
<tr>
<td>grand_total_devices</td>
<td>unsigned int</td>
<td>Total number of aggregates</td>
</tr>
<tr>
<td>total_number_waits_for_io</td>
<td>unsigned int</td>
<td>Total number of waits for I/O</td>
</tr>
<tr>
<td>average_wait_time_for_io_whole</td>
<td>unsigned int</td>
<td>Average wait time (whole number), average wait time in milliseconds</td>
</tr>
<tr>
<td>average_wait_time_for_io_decimal</td>
<td>unsigned int</td>
<td>Average wait time (decimal part), decimal part is in thousandths</td>
</tr>
</tbody>
</table>

volser             | char[8]  | DASD volser where aggregate resides              |
read_ind            | char[4]  | R/O or R/W (how aggregate is attached)           |

IO_REPORT2_GRand_TOTALS2

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>io_count</td>
<td>int</td>
<td>Count of IO_REPORT2 lines</td>
</tr>
<tr>
<td>grand_total_reads</td>
<td>unsigned long long</td>
<td>Total reads</td>
</tr>
<tr>
<td>grand_total_writes</td>
<td>unsigned long long</td>
<td>Total writes</td>
</tr>
<tr>
<td>grand_total_read_bytes</td>
<td>unsigned long long</td>
<td>Total bytes read (in kilobytes)</td>
</tr>
<tr>
<td>grand_total_write_bytes</td>
<td>unsigned long long</td>
<td>Total bytes written (in kilobytes)</td>
</tr>
<tr>
<td>grand_total_devices</td>
<td>unsigned long long</td>
<td>Total number of aggregates</td>
</tr>
<tr>
<td>total_number_waits_for_io</td>
<td>unsigned long long</td>
<td>Total number of waits for I/O</td>
</tr>
<tr>
<td>average_wait_time_for_io_whole</td>
<td>unsigned long long</td>
<td>Average wait time (whole number), average wait time in milliseconds</td>
</tr>
<tr>
<td>average_wait_time_for_io_decimal</td>
<td>unsigned long long</td>
<td>Average wait time (decimal part), decimal part is in thousandths</td>
</tr>
</tbody>
</table>

volser             | char[8]  | DASD volser where aggregate resides              |
read_ind            | char[4]  | R/O or R/W (how aggregate is attached)           |

360 z/OS: Distributed File Service zFS Administration
Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.
2. When sa_supported_ver is 0 or 1, output consists of IO_REPORT2_GRAND_TOTALS and IO_REPORT2. When sa_supported_ver is 2, output consists of IO_REPORT2_GRAND_TOTALS2 and IO_REPORT2_2.

Privilege required

None.

Related services

Statistics Iobydasd Information
Statistics Iocounts Information

Restrictions

None.

Examples

```c
#pragma linkage(BPXIPCT, OS)
#pragma LANGLVL(EXTENDED)
extern void BPXIPCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <time.h>
#define ZFSCALL_STATS 0x40000007
#define STATOP_IOBYAGGR 244 /* Performance API queries */
#define E2BIG 145

typedef struct syscall_parmlist_t {
    int               opcode;   /* Operation code to perform */
    int               parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct reset_time {
    unsigned int      posix_time_high; /* high order 32 bits since epoc */
    unsigned int      posix_time_low;  /* low order 32 bits since epoch */
    unsigned int      posix_usecs;     /* microseconds */
    int               pad1;
} RESET_TIME;

/**************************************************************************/
/* The following structure is the api query control block */
/* It is used for all api query commands */
/**************************************************************************/
typedef struct stat_api_t {
```
```c
#define SA_EYE "STAP"
char sa_eye[4];  /* 4 byte identifier must be */
int sa_len;     /* length of the buffer to put data into*/
    /* this buffer area follows this struct */
int sa_ver;     /* the version number currently always 1*/
#define SA_VER_2 0x02
#define SA_VER_INIT 0x01
char sa_flags;  /* flags field must be x00 or x80, */
    /* x80 means reset statistics */
#define SA_RESET 0x80
char sa_fill[3]; /* spare bytes */
int sa_supported_ver; /* version of data returned */
int sa_reserve[3]; /* Reserved */
struct reset_time reset_time_info;
} STAT_API;

typedef struct io_report2_2_t {
    char volser[8];
    unsigned int pavios;
    char read_ind[4];
    unsigned long long int temp_reads;
    unsigned long long int temp_read_bytes;
    unsigned long long int temp_writes;
    unsigned long long int temp_write_bytes;
    char allocation_dsname[84];
    char reserved[4];
} IO_REPORT2_2;

typedef struct io_report2_grand_totals_2_t {
    int io_count;    /* number IO_REPORT2 structs in buffer */
    int pad;
    unsigned long long int grand_total_reads;    /* Total # reads */
    unsigned long long int grand_total_writes;    /* Total # writes */
    unsigned long long int grand_total_read_bytes; /* Total bytes read */
    unsigned long long int grand_total_write_bytes; /* Total bytes written*/
    unsigned long long int grand_total_devices;    /* total # aggregates */
    unsigned long long int total_number_waits_for_io;
    unsigned int average_wait_time_for_io_whole;   /* in milliseconds */
    unsigned int average_wait_time_for_io_decimal; /* in thousandths */
} IO_REPORT2_GRAND_TOTALS_2;

/* Version 1 Output structures */
typedef struct io_report2_t {
    char volser[8];
    unsigned int pavios;
    char read_ind[4];
    unsigned int temp_reads;
    unsigned int temp_read_bytes;
    unsigned int temp_writes;
    unsigned int temp_write_bytes;
    char allocation_dsname[84];
} IO_REPORT2;

typedef struct io_report2_grand_totals_t {
    int io_count;    /* number IO_REPORT2 structs in buffer */
    unsigned int grand_total_reads;    /* Total # reads */
    unsigned int grand_total_writes;    /* Total # writes */
    unsigned int grand_total_read_bytes; /* Total bytes read */
    unsigned int grand_total_write_bytes; /* Total bytes written*/
    unsigned int grand_total_devices;    /* total # aggregates */
    unsigned int total_number_waits_for_io;
    unsigned int average_wait_time_for_io_whole;   /* in milliseconds */
    unsigned int average_wait_time_for_io_decimal; /* in thousandths */
    /* for example, */
    /*3 means .003 and */
    /*300 means .3 */
} IO_REPORT2_GRAND_TOTALS;

struct parmstruct {
    syscall_parmlist myparms;
}
```

Statistics iobyaggr Information
/* output buffer IO_REPORT2_GRAND_TOTALS_2 + multiple IO_REPORT2_2s */
char systemname[9];
}

int print_iobyaggr_version1(IO_REPORT2_GRAND_TOTALS *stgt,
IO_REPORT2 *str2);
int print_iobyaggr_version2(IO_REPORT2_GRAND_TOTALS_2 *stgt,
IO_REPORT2_2 *str2);

int main(int argc, char **argv)
{
  int buffer_success = 0;
  int bpxrv;
  int bpxrc;
  int bpxrs;
  int i,t;
  IO_REPORT2_GRAND_TOTALS_2 *stgt;
  IO_REPORT2_2 *str2;
  char *stsy;
  char buf[33];
  struct parmstruct *myp = &myparmstruct;
  int mypsize;
  int buflen;
  STAT_API *stapptr = &(myparmstruct.myapi);

  myparmstruct.myparms.opcode = STATOP_IOBYAGGR;
  myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
  myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
  /* Only specify a non-zero offset for the next field (parms[2]) if */
  /* you are running z/OS 1.7 and above, and you want to query the */
  /* iobyaggr statistics of a different system than this one */
  /* myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist) */
  /* + sizeof(STAT_API); */
  myparmstruct.myparms.parms[2] = 0;
  myparmstruct.myparms.parms[3] = 0;
  myparmstruct.myparms.parms[4] = 0;
  myparmstruct.myparms.parms[5] = 0;
  myparmstruct.myparms.parms[6] = 0;

  memset(stapptr, 0, sizeof(STAT_API));
  memcpy(stapptr->sa_eye, SA_EYE, 4);
  stapptr->sa_ver = SA_VER_2;
  stapptr->sa_len = 0;
  /* This next field should only be set if parms[2] is non-zero */
  /* strcpy(myparmstruct.systemname,"DCEIMGVQ"); */
  BPX1PCT("ZFS",
    ZFSCALL_STATS, /* Perf statistics operation */
    sizeof(myparmstruct), /* Length of Argument */
    (char *)&myparmstruct, /* Pointer to Argument */
    &bpxrv, /* Pointer to Return_value */
    &bpxrc, /* Pointer to Return_code */
    &bpxrs); /* Pointer to Reason_code */

  for(t = 0; t < 1000 && buffer_success == 0; t++)
  {
    if (bpxrv < 0)
    {
      if (bpxrc == E2BIG)
      {
        buflen = stapptr->sa_len; /* Get buffer size needed */
        mypsize = sizeof(syscall_parmlist) + sizeof(STAT_API) + buflen +
                  sizeof(myparmstruct.systemname);
        free(myp);
        myp = (struct parmstruct *)malloc((int)mypsize);
        memset(myp, 0, sizeof(struct parmstruct));
      }
      else
      { /* Handle return code */
        /* Process data */
      }
    }
  } /* End forloop */

  free(myp); /* Free buff if configured */

  return(buffer_success);
} /* End main */

Statistics iobyaggr Information
zFS application programming interface information 363
memset(myp, 0, mypsize);

printf("Need buffer size of %d, for a total of %d\n\n\n", buflen, mypsize);
myp->myparms.opcode = STATOP_IOBYAGGR;
myp->myparms.parms[0] = sizeof(syscall_parmlist);
myp->myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
myp->myparms.parms[2] = 0;

/* Only specify a non-zero offset for the next field (parms[2]) if */
/* you are running z/OS 1.7 and above, and you want to query the */
/* iobyaggr statistics of a different system than this one */
/* myp->myparms.parms[2] = sizeof(syscall_parmlist) */
/* */
/* + sizeof(STAT_API) + buflen; */

myp->myparms.parms[3] = 0;
myp->myparms.parms[4] = 0;
myp->myparms.parms[5] = 0;
myp->myparms.parms[6] = 0;

stapptr = (STAT_API *)((char *)myp + sizeof(syscall_parmlist));
memcpy(stapptr->sa_eye, SA_EYE, 4);
stapptr->sa_ver = SA_VER_2;
stapptr->sa_len = buflen;

stgt = (IO_REPORT2_GRAND_TOTALS_2 *)((char *)myp +
  sizeof(syscall_parmlist) +
  sizeof(STAT_API) + buflen);

str2 = (IO_REPORT2_2*) ((char*) stgt +
  sizeof(IO_REPORT2_GRAND_TOTALS_2));

/* This next field should only be set if parms[2] is non-zero */
/* strcpy(stsy,"DCEIMGVQ"); */

BPX1PCT("ZFS   ",
  ZFSCALL_STATS, /* Aggregate operation */
  mypsize, /* Length of Argument */
  (char *)myp, /* Pointer to Argument */
  &bpxrv, /* Pointer to Return_value */
  &bpxrc, /* Pointer to Return_code */
  &bpxrs); /* Pointer to Reason_code */

if (bpxrv != 0 && bpxrc == E2BIG )
  printf("E2BIG: %d times total\n", t++);
else if( bpxrv == 0 )
  }
  buffer_success = 1;

if (stapptr->sa_supported_ver == SA_VER_INIT)
  }
    IO_REPORT2_GRAND_TOTALS *stgt_v1;
    IO_REPORT2 *str2_v1;
    stgt_v1 = (IO_REPORT2_GRAND_TOTALS * )((char *)myp +
      sizeof(syscall_parmlist) +
      sizeof(STAT_API));

    str2_v1 = (IO_REPORT2 * ) ((char*) stgt +
      sizeof(IO_REPORT2_GRAND_TOTALS));
    print_iobyaggr_version1(stgt_v1,str2_v1);
  }
else
  print_iobyaggr_version2(stgt, str2);

unsigned int ptl = stapptr->reset_time_info.posix_time_low;
if (0 == ctime_r((time_t *) &ptl, buf))
  printf("Could not get timestamp.\n");
else
  */ Insert the microseconds into the displayable time value */
  strncpy((buf[27]), (buf[20]), 6);
if (t == 1000)
    printf("Number of failed buffer resizes exceeded.\n\n");
free(myp);
return 0;
}

int print_iobyaggr_version2(IO_REPORT2_GRAND_TOTALS_2 *stgt,
                      IO_REPORT2_2              *str2)
{
    int i;
    printf("\zelFS I/O by Currently Attached Aggregate\n");
    printf("\n");
    printf("DASD   PAV\n");
    printf("VOLSER I0s Mode Reads K bytes "
    "Writes     K bytes Dataset Name\n");
    printf("------------- ----------------- "
    "------------------------\n");
    for (i = 0; i < stgt->io_count; i++, str2++)
    {
        printf("%6.6s %3u %s %10llu %10llu %10llu %10llu  %-44.44s",
                str2->volser,
                str2->pavios,
                str2->read_ind,
                str2->temp_reads,
                str2->temp_read_bytes,
                str2->temp_writes,
                str2->temp_write_bytes,
                str2->allocation_dsname);
    }
}

Statistics iobyaggr Information

zFS application programming interface information 365
printf("%6llu %10llu %10llu %10llu %10llu  %-44.44s\n",
stgt->grand_total_devices,
stgt->grand_total_reads,
stgt->grand_total_read_bytes,
stgt->grand_total_writes,
stgt->grand_total_write_bytes, "*TOTALS*");
printf("\n");
printf("Total number of waits for I/O: %10u\n",
stgt->total_number_waits_for_io);
printf("Average I/O wait time: %9u.%3.3u (msecs)\n",
stgt->average_wait_time_for_io_whole,
stgt->average_wait_time_for_io_decimal);
printf("\n");
return 1;
}

int print_iobyaggr_version1(IO_REPORT2_GRAND_TOTALS *stgt,
                        IO_REPORT2 *str2)
{
    int i;
    printf("Version 1 output is being displayed\n");
    printf(" zFS I/O by Currently Attached Aggregate\n");
    printf("\n");
    printf("DASD PAV\n");
    printf("VOLSER IOs Mode Reads    K bytes    "
          "Writes      K bytes    Dataset Name\n");
    printf("-------- -- ------- ------------
");
    for (i = 0; i < stgt->io_count; i++, str2++) {
        printf("%6.6s %3u %s %10u %10u %10u %10u  %-44.44s\n",
st2->volser,
st2->pavios,
st2->read_ind,
st2->temp_reads,
st2->temp_read_bytes,
st2->temp_writes,
st2->temp_write_bytes,
st2->allocation_dsname);
    }
    printf("%6u %10u %10u %10u %10u  %-44.44s\n",
stgt->grand_total_devices,
stgt->grand_total_reads,
stgt->grand_total_read_bytes,
stgt->grand_total_writes,
stgt->grand_total_write_bytes, "*TOTALS*");
    printf("\n");
    printf("Total number of waits for I/O: %10u\n",
stgt->total_number_waits_for_io);
    printf("Average I/O wait time: %9u.%3.3u (msecs)\n",
stgt->average_wait_time_for_io_whole,
stgt->average_wait_time_for_io_decimal);
    printf("\n");
}
Statistics Iobydasd Information

**Purpose**

Displays information about the number of reads and writes and the number of bytes transferred for each DASD volume. The number of I/Os and the amount of data transferred is determined on a DASD basis.

**Format**

syscall_parmlist

<table>
<thead>
<tr>
<th>opcode</th>
<th>int</th>
<th>245</th>
<th>STATOP_IORYDASD</th>
</tr>
</thead>
<tbody>
<tr>
<td>parms[0]</td>
<td>int</td>
<td>offset to STAT_API</td>
<td></td>
</tr>
<tr>
<td>parms[1]</td>
<td>int</td>
<td>offset of output following STAT_API</td>
<td></td>
</tr>
<tr>
<td>parms[2]</td>
<td>int</td>
<td>offset to system name (optional)</td>
<td></td>
</tr>
<tr>
<td>parms[3]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parms[4]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parms[5]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parms[6]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**STAT_API**

| sa_eye | char[4] | "STAP" |
| sa_len | int | length of buffer that follows STAT_API |
| sa_ver | int | 1 or 2 |
| sa_flags | char[1] | 0x00 |
| SA_RESET | 0x80 | Reset statistics |
| sa_fill | char[3] | 0 |
| sa_supported_ver | int | version of data returned |
| sa_reserve | int[3] | 0 |
| posix_time_high | unsigned int | high order 32 bits since epoch |
| posix_time_low | unsigned int | low order 32 bits since epoch |
| posix_usec | unsigned int | microseconds |
| api_iobydasdhdr | number of lines | count of API_IOBYDASD_DATA lines |
| pad | int | 0 |
| grand_total_waits | hyper | total waits |
| average_wait_time_whole | int | average wait time (whole number) |
| average_wait_time_decimal | int | average wait time in milliseconds |
| api_iobydasd_data[number_of_lines] | spare | int | 0 |
| volser | char[6] | DASD volser |
| filler | char[2] | reserved |
| pavios | unsigned int | max number of concurrent I/Os zFS will issue for this DASD |
| reads | unsigned int | count of reads for this DASD |
| read_bytes | unsigned int | bytes read for this DASD (in kilobytes) |
| writes | unsigned int | count of writes for this DASD |
| write_bytes | unsigned int | bytes written for this DASD (in kilobytes) |
| waits | unsigned int | waits |
| avg_wait_whole | int | average wait time (whole number) |
| avg_wait_decimal | int | average wait time in milliseconds |
| --or-- | API_IOBYDASD_DATA2[number_of_lines] | spare | int | 0 |
| volser | char[6] | DASD volser |
| filler | char[2] | reserved |
| unsigned int | unsigned long long int | max number of concurrent I/Os zFS will issue for this DASD |
| reads | unsigned long long int | count of reads for this DASD |
| read_bytes | unsigned long long int | bytes read for this DASD (in kilobytes) |
| writes | unsigned long long int | count of writes for this DASD |
| write_bytes | unsigned long long int | bytes written for this DASD (in kilobytes) |
| waits | unsigned long long int | waits |
| avg_wait_whole | int | average wait time (whole number) |
| avg_wait_decimal | int | average wait time in milliseconds |

zFS application programming interface information 367
systemname      char[9]
Return_value     0 if request is successful, -1 if it is not successful
Return_code
EINTR          zFS is shutting down
EINVAL         Invalid parameter list
EMVSERR        Internal error occurred
E2BIG          Information too big for buffer supplied
Reason_code
0xEFnnxxxx     See z/OS Distributed File Service Messages and Codes

Usage notes
1. Reserved fields and undefined flags must be set to binary zeros.
2. When sasupported_ver is 0 or 1, the output consists of API_IOBYDASD_HDR and
   API_IOBYDASD_DATA. When sasupported_ver is 2, the output consists of API_IOBYDADD_HDR
   and API_IOBYDASD_DATA2.

Privilege required
None.

Related services
Statistics Iobyaggr Information
Statistics Iocounts Information

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *
#include <stdio.h>
#define ZFSCALL_STATS   0x40000007
#define STATOP_IOBYDASD 245     /* Performance API queries */
#define E2BIG           145
#define ENOMEM          132

typedef struct syscall_parmlist_t {
    int               opcode;   /* Operation code to perform */
    int               parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct reset_time {
    unsigned int            posix_time_high; /* high order 32 bits since epoc */
    unsigned int            posix_time_low; /* low order 32 bits since epoch */
    unsigned int            posix_usecs;  /* microseconds */
    int                     pad1;
} RESET_TIME;

typedef struct hyper_t {
    unsigned int high; /* unsigned int reserved */
    unsigned int low;
} hyper;

 /*********************************************************************/
/* The following structure is the api query control block */
/* It is used for all api query commands */
typedef struct stat_api_t {
```
#define SA_EYE "STAP"

char sa_eye[4]; /* 4 byte identifier must be */

int sa_len; /* length of the buffer to put data into*/
/* this buffer area follows this struct */

int sa_ver; /* the version number currently always 1*/

#define SA_VER_2 0x02
#define SA_VER_INIT 0x01
char sa_flags; /* flags field must be x00 or x80, */
/* x80 means reset statistics */

#define SA_RESET 0x80
char sa_fill[3]; /* spare bytes */

int sa_supported_ver; /* version of data returned */

int sa_reserve[3]; /* Reserved */

struct reset_time reset_time_info;
} STAT_API;

typedef struct api_iobydasd_hdr
{
    int number_of_lines;
    int pad;
    hyper grand_total_waits;
    int avg_wait_time_whole; /* in milliseconds */
    int avg_wait_time_decimal; /* in thousandths */
    /* of milliseconds */
    /* for example, 3 means .003 */
    /* and 300 means .3 */
} API_IOBYDASD_HDR;

typedef struct api_iobydasd_data_2
{
    int spare;
    char volser[6];
    char filler[2];
    unsigned int pavios;
    unsigned long long int reads;
    unsigned long long int read_bytes;
    unsigned long long int writes;
    unsigned long long int write_bytes;
    unsigned long long int waits;
    int avg_wait_whole;
    int avg_wait_decimal;
} API_IOBYDASD_DATA_2;

/* Version 1 output structure */
typedef struct api_iobydasd_data
{
    int spare;
    char volser[6];
    char filler[2];
    unsigned int pavios;
    unsigned int reads;
    unsigned int read_bytes;
    unsigned int writes;
    unsigned int write_bytes;
    unsigned int waits;
    int avg_wait_whole;
    int avg_wait_decimal;
} API_IOBYDASD_DATA;

struct parmstruct {
    syscall_parmlist myparms;
    STAT_API myapi;
    /* output buffer API_IOBYDASD_HDR + multiple API_IOBYDASD_DATA_2s */
    char systemname[9];
} myparmstruct;

int print_iobydasd_version1(API_IOBYDASD_HDR* stdh,
    API_IOBYDASD_DATA *stdd);
int print_iobydasd_version2(API_IOBYDASD_HDR* stdh,
    API_IOBYDASD_DATA_2 *stdd);

int main(int argc, char **argv)
{
    int buffer_success = 0;
    int bpxrv;
    int bpxrc;
    int bpxrs;
    int i,t;
    API_IOBYDASD_HDR *stdh;
    API_IOBYDASD_DATA_2 *stdd;
    char *stsy;

    Statistics iobydasd Information
zFS application programming interface information 369
Statistics iobydasd Information

```c
char                buf[33];
struct parmstruct   *myp = &myparmstruct;
int                 mypsize;
int                 buflen;
STAT_API            *stapptr = &(myparmstruct.myapi);

myparmstruct.myparms.opcode   = STATOP_IOBYDASD;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
myparmstruct.myparms.parms[2] = 0;

/* Only specify a non-zero offset for the next field (parms[2]) if */
/* you are running z/OS 1.7 and above, and you want to query the */
/* iobydasd statistics of a different system than this one        */
/* myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist)        */
/* + sizeof(STAT_API);                                          */

myparmstruct.myparms.parms[3] = 0;
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;

memset(stapptr, 0, sizeof(STAT_API));
memcpy(stapptr->sa_eye, SA_EYE, 4);
stapptr->sa_ver = SA_VER_2;
stapptr->sa_len = 0;

/* This next field should only be set if parms[2] is non-zero */
/* stcpy(myparmstruct.systemname, "DCEIMGVQ"); */

BPX1PCT("ZFS ",
    ZFSCALL_STATS,              /* Perf statistics operation */
    sizeof(myparmstruct),       /* Length of Argument */
    (char *)&myparmstruct,      /* Pointer to Argument */
    &bpxrv,                     /* Pointer to Return_value */
    &bpxrc,                     /* Pointer to Return_code */
    &bpxrs);                    /* Pointer to Reason_code */

for(t = 0; t < 1000 && buffer_success == 0; t++)
{
    if (bpxrv < 0)
    {
        if (bpxrc == E2BIG)
        {
            buflen = stapptr->sa_len; /* Get buffer size needed */
            mypsize = sizeof(syscall_parmlist) + sizeof(STAT_API) + buflen +
                      sizeof(myparmstruct.systemname);

            free(myp);
            myp = (struct parmstruct *)malloc((int)mypsise);
            memset(myp, 0, mypsize);

            printf("Need buffer size of %d, for a total of %d\n\n",
                   buflen, mypsize);
            myp->myparms.opcode = STATOP_IOBYDASD;
            myp->myparms.parms[0] = sizeof(syscall_parmlist);
            myp->myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
            myp->myparms.parms[2] = 0;

            /* Only specify a non-zero offset for the next field (parms[2]) if */
            /* you are running z/OS 1.7 and above, and you want to query the */
            /* iobydasd statistics of a different system than this one        */
            /* myp->myparms.parms[2] = sizeof(syscall_parmlist)                */
            /* + sizeof(STAT_API) + buflen;                                   */

            myp->myparms.parms[3] = 0;
            myp->myparms.parms[4] = 0;
            myp->myparms.parms[5] = 0;
            myp->myparms.parms[6] = 0;

            stapptr = (STAT_API *)((char *)myp + sizeof(syscall_parmlist));
            memcpy(stapptr->sa_eye, SA_EYE, 4);
stapptr->sa_ver = SA_VER_2;
stapptr->sa_len = buflen;
            stdh = (API_IOBYDASD_HDR *)((char *)myp +
                sizeof(syscall_parmlist) + sizeof(STAT_API));
            stdd = (API_IOBYDASD_DATA_2*)((char*)stdh + sizeof(API_IOBYDASD_HDR));

            stsy = (char *)((char *)myp + sizeof(syscall_parmlist) +
                sizeof(STAT_API) + buflen);

            /* This next field should only be set if parms[2] is non-zero */
            /* stcpy(stsy, "DCEIMGVQ"); */
        }
    }
}
```
BPX1PCT("ZFS
    ,
    ZFSCALL_STATS,  /* Perf stats operation */
    mypsize,        /* Length of Argument */
    (char *)myp,    /* Pointer to Argument */
    &bpxrv,        /* Pointer to Return_value */
    &bpxrc,        /* Pointer to Return_code */
    &bpxrs);        /* Pointer to Reason_code */
if( bpxrv != 0 && bpxrc == E2BIG )
    printf("E2BIG: %d times total\n", t++);
else if( bpxrv == 0 )
    {
    buffer_success = 1;
    if( stapptr->sa_supported_ver == SA_VER_INIT )
        {
        API_IOBYDASD_DATA *stdd_v1;
        stdd_v1 = (API_IOBYDASD_DATA *)((char *)stdh +
        sizeof(API_IOBYDASD_HDR));
        print_iobydasd_version1(stdh, stdd_v1);
        }
    else
        print_iobydasd_version2(stdh, stdd);

    unsigned int ptl = stapptr->reset_time_info.posix_time_low;
    if (0 == ctime_r((time_t *)&ptl, buf))
        printf("Could not get timestamp.\n");
    else
        {
        /* Insert the microseconds into the displayable time value */
        strncpy(&buf[27]), &buf[20]), 6);
        printf(&buf[20], "Last Reset Time: %s", buf);
        }
    free(myp);
    }
else
    { /* iobydasd failed with large enough buffer */
    printf("Error on iobydasd with large enough buffer\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
    }
else
    /* error was not E2BIG */
    printf("Error on iobydasd trying to get required size\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
    }
else
    /* asking for buffer size gave rv = 0; maybe there is no data */
    if (myparmstruct.myapi.sa_len == 0)
        {
        printf("No data\n");
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        }
    else
        { /* No, there was some other problem with getting the size needed */
        printf("Error getting size required\n");
        printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
        free(myp);
        return bpxrc;
        }
    if( t == 1000 )
        printf("Number of failed buffer resizes exceeded.\n");
    free(myp);
    return 0;
    }

int print_iobydasd_version2(API_IOBYDASD_HDR* stdh,
    API_IOBYDASD_DATA_2 *stdd)
Statistics iobydasd Information

```c
int i;
printf("%40czFS I/O by Currently Attached DASD/VOLs
", '');
printf("\n");
printf("DASD PAV\n");
printf("VOLSER IOs Reads K bytes "
"Writes
"K bytes Waits Average Wait\n");
printf("-------- ----------------- ----------------- ---------
"""");
printf("----------------- ----------------- ---------
");
printf("----------------- ----------------- ---------
");
for (i = 0; i < stdh->number_of_lines; i++, stdd++)
{
    printf("%6.6s %3u %20llu %20llu %20llu %20llu %6u.%3.3u
", 
        stdd->volser, 
        stdd->pavios, 
        stdd->reads, 
        stdd->write_bytes, 
        stdd->writes, 
        stdd->avg_wait_whole, 
        stdd->avg_wait_decimal);
}
printf("\n");
printf("Total number of waits for I/O: %u,,%u
", 
        stdh->grand_total_waits.high, stdh->grand_total_waits.low);
printf("Average I/O wait time: %9u.%3.3u (msecs)\n", 
        stdh->avg_wait_time_whole, 
        stdh->avg_wait_time_decimal);
printf("\n");
return 1;
}
```
Statistics Iocounts Information

Purpose
Displays information about how often zFS performs I/O for various circumstances and how often it waits on that I/O.

Format

```c
syscall_parmlist
opcode        int          243          STATOP_IOCOUNTS
parms[0]      int          Offset to STAT_API
parms[1]      int          Offset of output following STAT_API
parms[2]      int          Offset to system name (optional)
parms[3]      int          0
parms[4]      int          0
parms[5]      int          0
parms[6]      int          0

STAT_API
sa_eye        char[4]     "STAP"
sa_len        int          Length of buffer following STAT_API
sa_ver        int          1 or 2
sa_flags      char[1]     0x80 - Reset statistics
sa_fill       char[3]     Reserved
sa_supported_ver  int          Version of data returned
sa_reserve    int[3]     Reserved
posix_time_high unsigned int     High order 32 bits since epoch
posix_time_low unsigned int     Low order 32 bits since epoch
posix_useconds unsigned int     Microseconds

API_IO_BY_TYPE[3]
number_of_lines unsigned int     Count of API_IO_BY_TYPE lines (3)
count          unsigned int     Count of I/Os for type
waits          unsigned int     Number of waits for type
cancels        unsigned int     Number of cancels for type
merges         unsigned int     Number of merges for type
type           typechar[6]     Reserved
description    char[54]      Type description

API_IO_BY_CIRC[19]
number_of_lines unsigned int     Count of API_IO_BY_CIRC lines (19)
count          unsigned int     Count of I/Os for circumstance
waits          unsigned int     Number of waits for circumstance
cancels        unsigned int     Number of cancels for circumstance
merges         unsigned int     Number of merges for circumstance
type           typechar[6]     Reserved
description    char[54]      Circumstance description

-- or --

API_IO_HDR
number_of_type_lines unsigned int     Number of API_IO_BY_TYPE2 lines (3)
umber_of_circ_lines unsigned int     Number of API_IO_BY_CIRC2 lines (19)
reserved[6]    int          Reserved

API_IO_BY_TYPE2[3]
count          unsigned long long  Count of I/Os for type
waits          unsigned long long  Number of waits for type
cancels        unsigned long long  Number of cancels for type
merges         unsigned long long  Number of merges for type
type           char[6]      Reserved
description    char[54]      Type description
pad1           char[4]      Pad bytes

API_IO_BY_CIRC2[19]
count          unsigned long long  Count of I/Os for circumstance
waits          unsigned long long  Number of waits for circumstance
cancels        unsigned long long  Number of cancels for circumstance
merges         unsigned long long  Number of merges for circumstance
type           char[6]      Reserved
description    char[54]      Circumstance description
pad1           char[4]      Pad bytes

systemname     char[9]

Return_value  0 if request is successful, -1 if it is not successful

Return_code
EINTR          zFS is shutting down
EINVAL         Invalid parameter list
```
Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.
2. When sa_supported_ver is 0 or 1, the output consists of API_IO_BY_TYPE and 
   API_IO_BY_CIRC. When sa_supported_ver is 2, the output consists of API_IO_HDR, 
   API_IO_BY_TPYE2, and API_IO_BY_CIRC2

Privilege required

None.

Related services

Statistics Iobyaggr Information
Statistics Iobydasd Information

Restrictions

None.

Examples

```c
#include <stdio.h>
#define ZFSSCALL_STATS   0x40000007
#define STATOP_IOCOUNTS 243 /* Performance API queries */
#define TOTAL_TYPES     3
#define TOTAL_CIRC      19
#define SA_VER_INIT     0x01

typedef struct syscall_parmlist_t
{
    int               opcode;   /* Operation code to perform */
    int               parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct reset_time {
    unsigned int            posix_time_high; /*high order 32 bits since epoc*/
    unsigned int            posix_time_low;  /*low order 32 bits since epoch*/
    unsigned int            posix_usecs;     /*microseconds */
    int                     pad1;
} RESET_TIME;

typedef struct stat_api_t {
    #define            SA_EYE "STAP"
    char              sa_eye[4];     /* 4 byte identifier must be */
    int               sa_len;       /* length of the buffer to put data into*/
    /* this buffer area follows this struct */
    int               sa_ver;       /* the version number currently always 1*/
    char              sa_flags;     /* flags field must be x00 or x80, */
    /* x80 means reset statistics */
    #define            SA_VER_2 0x02
    char              sa_supported_ver; /* version of data returned */
    int               sa_reserve[3]; /* Reserved */
```

Statistics iocounts Information

374 z/OS: Distributed File Service zFS Administration
struct reset_time reset_time_info;
} STAT_API;

typedef struct api_iocount_hdr_2 {
    int number_of_type_lines;
    int number_of_circ_lines;
    int reserved[6];
} API_IOCOUNTHDR_2;

typedef struct API_IO_BY_TYPE_2_t {
    unsigned long long int count;
    unsigned long long int waits;
    unsigned long long int cancels; /* Successful cancels of IO */
    unsigned long long int merges; /* Successful merges of IO */
    char type[6];
    char description[54]; /*add 3 bytes for padding */
    char reserved[4];
} API_IO_BY_TYPE_2;

typedef struct API_IO_BY_CIRC_2_t {
    unsigned long long int count;
    unsigned long long int waits;
    unsigned long long int cancels;
    unsigned long long int merges;
    char type[6];
    char description[54]; /*add 3 bytes for padding */
    char reserved[4];
} API_IO_BY_CIRC_2;

/* Version 1 structures */
typedef struct API_IO_BY_TYPE_t {
    unsigned int number_of_lines;
    unsigned int count;
    unsigned int waits;
    unsigned int cancels; /* Successful cancels of IO */
    unsigned int merges; /* Successful merges of IO */
    char reserved1[6];
    char description[51];
    char pad1[3];
} API_IO_BY_TYPE;

typedef struct API_IO_BY_CIRC_t {
    unsigned int number_of_lines;
    unsigned int count;
    unsigned int waits;
    unsigned int cancels;
    unsigned int merges;
    char reserved1[6];
    char description[51];
    char pad1[3];
} API_IO_BY_CIRC;

/*********************************************************************/
/* The following structures are used to represent cfgop queries */
/* for iocounts */
/*********************************************************************/
struct parmstruct {
    syscall_parmlist myparms;
    STAT_API myapi;
    API_IOCOUNTHDR_2 myiocounthdr;
    API_IO_BY_TYPE_2 mystatsbytype[TOTAL_TYPES];
    API_IO_BY_CIRC_2 mystatsbycirc[TOTAL_CIRC];
    char systemname[9];
} myparmstruct;

int print_iocounts_version1(STAT_API* stapptr);
int print_iocounts_version2(STAT_API          *stapptr,
                           API_IOCOUNTHDR_2 *hdrptr,
                           API_IO_BY_TYPE_2  *stiotptr,
                           API_IO_BY_CIRC_2  *stiocptr);

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    int i;
    STAT_API *stapptr = &(myparmstruct.myapi);
    API_IOCOUNTHDR_2 *hdrptr = &(myparmstruct.myiocounthdr);
    ...
Statistics iocounts Information

APfIOfBYfTYPE_2_fstiotpfr = &(myparmstruct.mystatsbytype[0]);
APfIOfBYfCIRC_2_fstioctpfr = &(myparmstruct.mystatsbycirc[0]);
char buf[33];

myparmstruct.myparms.opcode = STATOP_IOCOUNTS;
myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) +
    sizeof(STAT_API);
myparmstruct.myparms.parms[2] = 0;

/* Only specify a non-zero offset for the next field (parms[2]) if you are running z/OS 1.7 and above, and you want to query the iocounts of a different system than this one */
/* myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist) */
/* + sizeof(STAT_API) */
/* + (sizeof(API_IOCOUNT_HDR_2 */
/* + TOTAL_TYPES * sizeof(API_IO_BY_TYPE_2)) */
/* + (TOTAL_CIRC * sizeof(API_IO_BY_CIRC_2)); */

myparmstruct.myparms.parms[3] = 0;
myparmstruct.myparms.parms[4] = 0;
myparmstruct.myparms.parms[5] = 0;
myparmstruct.myparms.parms[6] = 0;

memset(stapptr, 0, sizeof(STAT_API));
memcpy(stapptr->sa_eye, SA_EYE, 4);
stapptr->sa_ver = SA_VER_2;
stapptr->sa_len = (int)(sizeof(API_IOCOUNT_HDR_2) +
    TOTAL_TYPES * sizeof(API_IO_BY_TYPE_2)) +
    TOTAL_CIRC * sizeof(API_IO_BY_CIRC_2));

/* This next field should only be set if parms[2] is non-zero */
/* strcpy(myparmstruct.systemname,"DCEIMGVQ"); */

BPX1PCT("ZFS ",
    ZFSCALL_STATS,
    /* Perf statistics operation */
    sizeof(myparmstruct),
    /* Length of Argument */
    (char *)&myparmstruct,
    /* Pointer to Argument */
    &bpvxv,
    /* Pointer to Return_value */
    &bpvxcn,
    /* Pointer to Return_code */
    &bpvrs);

if (bpvxv < 0)
{
    printf("Error querying iocounts, BPXRV = %d BPXRC = %d BPXRS = %x\n",
        bpvxv, bpvxcn, bpvrs);
    return bpvxcn;
}
else
{
    /* Check the output that version that was returned */
    if (stapptr->sa_supported_ver == SA_VER_INIT)
        print_iocounts_version1(stapptr);
    else
        print_iocounts_version2(stapptr, hdrptr, stiotptr, stiocptr);

    unsigned int ptl = stapptr->reset_time_info.posix_time_low;
    if (0 == ctime_r((time_t *) &ptl, buf))
        printf("Could not get timestamp.\n");
    else
    {
        /* Insert the microseconds into the displayable time value */
        strncpy(&(buf[27]), &(buf[20]), 6);
        sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usecs);
        buf[26] = ' ':buf[19] = '.';
        printf("Last Reset Time: %s", buf);
    }

    return 0;
}

int print_iocounts_version1(STAT_API* stapptr)
{
    char *p = (char*) stapptr;
p += sizeof(STAT_API);
    API_IO_BY_TYPE *stiotptr = (API_IO_BY_TYPE*) p;
p += sizeof(API_IO_BY_TYPE) * TOTAL_TYPES;
    API_IO_BY_CIRC *stiocptr = (API_IO_BY_CIRC*) p;

    int i;
    printf("Displaying Version 1 Output\n");

    int print_iocounts_version2(STAT_API* stapptr, STAT_API* hdrptr, API_IO_BY_TYPE* stiotptr, API_IO_BY_CIRC* stiocptr)
    {
        char *p = (char*) stapptr;
p += sizeof(STAT_API);
p += sizeof(API_IOCOUNT_HDR_2) +
    TOTAL_TYPES * sizeof(API_IO_BY_TYPE_2) +
    TOTAL_CIRC * sizeof(API_IO_BY_CIRC_2));

    /* Check the output that version that was returned */
    if (stapptr->sa_supported_ver == SA_VER_INIT)
        print_iocounts_version1(stapptr);
    else
        print_iocounts_version2(stapptr, hdrptr, stiotptr, stiocptr);

    unsigned int ptl = stapptr->reset_time_info.posix_time_low;
    if (0 == ctime_r((time_t *) &ptl, buf))
        printf("Could not get timestamp.\n");
    else
    {
        /* Insert the microseconds into the displayable time value */
        strncpy(&(buf[27]), &(buf[20]), 6);
        sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usecs);
        buf[26] = ' ':buf[19] = '.';
        printf("Last Reset Time: %s", buf);
    }

    return 0;
}

int print_iocounts_version2(STAT_API* stapptr, STAT_API* hdrptr, API_IO_BY_TYPE* stiotptr, API_IO_BY_CIRC* stiocptr)
{
    char *p = (char*) stapptr;
p += sizeof(STAT_API);
p += sizeof(API_IOCOUNT_HDR_2) +
    TOTAL_TYPES * sizeof(API_IO_BY_TYPE_2) +
    TOTAL_CIRC * sizeof(API_IO_BY_CIRC_2));

    /* Check the output that version that was returned */
    if (stapptr->sa_supported_ver == SA_VER_INIT)
        print_iocounts_version1(stapptr);
    else
        print_iocounts_version2(stapptr, hdrptr, stiotptr, stiocptr);

    unsigned int ptl = stapptr->reset_time_info.posix_time_low;
    if (0 == ctime_r((time_t *) &ptl, buf))
        printf("Could not get timestamp.\n");
    else
    {
        /* Insert the microseconds into the displayable time value */
        strncpy(&(buf[27]), &(buf[20]), 6);
        sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usecs);
        buf[26] = ' ':buf[19] = '.';
        printf("Last Reset Time: %s", buf);
    }

    return 0;
}

int print_iocounts_version2(STAT_API* stapptr, STAT_API* hdrptr, API_IO_BY_TYPE* stiotptr, API_IO_BY_CIRC* stiocptr)
{
    char *p = (char*) stapptr;
p += sizeof(STAT_API);
p += sizeof(API_IOCOUNT_HDR_2) +
    TOTAL_TYPES * sizeof(API_IO_BY_TYPE_2) +
    TOTAL_CIRC * sizeof(API_IO_BY_CIRC_2));

    /* Check the output that version that was returned */
    if (stapptr->sa_supported_ver == SA_VER_INIT)
        print_iocounts_version1(stapptr);
    else
        print_iocounts_version2(stapptr, hdrptr, stiotptr, stiocptr);

    unsigned int ptl = stapptr->reset_time_info.posix_time_low;
    if (0 == ctime_r((time_t *) &ptl, buf))
        printf("Could not get timestamp.\n");
    else
    {
        /* Insert the microseconds into the displayable time value */
        strncpy(&(buf[27]), &(buf[20]), 6);
        sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usecs);
        buf[26] = ' ':buf[19] = '.';
        printf("Last Reset Time: %s", buf);
    }

    return 0;
}

int print_iocounts_version2(STAT_API* stapptr, STAT_API* hdrptr, API_IO_BY_TYPE* stiotptr, API_IO_BY_CIRC* stiocptr)
{
    char *p = (char*) stapptr;
p += sizeof(STAT_API);
p += sizeof(API_IOCOUNT_HDR_2) +
    TOTAL_TYPES * sizeof(API_IO_BY_TYPE_2) +
    TOTAL_CIRC * sizeof(API_IO_BY_CIRC_2));

    /* Check the output that version that was returned */
    if (stapptr->sa_supported_ver == SA_VER_INIT)
        print_iocounts_version1(stapptr);
    else
        print_iocounts_version2(stapptr, hdrptr, stiotptr, stiocptr);

    unsigned int ptl = stapptr->reset_time_info.posix_time_low;
    if (0 == ctime_r((time_t *) &ptl, buf))
        printf("Could not get timestamp.\n");
    else
    {
        /* Insert the microseconds into the displayable time value */
        strncpy(&(buf[27]), &(buf[20]), 6);
        sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usecs);
        buf[26] = ' ':buf[19] = '.';
        printf("Last Reset Time: %s", buf);
    }

    return 0;
}
if (stiotptr->number_of_lines != TOTAL_TYPES)
{
    printf("Unexpected number of IO Types, %d instead of TOTAL_TYPES\n", 
stiotptr->number_of_lines);
    return 1;
}
if (stiocptr->number_of_lines != TOTAL_CIRC)
{
    printf("Unexpected number of IO Circumstances, %d instead of TOTAL_CIRC\n", 
stiocptr->number_of_lines);
    return 2;
}
printf("\n    I/O Summary By Type\n");
printf("-----------\n");
printf("Count    Waits    Cancels    Merges    Type\n");
printf("---------- ---------- ---------- ---------- ----------\n");
for (i = 0; i < TOTAL_TYPES; i++)
{
    printf("%10u %10u %10u %10u %s\n", 
stiotptr->count, stiotptr->waits, 
stiotptr->cancels, stiotptr->merges, 
stiotptr->description);
    stiotptr = stiotptr + 1;
}
printf("\n");
printf("    I/O Summary By Circumstance\n");
printf("-----------\n");
printf("Count    Waits    Cancels    Merges    Circumstance\n");
printf("---------- ---------- ---------- ---------- ------------\n");
for (i = 0; i < TOTAL_CIRC; i++)
{
    printf("%10u %10u %10u %10u %s\n", 
stiocptr->count, stiocptr->waits, 
stiocptr->cancels, stiocptr->merges, 
stiocptr->description);
    stiocptr = stiocptr + 1;
}
return 0;

int print_iocounts_version2(STAT_API          *stapptr, 
    API_IOCOUNT_HDR_2 *hdrptr, 
    API_IO_BY_TYPE_2  *stiotptr, 
    API_IO_BY_CIRC_2  *stiocptr)
{
    int i;
    if (hdrptr->number_of_type_lines != TOTAL_TYPES)
    {
        printf("Unexpected number of IO Types, %d instead of TOTAL_TYPES\n", 
hdrptr->number_of_type_lines);
        return 1;
    }
    if (hdrptr->number_of_circ_lines != TOTAL_CIRC)
    {
        printf("Unexpected number of IO Circumstances, %d instead of TOTAL_CIRC\n", 
hdrptr->number_of_circ_lines);
        return 2;
    }
    printf("\n    I/O Summary By Type\n");
    printf("-----------\n");
    printf("Count    Merges    Type\n");
    printf("---------- ---------- \n");
    printf("---------- \n");
    for (i = 0; i < TOTAL_TYPES; i++)
    {
        printf("%20llu %20llu %20llu %20llu %s\n", 
stiotptr->count, stiotptr->waits, 
stiotptr->cancels, stiotptr->merges, 
stiotptr->description);
        stiotptr = stiotptr + 1;
    }
    printf("\n");
<table>
<thead>
<tr>
<th>Count</th>
<th>Waits</th>
<th>Cancels</th>
<th>Merges</th>
<th>Circumstance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

for (i = 0; i < TOTAL_CIRC; i++)
{
    printf("%lu %lu %lu %s
",
            stiocptr->count, stiocptr->waits,
            stiocptr->cancels, stiocptr->merges,
            stiocptr->description);
    stiocptr = stiocptr + 1;
    printf("\n");
}
return 0;
**Statistics Kernel Information**

**Purpose**

A performance statistics operation that returns kernel counters, including the number of kernel operations and average time for the operation.

**Format**

```c
syscall_parmlist
  opcode    int    246    STATOP_KNPFS
parms[0]   int    Offset to STAT_API
parms[1]   int    Offset of output following STAT_API
parms[2]   int    Offset to system name (optional)
parms[3]   int    0
parms[4]   int    0
parms[5]   int    0
parms[6]   int    0

STAT_API
  sa_eye    char[4]    "STAP"
  sa_len    int    Length of buffer following STAT_API
  sa_ver    int    1 or 2 - Reset statistics
  sa_flags  char[1]    0x80 - Reset statistics
  sa_fill   char[3]    Reserved
  sa_supported_ver    int    Version of data returned or 0
  sa_reserve    int[3]    Reserved
  posix_time_high    unsigned int    High order 32 bits since epoch
  posix_time_low    unsigned int    Low order 32 bits since epoch
  posix_useconds    unsigned int    Microseconds
  pad1    int    Reserved

KERNEL_CALL_STATS
  kc_eye                        char[8]    Reserved
  kc_version       short    Reserved
  kc_len           short    Reserved
  pad1             int    Reserved

KERNEL_LINE[40]
  kl_operation_name    char[27]    Operation name string
  kl_valid           char    Operation entry is valid (0x01)
  kl_count         unsigned int    Count of operations
  kl_time          two_words    High - integer part of average time
  kl_bytes         hyper    Bytes associated with read and write operations, 0 otherwise
  kl_time_whole    unsigned int    Whole portion of average time
  kl_time_decimal  unsigned int    Decimal portion of average time
  pad1             int    Reserved

-- or --

KERNEL_CALL_STATS2
  kc_eye                        char[8]    "KCSTAT2"
  kc_version       short    1
  kc_len           short    Size of KERNEL_CALL_STATS2
  pad1             int    Reserved
  kc_kernel_line_count  unsigned int    Number of KERNEL_LINE2s
  kc_client_line_count  unsigned int    Number of KERNEL_LINE2s for clients
  kc_totalops        unsigned long long    Total operations
  kc_totalxcfops     unsigned long long    Total xcf operations
  kc_client_totalops unsigned long long    Total operations for clients
  kc_client_totalxcfops unsigned long long    Total xcf operations for clients
  kc_totaltime        hyper    High=integer part of average wait time
  kc_totaltime_whole  unsigned int    Whole portion of average time
  kc_totaltime_decimal  unsigned int    Decimal portion of average total time
```
Statistics Kernel Information

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>kc_client_totaltime_whole</td>
<td>unsigned int</td>
<td>Whole portion of average client total time</td>
</tr>
<tr>
<td>kc_client_totaltime_decimal</td>
<td>unsigned int</td>
<td>Decimal portion of average client total time</td>
</tr>
<tr>
<td>kc_reserved[10]</td>
<td>int</td>
<td>Reserved</td>
</tr>
<tr>
<td>KERNEL_LINE2[n]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>kl_operation_name</td>
<td>char[27]</td>
<td>Operation name string</td>
</tr>
<tr>
<td>kl_valid</td>
<td>char</td>
<td>1 - operation entry valid</td>
</tr>
<tr>
<td>padl</td>
<td>int</td>
<td>Reserved</td>
</tr>
<tr>
<td>kl_xcfcount</td>
<td>unsigned long</td>
<td>Count of xcf operations</td>
</tr>
<tr>
<td>kl_time</td>
<td>hyper</td>
<td>High=integer part of average time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low=fractional part of average time</td>
</tr>
<tr>
<td>kl_bytes</td>
<td>unsigned long</td>
<td>Bytes in read and write operations, otherwise 0</td>
</tr>
<tr>
<td>kl_reserved</td>
<td>int[4]</td>
<td>Reserved</td>
</tr>
<tr>
<td>systemname</td>
<td>char[9]</td>
<td>System to get stats from</td>
</tr>
</tbody>
</table>

Return_value: 0 if request is successful, -1 if it is not successful

Return_code:
- EINTR: zFS is shutting down
- EINVAL: Invalid parameter list
- EMVSERR: Internal error occurred
- E2BIG: Information too big for buffer supplied
- Reason_code: 0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.
2. When `a_supported_ver` is 0 or 1, output consists of KERNEL_CALL_STATS and KERNEL_LINE. When `sa_supported_ver` is 2, output consists of KERNEL_CALL_STATS2 and KERNEL_LINE2.
3. When `a_supported_ver` is 2, the KERNEL_LINE2 follows the KERNEL_CALL_STATS2 structure. There are kc_kernel_line_count KERNEL_LINE2 structures to represent kernel lines of output. These are followed by kc_client_line_count KERNEL_LINE2 structures of client output lines.

Privilege required

None.

Related services

Statistics Vnode Cache Information
Statistics Metadata Cache Information

Restrictions

None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>
#include <stdlib.h>
#include <stdint.h>
#include <time.h>

#define ZFSCALL_STATS 0x40000007
#define STATOP_KNPFS 246
#define BUFFER_SIZE 1024 * 64
#define SA_VER_INIT 0x01
```
typedef struct syscall_parmlist_t {
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef union {
    struct double_word_t {
        unsigned int first_word;
        unsigned int second_word;
    } double_word;
    double alignment_dummy;
} two_words;

#define MAX_KERNEL_LINES 40

typedef struct KERNEL_line_t2 {
    char               kl_operation_name[27];
    char               kl_valid;
    int                pad1;
    unsigned long long kl_count;
    unsigned long long kl_xcfcount;
    two_words          kl_time;
    uint64_t           kl_bytes;
    int                kl_reserved[4];
} KERNEL_LINE2;

typedef struct kernel_call_stats_t2 {
    char               kc_eye[8];  /*eye catcher */
    short              kc_version;
    short              kc_len;
    int                pad1;
    int                kc_kernel_line_count;
    int                kc_client_line_count;
    unsigned long long kc_totalops;    /*Owner grand Total operations*/
    unsigned long long kc_totalxcfops;    /*Owner grand Total xcf operations*/
    unsigned long long kc_client_totalops;    /*Client grand Total operations*/
    unsigned long long kc_client_totalxcfops;    /*Client grand Total operations*/
    two_words          kc_totaltime;          /*Owner Grand Total wait time*/
    two_words          kc_client_totaltime;   /*Client Grand Total wait time*/
    int                kc_reserved[10];
} KERNEL_CALL_STATS2;

/* Version 1 Output Structures */
typedef struct KERNEL_line_t {
    char              kl_operation_name[27];
    char              kl_valid;
    unsigned int      kl_count;
    two_words         kl_time;
    int               kl_reserved[6];
} KERNEL_LINE;

typedef struct kernel_call_stats_t {
    char              kc_eye[8];      /*eye catcher */
    short             kc_version;
    short             kc_len;
    int               pad1;
    KERNEL_LINE      OUTPUT[MAX_KERNEL_LINES];
    unsigned int      kc_totalops;    /*Grand Total operations */
    int               pad2;
    two_words         kc_totaltime;   /*Grand Total wait time*/
    int               kc_valid_slots; /* Number of slots in the above array*/
               /* that actually contain data*/
    int              kc_reserved[10];
    int               pad3;
} KERNEL_CALL_STATS;

/* reset timestamp */
typedef struct reset_time {
    unsigned int             posix_time_high; /*high order 32 bits since epoch*/
    unsigned int             posix_time_low;  /*low order 32 bits since epoch*/
    unsigned int             posix_usecs;     /*microseconds*/
    int                      pad1;
} RESET_TIME;

********************************************************************
/* The following structure is the api query control block */
/* It is used for all api query commands */
********************************************************************
typedef struct stat_api_t
{
    #define SA_EYE "STAP" /* 4 byte identifier must be */
    char sa_eye[4];     /* this buffer area follows this struct*/
    int sa_len;        /* length of the buffer to put data into*/
    int sa_ver;        /* the version number currently always 1*/
    #define SA_VER_2 0x02 /* flags field must be x00 or x08, 
x08 means reset statistics*/
    char sa_flags;      /* flags field must be x00 or x80, 
x00 means reset statistics*/
    #define SA_RESET 0x80 /* spare bytes */
    struct reset_time reset_time_info;
} STAT_API;

struct parmstruct {
    syscall_parmlist myparms;
    STAT_API myapi;
    KERNEL_CALL_STATS2 mystats;
    KERNEL_LINE2 mykernline;
    char systemname[9];
} myparmstruct;

int print_stat_kern_version1(STAT_API* stapptr);

int main(int argc, char **argv)
{
    int bpxrv;
    int bpxrc;
    int bpxrs;
    int i,j;
    int processing_server_data = 1;
    int lines;
    int buff_fill_len;
    char itoaBuff[11];
    two_words totaltime;
    unsigned long long totalops;
    unsigned long long totalxcfops;
    STAT_API local_req;
    char* buffp = NULL;
    syscall_parmlist* parmp = NULL;
    STAT_API* stapptr = NULL;
    KERNEL_CALL_STATS2* kcp = NULL;
    KERNEL_LINE2* klp = NULL;
    char buf[33];
    stapptr = &local_req;
    memset(stapptr, 0x00, sizeof(STAT_API));
    memcpy(stapptr->sa_eye, SA_EYE, 4);
    stapptr->sa_ver = SA_VER_2;
    stapptr->sa_len = ((2 * MAX_KERNEL_LINES) * sizeof(KERNGLINE2)) +
    sizeof(KERNEL_CALL_STATS2);
    buffp = (char*) malloc(BUFFER_SIZE);
    if( buffp == NULL )
    {
        printf("Malloc Error\n");
        return 0;
    }
    memset( buffp, 0x00, sizeof(syscall_parmlist) + sizeof(STAT_API));
    parmp = (syscall_parmlist*) &buffp[0];
    parmp->opcode = STATOP_KNPFS;
    parmp->parms[0] = sizeof(syscall_parmlist);
    parmp->parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
    parmp->parms[2] = 0;
    /* Only specify a non-zero offset for the next field (parms[2]) if 
    /* you are running z/OS 1.7 and above, and you want to query the kernel */
    /* statistics of a different system than this one */
    /* parmp->parms[2] = sizeof(syscall_parmlist) + sizeof(STAT_API) + */
    /* sizeof(KERNEL_CALL_STATS2); */
    parmp->parms[3] = 0;
    parmp->parms[4] = 0;
    parmp->parms[5] = 0;
    parmp->parms[6] = 0;
buff_fill_len = sizeof(syscall_parmlist);
stapptr = (STAT_API*) &buffp[buff_fill_len];
memcpy(stapptr, &local_req, sizeof(STAT_API));
buff_fill_len += sizeof(STAT_API);

/* This next field should only be set if parms[2] is non-zero */
/* strcpy(myparmstruct.systemname,"DCEIMGVQ"); */

BPX1PCT("ZFS ",
    ZFSCALL_STATS, /* Perf statistics operation */
    BUFFER_SIZE, /* Length of Argument */
    (char*) buffp, /* Pointer to Argument */
    &bpxrv, /* Pointer to Return_value */
    &bpxrc, /* Pointer to Return_code */
    &bpxrs); /* Pointer to Reason_code */

if (bpxrv < 0) {
    printf("Error querying kernel calls, "
        "BPXRV = %d BPXRC = %d BPXRS = %x\n",
        bpxrv, bpxrc, bpxrs);
    return bpxrc;
} else {
    if (stapptr->sa_supported_ver == SA_VER_INIT) {
        print_stat_kern_version1(stapptr);
    } else {
        /* Get the pointers to the output structures */
        kcp = (KERNEL_CALL_STATS2*) &buffp[buff_fill_len];
        buff_fill_len += sizeof(KERNEL_CALL_STATS2);
        klp = (KERNEL_LINE2*) &buffp[buff_fill_len];
        lines = kcp->kc_kernel_line_count;
        totaltime = kcp->kc_totaltime;
        totalops = kcp->kc_totalops;
        totalxcfops = kcp->kc_totalxcfops;
        printf("          zFS Kernel PFS Calls\n");
        printf("          ---------------------\n");
        printf("          \n");
    }
}

/* Print out the Totals */
printf("------------      ----------   ----------      ----------\n");
printf("%13s     %10llu   %10llu   %9u.%3.3u\n", "
};
}

} else { /* otherwise loop again printing out client stats */
    int do_client = 1;
    while( do_client ) {
        if (processing_server_data )
            printf("%15c On Owner \n", ' ');
        else
            printf("%15c On Client \n", ' ');
        printf("          \n");
        printf("Operation Count        XCF req \n");
        printf("Avg Time Bytes \n");
        printf("\n");
    }
    for (j = 0; j < lines; j++) {
        if (!klp->kl_valid) break;
        sprintf( itoaBuff, "%d", klp->kl_bytes );
        printf("%13s %10llu %10llu %9u.%3.3u %10s\n", "
        klp->kl_operation_name,
        klp->kl_count,
        klp->kl_xcfcount,
        klp->kl_time.double_word.first_word,
        klp->kl_time.double_word.second_word,
        klp->kl_bytes ? itoaBuff : "\n";
    }
}
"TOTALS*",
    totalops,
    totalxcfops,
    totaltime.double_word.first_word,
    totaltime.double_word.second_word);

    /*! If client data exists, and we have not already processed it */
    if ( (processing_server_data) && (kcp->kc_client_line_count) )
    {
        /*! setup the client data */
        lines = kcp->kc_client_line_count;
        totaltime = kcp->kc_client_totaltime;
        totalops = kcp->kc_client_totalops;
        totalxcfops = kcp->kc_client_totalxcfops;
        processing_server_data = 0;
        do_client = 1;
    }
    else
    {
        do_client = 0;
    }

    if (0 == ctime_r((time_t*) & stapptr->reset_time_info.posix_time_low, buf))
        printf("Could not get timestamp.\n");
    else
        { /* Insert the microseconds into the displayable time value */
            strncpy(&(buf[27]), &(buf[20]), 6);
            sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usecs);
            buf[26] = ' ';
            buf[19] = '.';
            printf("Last Reset Time: %s", buf);
        }
    return 0;
}

int print_stat_kern_version1(STAT_API* stapptr)
{
    int i;
    char *p = (char*) stapptr;
    p += sizeof(STAT_API);
    KERNEL_CALL_STATS *stkcptr = (KERNEL_CALL_STATS*) p;

    printf("Displaying the Version 1 Stats\n");
    printf("%34s\n", "zFS Kernel PFS Calls");
    printf("%34s\n", "---------------------");
    printf("\n");
    printf("Operation Count Avg Time \n");
    printf("------- --------- ----------\n");

    i = 0;
    while (stkcptr->OUTPUT[i].kl_valid == 1)
    {
        printf("%13s %10u %9u.%3.3u\n",
               stkcptr->OUTPUT[i].kl_operation_name,
               stkcptr->OUTPUT[i].kl_count,
               stkcptr->OUTPUT[i].kl_time.double_word.first_word,
               stkcptr->OUTPUT[i].kl_time.double_word.second_word);
        i += 1;
    }
    printf("------- --------- ----------\n");
    printf("*TOTALS* %10u %9u.%3.3u\n",
               stkcptr->kc_totalops,
               stkcptr->kc_totaleme.double_word.first_word,
               stkcptr->kc_totaleme.double_word.second_word);
## Purpose

A performance statistics operation that returns locking information. Requesting version 1 output returns counters with 4-byte values. Requesting version 2 output returns counters with 8-byte values.

### Format

<table>
<thead>
<tr>
<th>syscall_parmlist</th>
<th>int</th>
<th>240</th>
<th>STATOP_LOCKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>opcode</td>
<td>int</td>
<td>0</td>
<td>Offset to STAT_API</td>
</tr>
<tr>
<td>parm[0]</td>
<td>int</td>
<td>0</td>
<td>Offset of output following</td>
</tr>
<tr>
<td>parm[1]</td>
<td>int</td>
<td>0</td>
<td>Offset to system name</td>
</tr>
<tr>
<td>parm[2]</td>
<td>int</td>
<td>0</td>
<td>Offset of output following</td>
</tr>
<tr>
<td>parm[3]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parm[4]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parm[5]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>parm[6]</td>
<td>int</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STAT_API</th>
<th>char[4]</th>
<th>&quot;STAP&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>sa_len</td>
<td>int</td>
<td>Length of buffer that follows STAT_API</td>
</tr>
<tr>
<td>sa_ver</td>
<td>int</td>
<td>1 or 2</td>
</tr>
<tr>
<td>sa_flags</td>
<td>char[3]</td>
<td>0x80 for reset; 0 otherwise</td>
</tr>
<tr>
<td>sa_supported_ver</td>
<td>int[3]</td>
<td>Version of data returned (0 and 1 both mean version 1)</td>
</tr>
<tr>
<td>sa_reserve</td>
<td>int[3]</td>
<td>Reserved</td>
</tr>
<tr>
<td>posix_time_high</td>
<td>unsigned int</td>
<td>High order 32 bits since epoch</td>
</tr>
<tr>
<td>posix_time_low</td>
<td>unsigned int</td>
<td>Low order 32 bits since epoch</td>
</tr>
<tr>
<td>posix_useconds</td>
<td>unsigned int</td>
<td>Microseconds</td>
</tr>
<tr>
<td>pad1</td>
<td>int</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STAT_LOCKING</th>
<th>int</th>
<th>Reserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>stlk_total_monitored_sleep</td>
<td>unsigned int</td>
<td>Number of monitored sleeps</td>
</tr>
<tr>
<td>stlk_waiting</td>
<td>unsigned int</td>
<td>Number of wait ups</td>
</tr>
<tr>
<td>stlk_total_wait_for_locks</td>
<td>unsigned int</td>
<td>Total waits for locks</td>
</tr>
<tr>
<td>pad1</td>
<td>int</td>
<td>Reserved</td>
</tr>
<tr>
<td>stlk_average_monitored_sleep_time</td>
<td>double</td>
<td>Average monitored sleep time in msecs (left of decimal)</td>
</tr>
<tr>
<td>stlk_avg_mon_sleep_time</td>
<td>int</td>
<td>Average monitored sleep time in msecs. Decimal part is in thousandths (3 means .003, 00 means .3)</td>
</tr>
<tr>
<td>stlk_total_contentions</td>
<td>unsigned int</td>
<td>Total lock contention</td>
</tr>
<tr>
<td>stlk_reserved_space</td>
<td>char[48]</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>count</td>
<td>int</td>
<td>Number of waits for lock</td>
</tr>
<tr>
<td>async</td>
<td>int</td>
<td>Asynchronous disposition</td>
</tr>
<tr>
<td>spins</td>
<td>int</td>
<td>Number of attempts to get</td>
</tr>
</tbody>
</table>
### Statistics Locking Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pad</td>
<td>int</td>
<td>lock that did not resolve immediately Keep alignment boundaries</td>
</tr>
<tr>
<td>percentage</td>
<td>double</td>
<td>Percentage &gt;= 1</td>
</tr>
<tr>
<td>percentage_whole</td>
<td>int</td>
<td>Percentage &gt;= 1. Decimal part is in thousandths (3 means .003 and 300 means .3)</td>
</tr>
<tr>
<td>percentage_decimal</td>
<td>int</td>
<td>Percentage &lt; 1. Decimal part is in thousandths (3 means .003 and 300 means .3)</td>
</tr>
<tr>
<td>description</td>
<td>char[84]</td>
<td>Description of the lock</td>
</tr>
<tr>
<td>pad2</td>
<td>int</td>
<td>Reserved</td>
</tr>
<tr>
<td>sleepcount</td>
<td>unsigned int</td>
<td>Time spent sleeping</td>
</tr>
<tr>
<td>pad</td>
<td>int</td>
<td>Keep alignment boundaries</td>
</tr>
<tr>
<td>percentage</td>
<td>double</td>
<td>Percentage of time spent sleeping</td>
</tr>
<tr>
<td>percentage_whole</td>
<td>int</td>
<td>Percentage &gt;= 1</td>
</tr>
<tr>
<td>percentage_decimal</td>
<td>int</td>
<td>Percentage &lt; 1. Decimal part is in thousandths (3 means .003 and 300 means .3)</td>
</tr>
<tr>
<td>description</td>
<td>char[84]</td>
<td>Description of the thread</td>
</tr>
<tr>
<td>pad</td>
<td>int</td>
<td>Keep alignment boundaries</td>
</tr>
<tr>
<td>systemname</td>
<td>char[9]</td>
<td>-- or --</td>
</tr>
<tr>
<td>statlock2</td>
<td>int[2]</td>
<td>reservation1 int[]</td>
</tr>
<tr>
<td>stlk_untimed_sleeps</td>
<td>unsigned long</td>
<td>Untimed sleeps</td>
</tr>
<tr>
<td>stlk_timed_sleeps</td>
<td>unsigned long</td>
<td>Timed sleeps</td>
</tr>
<tr>
<td>stlk_wakeups</td>
<td>unsigned long</td>
<td>Wake ups</td>
</tr>
<tr>
<td>stlk_total_wait_for_locks</td>
<td>unsigned long</td>
<td>Total waits for locks</td>
</tr>
<tr>
<td>stlk_average_lock_wait_time</td>
<td>double</td>
<td>Average lock wait time</td>
</tr>
<tr>
<td>stlk_avg_lock_wait_time_whole</td>
<td>int</td>
<td>Average lock wait time in msecs (left of the decimal part)</td>
</tr>
<tr>
<td>stlk_avg_lock_wait_time_decimal</td>
<td>int</td>
<td>Average lock wait time in msecs Decimal part (3 means .003, 300 means .3)</td>
</tr>
<tr>
<td>stlk_total_monitored_sleeps</td>
<td>unsigned long</td>
<td>Total monitored sleeps</td>
</tr>
<tr>
<td>stlk_average_monitored_sleep_time</td>
<td>double</td>
<td>Average monitored sleep time</td>
</tr>
<tr>
<td>stlk_avg_mon_sleep_time_whole</td>
<td>int</td>
<td>Average monitored sleep time in msecs left of the decimal</td>
</tr>
<tr>
<td>stlk_avg_mon_sleep_time_decimal</td>
<td>int</td>
<td>Average monitored sleep time in msecs. Decimal part in thousandths (3 means .003, 300 means .3)</td>
</tr>
<tr>
<td>stlk_total_contentions</td>
<td>unsigned long</td>
<td>Total lock contention</td>
</tr>
<tr>
<td>stlk_reserved_space</td>
<td>char[48]</td>
<td>Reserved for future</td>
</tr>
<tr>
<td>stlk_lock_line_count</td>
<td>int</td>
<td>Number of lock lines</td>
</tr>
<tr>
<td>stlk_sleep_line_count</td>
<td>int</td>
<td>Number of sleep lines</td>
</tr>
</tbody>
</table>

### LOCK_LINE2[m]

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>count</td>
<td>unsigned long</td>
<td>Number of thread waits for this lock</td>
</tr>
<tr>
<td>async</td>
<td>unsigned long</td>
<td>Asynchronous disposition</td>
</tr>
<tr>
<td>spins</td>
<td>unsigned long</td>
<td>Number of attempts to get lock that did not resolve immediately</td>
</tr>
<tr>
<td>percentage</td>
<td>double</td>
<td>Percentage &gt;= 1</td>
</tr>
<tr>
<td>percentage_whole</td>
<td>int</td>
<td>Percentage &gt;= 1. Decimal part is in thousandths (3 means .003 and 300 means .3)</td>
</tr>
<tr>
<td>percentage_decimal</td>
<td>int</td>
<td>Percentage &lt; 1. Decimal part is in thousandths (3 means .003, 300 means .3)</td>
</tr>
<tr>
<td>description</td>
<td>char[84]</td>
<td>Description of the lock</td>
</tr>
<tr>
<td>pad</td>
<td>int</td>
<td>Fill space to align</td>
</tr>
<tr>
<td>SLEEP_LINE2[n]</td>
<td>unsigned long</td>
<td>Time spent sleeping</td>
</tr>
</tbody>
</table>
Usage notes

1. When sa_supported_ver is 0 or 1, the output consists of STAT_LOCKING, followed by one or more LOCK_LINE, followed by one for more SLEEP_LINE. When sa_supported_ver is 2, the output consists of STAT_LOCKING2, followed by one or more LOCK_LINE2, followed by one for more SLEEP_LINE2.

2. Reserved fields and undefined flags must be set to binary zeros.

Privilege required

None.

Related services

Statistics Storage Information
Statistics User Cache Information

Restrictions

None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_STATS 0x40000007
#define STATTOP_LOCKING 240 /* Performance API queries */
#define BUFFER_SIZE 1024 * 64
#define TOP15 15

typedef struct syscall_parmlist_t {
  int opcode;    /* Operation code to perform */
  int parms[7];  /* Specific to type of operation, provides access to the parms */
  int parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct lock_line_2 {
  unsigned long long int count; /* Number of thread waits for this lock */
  unsigned long long int async; /* Asynchronous disposition */
  unsigned long long int spins; /* Number of attempts to get lock */
  double reserved; /* that didn't resolve immediately*/
  int percentage_whole; /* percentage >= 1*/
  int percentage_decimal; /* percentage < 1*/
  char description[84]; /* Description of the lock */
  int pad2;
} LOCK_LINE_2;

typedef struct sleep_line_2 {
  unsigned long long int sleepcount; /* Time spent sleeping */
  double reserved;
```

Statistics Locking Information

zFS application programming interface information 387
Statistics Locking Information

```c
int percentage_whole;  /* Percentage >=1 */
int percentage_decimal;  /* Percentage < 1 */
char description[84];  /* Description of the thread*/
int pad2;
} SLEEP_LINE_2;

/* Version 1 Output Structures */
typedef struct Lock_line_t
{
    int count;  /* Number of thread waits for this lock */
    int async;  /* Asynchronous disposition*/
    int spins;  /* Number of attempts to get lock that did not resolve immediately*/
    int pad1;
    double percentage;
    int percentage_whole;  /* percentage >= 1*/
    int percentage_decimal;  /* percentage < 1*/
    /* in thousandths.*/
    /* For example, 3 means .003 and 300 means .3 */
    char description[84];  /* Description of the lock */
    int pad2;
} LOCK_LINE;

typedef struct Sleep_line_t
{
    unsigned int sleepcount;  /* Time spent sleeping */
    int pad1;
    double percentage;  /* Percentage of time spent sleeping*/
    int percentage_whole;  /* Percentage >=1 */
    int percentage_decimal;  /* Percentage < 1*/
    /* in thousandths.*/
    /* For example, 3 means .003 and 300 means .3 */
    char description[84];  /* Description of the thread*/
    int pad2;
} SLEEP_LINE;

typedef struct stat_locking_t
{
    int reserved1;
    unsigned int stlk_untimed_sleeps;  /* Number of untimed sleeps */
    unsigned int stlk_timed_sleeps;  /* Number of timed sleeps */
    unsigned int stlk_wakeups;  /* Number of wake ups */
    unsigned int stlk_total_wait_for_locks;  /* Total waits for locks */
    int pad1;
    double stlk_average_lock_wait_time;  /*Average lock wait time */
    int stlk_avg_lock_wait_time_whole;  /*Average lock wait time in msecs*/
    int stlk_avg_lock_wait_time_decimal;  /*Average lock wait time in msecs*/
    /* decimal portion */
    /* in thousandths */
    /* For example, 3 means .003 and 300 means .3 */
    unsigned int stlk_total_monitored_sleeps;  /* Total monitored sleeps */
    int pad2;
    double stlk_average_monitored_sleep_time;  /* Average monitored sleep time */
    int stlk_avg_mon_sleep_time_whole;  /* Average monitored sleep time */
    int stlk_avg_mon_sleep_time_decimal;  /* Average monitored sleep */
    /* in msecs left of the */
    /* decimal part */
    /* time in msecs */
    /* decimal portion */
    /* in thousandths */
    /* For example, 3 means .003 */
    /* and 300 means .3 */
    unsigned int stlk_total_contentions;  /*Total lock contention of all kinds*/
    char stlk_reserved_space[48];  /* reserved for future use */
    int pad3;

    #define MAX_LOCKS 15 /* Maximum number of locks in this release*/
    #define MAX_SLEEPS 5 /* Maximum number of sleeps in this release*/
    LOCK_LINE stlk_locks[MAX_LOCKS];  /* Storage for the lock data */
    SLEEP_LINE stlk_sleeps[MAX_SLEEPS];  /* Storage for the top 5 most */
    /* common sleep threads*/
} STAT_LOCKING;

/* reset timestamp */
typedef struct reset_time
{
    unsigned int posix_time_high;  /* high order 32 bits since epoch */
    unsigned int posix_time_low;  /* low order 32 bits since epoch */
    unsigned int posix_usecs;  /* microseconds */
    int pad1;
} RESET_TIME;

/*****************************************************************************/
/* The following structure is the api query control block */
/* It is used for all api query commands */
```
/** typedef struct stat_api_t { **/ 
typedef struct stat_api_t { 
  #define SA_EYE "STAP" /* 4 byte identifier must be */ char sa_eye[4]; /* length of the buffer to put data into*/ 
  int sa_len; /* this buffer area follows this struct */ 
  int sa_ver; /* the version number currently always 1*/ 
#define SA_VER_2 0x02 
#define SA_VER_INIT 0x01 
  char sa_flags; /* flags field must be x00 or x80, */ 
  /* x80 means reset statistics */ 
#define SA_RESET 0x80 
  char sa_fill[3]; /* spare bytes */ 
  int sa_supported_ver; /* version of data returned */ 
  int sa_reserve[3]; /* Reserved */ 
  struct reset_time reset_time_info; 
} STAT_API; } STAT_API; 

typedef struct api_lock_stats_2 { 
  int pad1; 
  int ls_total_bytes_of_data; /* Total bytes of data*/ 
  unsigned long ls_total_sleeps; /* Total bytes of untimed sleeps*/ 
  unsigned long ls_time_sleeps; /* Total bytes of timed sleeps */ 
  unsigned long ls_wakeups; /* Number of wake ups */ 
  unsigned long ls_total_wait_for_locks; /* Total waits for locks */ 
  double ls_average_lock_wait_time; /*Average lock wait time */ 
  int ls_avg_lock_wait_time_whole; /*Average lock wait time in msecs left */ 
  int ls_avg_lock_wait_time_decimal; /*Average lock wait time in msecs decimal portion */ 
  unsigned long ls_total_monitored_sleeps; /*Total monitored sleeps */ 
  double ls_average_monitored_sleep_time; /*Average monitored sleep time */ 
  int ls_avg_mon_sleep_time_whole; /*Average monitored sleep time in msecs */ 
  int ls_avg_mon_sleep_time_decimal; /*Average monitored sleep time in msecs */ 
  unsigned long ls_total_contentions; /*Total lock contention */ 
  char ls_reserved_space[48]; /* reserved for future use */ 
#define MAX_LOCKS 15 /* Maximum number of locks in this release*/ 
#define MAX_SLEEPS 5 /* Maximum number of sleeps in this release*/ 
  int ls_lock_line_count; /* count of lock lines, currently 15 */ 
  int ls_sleep_line_count; /* count of sleep lines, currently 5 */ 
} API_LOCK_STATS_2; } API_LOCK_STATS_2; 

int print_locking_version1(char *buffp, int buff_fill_len); 
int print_locking_version2(char *buffp, int buff_fill_len); 

int main(int argc, char **argv) { 
  int bpxrv; 
  int bpxrc; 
  int bpxrs; 
  int i; 
  int buff_fill_len; 
  STAT_API local_req; 
  char *buffp = NULL; 
  syscall_parmlist *parmp = NULL; 
  STAT_API *stapptr = NULL; 
  stapptr = &local_req; 
  memset(stapptr, 0x00, sizeof(STAT_API)); 
  memcp(stapptr->sa_eye, SA_EYE, 4); 
  stapptr->sa_ver = SA_VER_2; 
  stapptr->sa_len = 2 * sizeof(API_LOCK_STATS_2) + (MAX_LOCKS * sizeof(LOCK_LINE_2)) + (MAX_SLEEPS * sizeof(SLEEP_LINE_2)); 
  buffp = (char*) malloc(BUFFER_SIZE); 
  if (buffp == NULL) 
    
    printf("Malloc Error\n"); 
    return 0; 
  } 
  memset(buffp, 0x00, sizeof(syscall_parmlist) + sizeof(STAT_API));
parmp = (syscall_parmlist*) &buffp[0];
parmp->opcode = STATOP_LOCKING;
parmp->parms[0] = sizeof(syscall_parmlist);
parmp->parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
parmp->parms[2] = 0;
parmp->parms[3] = 0;
parmp->parms[4] = 0;
parmp->parms[5] = 0;
parmp->parms[6] = 0;

buff_fill_len = sizeof(syscall_parmlist);
stapptr = (STAT_API*) &buffp[buff_fill_len];
memcpy(stapptr, &local_req, sizeof(STAT_API));
buff_fill_len += sizeof(STAT_API);

BPX1PCT("ZFS     ",
ZFS_CALL_STATS,              /* Perf statistics operation */
BUFFER_SIZE,            /* Length of Argument */
buff,                      /* Pointer to Argument */
&bpxrv,                     /* Pointer to Return_value */
&bpxrc,                     /* Pointer to Return_code */
&bpxrs);                    /* Pointer to Reason_code */

if (bpxrv < 0)
{
    printf("Error querying locking stats, BPXRV = %d BPXRC = %d BPXRS = %x\n", 
bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
{
    if( stapptr->sa_supported_ver == SA_VER_INIT )
        print_locking_version1(buffp, buff_fill_len);
    else
        print_locking_version2(buffp, buff_fill_len);
    return 0;
}

int print_locking_version2(char *buffp,
int  buff_fill_len)
{
int i;
API_LOCK_STATS_2  *stlkptr = NULL;
LOCK_LINE_2       *llp     = NULL;
SLEEP_LINE_2      *slp     = NULL;

/* Point at output structures located in the buffer */
stlkptr = (API_LOCK_STATS_2*) &buffp[buff_fill_len];
buff_fill_len += sizeof(API_LOCK_STATS_2);
llp     = (LOCK_LINE_2*) &buffp[buff_fill_len];
buff_fill_len += sizeof(LOCK_LINE_2);

/* Print out the locking statistics */
printf("%55s\n","Locking Statistics\n\n");
printf("Untimed sleeps: %20llu   Timed Sleeps: %20llu   Wakeups: %20llu\n\n",
stlkptr->ls_untimed_sleeps,
stlkptr->ls_timed_sleeps,
stlkptr->ls_wakeups);
printf("%-42s %20llu\n",
"Total waits for locks:",
stlkptr->ls_total_wait_for_locks);
printf("%-42s %10u.%3.3u (msecs)\n",
"Average lock wait time:",
stlkptr->ls_avg_lock_wait_time_whole,
stlkptr->ls_avg_lock_wait_time_decimal);
printf("%-42s %10llu\n",
"Total monitored sleeps:",
stlkptr->ls_total_monitored_sleeps);
printf("%-42s %10u.%3.3u (msecs)\n",
"Average monitored sleep time:",
stlkptr->ls_avg_mon_sleep_time_whole,
stlkptr->ls_avg_mon_sleep_time_decimal);

printf("%20c       Top %u Most Highly Contended Locks\n", 
'Spin', TOP15);
printf(" Thread        Async                 
"
printf(" Wait               Disp.                 
"  "Resol.                Pct.     Description   \n");
printf("--------------------  --------------------  
"  "--------------------  ------   --------------
");
/* Iterate through all the LOCK_LINE_2 structures */
for (i = 0; i < stkptr->ls_lock_line_count; i++ )
{
    printf("%20llu  %20llu  %20llu  %3u.%1.1u%%   %.80s\n", 
           llp->count, llp->async, llp->spins, 
           llp->percentage_whole, llp->percentage_decimal, 
           llp->description);
    llp++;
}
printf("\n");
printf("Total lock contention of all kinds: %10llu\n
", 
       stkptr->ls_total_contentions);
printf("Top 5 Most Common Thread Sleeps\n");
printf("Thread Wait          Pct.      Description\n"  "--------  -------   -----------\n");
/* Point where the SLEEP_LINE_2 output structures begin in the buffer */
slp = (SLEEP_LINE_2*) llp;
for (i = 0; i < stkptr->ls_sleep_line_count; i++ )
{
    printf(" %20llu    %3u.%-3.1u%%   %.80s\n
", 
           slp->sleepcount, 
           slp->percentage_whole, slp->percentage_decimal, 
           slp->description);
    slp++; /* point at next entry */
}
return 1;}

int print_locking_version1(char *buffp, 
            int  buff_fill_len)
{
    int i;
    printf("Version 1 Output is being displayed\n\n");
    STAT_LOCKING *stkptr;
    stkptr = (STAT_LOCKING*) &buffp[buff_fill_len];
    printf("%50s\n\n", "Locking Statistics");
    printf("Untimed sleeps:               %10u \n", stkptr->stlk_untimed_sleeps);
    printf("Timed Sleeps:                 %10u \n", stkptr->stlk_timed_sleeps);
    printf("Wakeups:                      %10u \n
", stkptr->stlk_wakeups);
    printf("Total waits for locks:        %10u\n", 
            stkptr->stlk_total_wait_for_locks);
    printf("Average lock wait time:       %6u.%3.3u (msecs)\n", 
            stkptr->stlk_avg_lock_wait_time_whole, 
            stkptr->stlk_avg_lock_wait_time_decimal);
    printf("Total monitored sleeps:       %10u\n", 
            stkptr->stlk_total_monitored_sleeps);
    printf("Average monitored sleep time: %6u.%3.3u (msecs)\n", 
            stkptr->stlk_avg_mon_sleep_time_whole, 
            stkptr->stlk_avg_mon_sleep_time_decimal / 1000);
    printf("\n");
    printf("Top %u Most Highly Contended Locks\n\n", MAX_LOCKS);
    printf("Thread       Async       Spin                           
"  "Wait       Disp.       Resol.    Pct.   Description   \n"  "---------- ----------  ----------  -----  --------------
");
for (i = 0; i < MAX_LOCKS; i++)
{
    printf("%10u %10u  %10u %3u.%1.1u%%  %.80s\n", 
           stkptr->stlk_locks[i].count, 
           stkptr->stlk_locks[i].async, 
           stkptr->stlk_locks[i].spins, 
           stkptr->stlk_locks[i].percentage_whole, 
           stkptr->stlk_locks[i].percentage_decimal / 100, 
           stkptr->stlk_locks[i].description);
}
printf("\n");
printf("Total lock contention of all kinds: u\n",
   stkptr->stk_total_contentions);

printf("\n");
printf("Top %u Most Common Thread Sleeps\n\n", MAX_SLEEPS);

printf("Thread Wait      Pct.     Description\n");
printf("-----------      -----     -----------\n");

for (i = 0; i < MAX_SLEEPS; i++)
{
   printf("%10u   %3u.%lu%%   %.80s\n",
      stkptr->stk_sleeps[i].sleepcount,
      stkptr->stk_sleeps[i].percentage_whole,
      stkptr->stk_sleeps[i].percentage_decimal / 100,
      stkptr->stk_sleeps[i].description);
}
}
Statistics Log Cache Information

Purpose
A performance statistics operation that returns log cache counters, such as the number of requests, hits, and waits on the log buffer cache.

Beginning in z/OS V2R2, a new log caching facility is used. If version 1 output is requested, only the fields al_buffers and al_writtenPages are filled in with actual data. All other fields are filled in with zeroes. Statistics for the new log caching facility is returned when version 2 output is requested.

Format
syscall_parmlist
  opcode int 247 STATOP_LOG_CACHE
  parms[0] int Offset to STAT_API
  parms[1] int Offset of output following STAT_API
  parms[2] int Offset to system name (optional)
  parms[3] int 0
  parms[4] int 0
  parms[5] int 0
  parms[6] int 0

STAT_API
  sa_eye char[4] "STAP"
  sa_len int Length of buffer following STAT_API
  sa_ver int 1 or 2
  sa_flags char[1] 0x80 - Reset statistics
  sa_fill char[3] Reserved
  sa_supported_ver int Version returned in output buffer
  sa_reserve int[3] Reserved
  posix_time_high unsigned int High order 32 bits since epoch
  posix_time_low unsigned int Low order 32 bits since epoch
  posix_useconds unsigned int Microseconds
  pad1 int Reserved

API_LOG_STATS
  al_eye char[4] "ALOG"
  al_size short Size of output
  al_version char Version (1)
  al_reserved1 char Reserved byte
  al_buffers unsigned long long int Number of buffers used
  al_reserved2 int Reserved
  al_buffersize int Size of each buffer in K bytes
  al_lookups_reserved int Reserved
  al_lookups int Lookups/creates of item in log buffer cache
  al_hits Reserved
  al_hits int Hits - number of items time item found in cache
  al_writtenPages unsigned long long int Number of log buffer pages written to disk
  al_fullWaits_reserved int Reserved
  al_fullWaits int Number of times new log buffer requires wait on prior log pages
  al_nbsWaits_reserved int Reserved
  al_nbsWaits int Number of times new log buffer requires wait on new block user I/O
  al_reserved3 int[10] Reserved

API_NL_STATS
  nl_eye char[4] "NLST"
  nl_sizeE short Size of output structure
  nl_version char 2
  nl_future char Reserved for future use
  nl_logs unsigned int Number of log files reclaimed at log-full time
  nl_reclaim_pct unsigned int Percentage of logs blocks to write per log I/O
  nl_blocks_per_pio unsigned int Max number of log file inactive buffer schedule percentage (of log size)
  nl_sched_pct unsigned int Number of pages in log
<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>nl_fixed</td>
<td>int</td>
<td>Non-zero if cache permanently fixed in memory</td>
</tr>
<tr>
<td>nl_freeitems</td>
<td>int</td>
<td>Number of unused pages in cache</td>
</tr>
<tr>
<td>nl_ios</td>
<td>int</td>
<td>Number of I/Os in-progress</td>
</tr>
<tr>
<td>nl_numblks</td>
<td>int</td>
<td>Number of dirty metadata blocks</td>
</tr>
<tr>
<td>nl_future1</td>
<td>int</td>
<td>Number of unused pages in cache</td>
</tr>
<tr>
<td>nl_tran_started</td>
<td>int</td>
<td>Number of started transactions</td>
</tr>
<tr>
<td>nl_act_schedules</td>
<td>int</td>
<td>Number of times active records scheduled to disk</td>
</tr>
<tr>
<td>nl_comp_schedules</td>
<td>int</td>
<td>Number of times complete records scheduled to disk</td>
</tr>
<tr>
<td>nl_act_pages</td>
<td>int</td>
<td>Number of active pages scheduled to disk</td>
</tr>
<tr>
<td>nl_comp_pages</td>
<td>int</td>
<td>Number of completed pages scheduled to disk</td>
</tr>
<tr>
<td>nl_tran_merged</td>
<td>int</td>
<td>Number of merged transactions</td>
</tr>
<tr>
<td>nl_act_recswrote</td>
<td>int</td>
<td>Number of active records written</td>
</tr>
<tr>
<td>nl_comp_recswrote</td>
<td>int</td>
<td>Number of complete tran records written</td>
</tr>
<tr>
<td>nl_comp_transize</td>
<td>int</td>
<td>Number of batched/merged transactions written</td>
</tr>
<tr>
<td>nl_tran_active_force</td>
<td>int</td>
<td>Number of times an active tran forced</td>
</tr>
<tr>
<td>nl_tran_complete_force</td>
<td>int</td>
<td>Number of times a complete tran forced</td>
</tr>
<tr>
<td>nl_recoveries</td>
<td>int</td>
<td>Number of times log file recovery was run</td>
</tr>
<tr>
<td>nl_bufupdates</td>
<td>int</td>
<td>Number of buffer updates</td>
</tr>
<tr>
<td>nl_bufnew</td>
<td>int</td>
<td>Number of buffer updates creating new update record</td>
</tr>
<tr>
<td>nl_bufavoid</td>
<td>int</td>
<td>Number of buffer updates avoided due to prior update</td>
</tr>
<tr>
<td>nl_bufovlap</td>
<td>int</td>
<td>Number of buffer updates that had overlap</td>
</tr>
<tr>
<td>nl_killavoid</td>
<td>int</td>
<td>Avoided metadata IOs due to kill-avoid</td>
</tr>
<tr>
<td>nl_schedules</td>
<td>int</td>
<td>Number of times older buffers scheduled to disks</td>
</tr>
<tr>
<td>nl_bufsched</td>
<td>int</td>
<td>Number of actual buffers schedules and also avg. quicksort size</td>
</tr>
<tr>
<td>nl_endmerges</td>
<td>int</td>
<td>Number of times merged active records with previously completed active tran</td>
</tr>
<tr>
<td>nl_endmgcnt</td>
<td>int</td>
<td>Number of records merged active records with previously completed active tran</td>
</tr>
<tr>
<td>nl_endnew</td>
<td>int</td>
<td>Number of records merged that were new to prior completed tran records</td>
</tr>
<tr>
<td>nl_endavoid</td>
<td>int</td>
<td>Number of records merged that could be skipped because prior completed record covered it</td>
</tr>
<tr>
<td>nl_endovlap</td>
<td>int</td>
<td>Number of records merged that had overlap with previously written trans</td>
</tr>
<tr>
<td>nl_nbswrites</td>
<td>int</td>
<td>Number of times we added NBS blocks to active tran</td>
</tr>
<tr>
<td>nl_kills</td>
<td>int</td>
<td>Number of kill calls for buffers deallocd with tran</td>
</tr>
<tr>
<td>nl_forcecomp</td>
<td>int</td>
<td>Number of times a forced write of buffer forces complete tran recods to log</td>
</tr>
<tr>
<td>nl_forceact</td>
<td>int</td>
<td>Number of times a forced write of buffer forces active tran recods to log</td>
</tr>
<tr>
<td>nl_forces</td>
<td>int</td>
<td>Number of force calls</td>
</tr>
<tr>
<td>nl_forcewaits</td>
<td>int</td>
<td>Number of times a force has to wait for in-progress log pages</td>
</tr>
</tbody>
</table>
### Usage notes
1. Reserved fields and undefined flags must be set to binary zeros.
2. The output buffer contains an API_LOG_STATS structure when version 1 information is returned; for example, when sa_supported_ver is 0 or 1. Otherwise, it contains an API_NL_STATS structure when sa_supported_ver is 2.
3. As previously noted, when V2R2 returns version 1 data in API_LOG_STATS, only the al_buffers and al_writtenPages fields are set.

### Privilege required
None.

### Related services
Statistics Vnode Cache Information
Statistics Metadata Cache Information

### Restrictions
None.

### Examples
```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_STATS 0x40000007
#define STATOP_LOG_CACHE 247 /* Performance API queries */
#define BUFFER_SIZE 1024 * 64
#define CONVERT_RATIO_TO_INTS(RATIO, INTEGER, DECIMAL) 
  \{
    INTEGER = (int)RATIO; 
    DECIMAL = (int)((RATIO - (double)INTEGER) * (double)1000.0); 
  \}
typedef struct syscall_parmlist_t 
  {
```
int opcode; /* Operation code to perform */
int parms[7]; /* Specific to type of operation, */
/* provides access to the parms */
/* parms[4]-parms[6] are currently unused*/
}

syscall_parmlist;

typedef struct hyper {
    unsigned int high; /* unsigned int reserved */
    unsigned int low;
} hyper;

typedef struct API_NL_STATS_t {
    char nl_eye[4]; /* Eye catcher = AMET */
#define NL_EYE "AMET"
    short nl_size; /* Size of output structure */
#define NL_VER_2 2
    char nl_version; /* Version of statistics returned */
    unsigned int nl_logs; /* Number of log files */
    unsigned int nl_reclaim_pct; /* Pct. of log reclaimed at log-full time */
    unsigned int nl_blocks_per_pio; /* Max number of log file blocks to write
per log I/O */
    unsigned int nl_sched_pct; /* Inactive buffer schedule pct. (of log size)*/
    unsigned int nl_cachesize; /* Number of pages in cache*/
    unsigned int nl_fixed; /* Non-zero if cache permanently fixed in memory*/
    unsigned int nl_freeitems; /* Number of unused pages in cache*/
    unsigned int nl_los; /* Number of I/Os in-progress*/
    unsigned int nl_numblks; /* Number of dirty meta blocks*/
    unsigned int nl_future1; /* Number of unused pages in cache*/
    unsigned long long int nl_tran_started; /* Number of started
transactions */
    unsigned long long int nl_act_schedules; /* Number of times active
records scheduled to disk */
    unsigned long long int nl_comp_schedules; /* Number of times complete
records scheduled to disk */
    unsigned long long int nl_act_pages; /* Number of active pages
scheduled to disk */
    unsigned long long int nl_comp_pages; /* Number of completed pages
scheduled to disk */
    unsigned long long int nl_tran_merged; /* Number of merged
transactions */
    unsigned long long int nl_act_recswrote; /* Number of active records
written */
    unsigned long long int nl_comp_recswrote; /* Number of complete tran
records written */
    unsigned long long int nl_comp_transize; /* Number of batched/merged
transactions written */
    unsigned long long int nl_tran_active_force; /* Number of times an active
tran forced */
    unsigned long long int nl_tran_complete_force; /* Number of times a complete
tran forced */
    unsigned long long int nl_recoveries; /* Number of times log file
recovery was run */
    unsigned long long int nl_bufupdates; /* Number of buffer updates */
    unsigned long long int nl_bufnew; /* Number of buffer updates
creating new update record*/
    unsigned long long int nl_bufavoid; /* Number of buffer updates
avoided due to prior update */
    unsigned long long int nl_bufovlap; /* Number of buffer updates
that had overlap */
    unsigned long long int nl_killavoid; /* Avoided metadata I/Os due to
kill-avoid */
    unsigned long long int nl_schedules; /* Number of times older
buffers scheduled to disks*/
    unsigned long long int nl_bufsched; /* Number of actual buffers
schedules and also avg.
quicksort size */
    unsigned long long int nl_endmerges; /* Number of times merged
active records with
previously completed active tran */
    unsigned long long int nl_endmgcnt; /* Number of records merged
active records with
previously completed active tran */
    unsigned long long int nl_endnew; /* Number of records merged
that were new to prior
completed tran records */
    unsigned long long int nl_endavoid; /* Number of records merged
could be skipped
because prior completed
unsigned long long int nl_endovlap; /* Number of records merged that had overlap with previously written trans */
unsigned long long int nl_nbswrites; /* Number of times we added NBS blocks to active tran */
unsigned long long int nl_kills; /* Number of kill calls for buffers deallocated with tran */
unsigned long long int nl_forcecomp; /* Number of times a forced write of buffer forces complete tran recods to log */
unsigned long long int nl_forceact; /* Number of times a forced write of buffer forces active tran recods to log */
unsigned long long int nl_forces; /* Number of force calls */
unsigned long long int nl_forcewaits; /* Number of times a force has to wait for in-progress log pages*/
unsigned long long int nl_hfact; /* Number of times a handle-full has to write active records*/
unsigned long long int nl_hfcomp; /* Number of times a handle-full has to write comp records*/
unsigned long long int nl_hf; /* Number of handle full calls */
unsigned long long int nl_hfsched; /* Number of times a handle-full had to schedule buffers */
unsigned long long int nl_hfsched_blocks; /* Number of times a handle-full scheduled buffers and hence quicksort blocks */
unsigned long long int nl_sync; /* Number of times a log sync was requested */
unsigned long long int nl_bufwaits; /* Number of time new log buffer requires wait on prior log pages */
unsigned long long int nl_bufmallocs; /* Number of emergency mallocs to avoid deadlock */
unsigned long long int nl_act_comp_copies; /* Number of times a write to active log had to copy completed tran bytes */
unsigned long long int nl_future2[8]; /* Stats for the future */
}

/* Version 1 Output structure */
typedef struct API_LOG_STATS_t {
    char al_eye[4]; /* Eye catcher = ALOG */
    #define LS_EYE "ALOG"
    short al_size; /* Size of output structure */
    #define LS_VER_INITIAL 1 /* Version of stats */
    char al_version; /* Version of log stats */
    hyper al_buffers; /* Number of buffers used */
    int al_reserved2; /* Reserved for future use, 0 in version 1 */
    int al_buffsize; /* Size in kilobytes of one buffer */
    hyper al_lookups; /* Lookups/creates of item in log buffer cache */
    hyper al_hits; /* Hits, number of times item found in cache */
    hyper al_writtenPages; /* Number of log buffer pages written to disk */
    hyper al_fullMails; /* Number of time new log buffer requires wait on new block user I0 */
    int al_reserved3[10]; /* Reserved for future use */
} API_LOG_STATS;

/* reset timestamp */
typedef struct reset_time {
    unsigned int posix_time_high; /* high order 32 bits since epoc */
    unsigned int posix_time_low; /* low order 32 bits since epoch */
    unsigned int posix_usecs; /* microseconds */
    int pad1;
} RESET_TIME;

 constructors Log Cache Information
zFS application programming interface information
Statistics Log Cache Information

```c
#define SA_EYE "STAP"
char sa_eye[4]; /* 4 byte identifier must be */
int sa_len; /* length of the buffer to put data into*/
/* this buffer area follows this struct */
int sa_ver; /* the version number currently 1 or 2 */
#define SA_VER_2 0x02
#define SA_VER_INIT 0x01
char sa_flags; /* flags field must be x00 or x80, */
/* x80 means reset statistics */
#define SA_RESET 0x80
char sa_fill[3]; /* spare bytes */
int sa_supported_ver; /* version of data returned */
int sa_reserve[3]; /* Reserved */
struct reset_time reset_time_info;
} STAT_API;

int print_logcache_version1(char *buffp, int buff_fill_len);
int print_logcache_version2(char *buffp, int buff_fill_len);

int main(int argc, char **argv)
{
    int bp xr;
    int bpxr c;
    int bpxr s;
    int i;
    double temp_ratio;
    int buf f_fill_len;
    int whole, decimal;
    char buf[33];

    unsigned long long int temp_hits, temp_total;

    STAT_API local_req;
    char* buffp = NULL;
    syscall_parmlist* parmp = NULL;
    STAT_API* stapptr = NULL;
    API_NL_STATS* nlp = NULL;

    stapptr = &local_req;
    memset( stapptr, 0x00, sizeof(STAT_API) );
    memcpy( stapptr->sa_eye, SA_EYE, 4 );

    stapptr->sa_ver = NL_VER_2;
    stapptr->sa_len = sizeof(API_NL_STATS);

    buffp = (char*) malloc(BUFFER_SIZE);
    if( buffp == NULL )
    {
        printf("Malloc Error\n");
        return 0;
    }

    memset( buffp, 0x00, sizeof(syscall_parmlist) + sizeof(STAT_API));

    parmp = (syscall_parmlist*) buffp[0];
    parmp->opcode = STATOP_LOG_CACHE;
    parmp->parms[0] = sizeof(syscall_parmlist);
    parmp->parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
    parmp->parms[2] = 0;
    parmp->parms[3] = 0;
    parmp->parms[4] = 0;
    parmp->parms[5] = 0;
    parmp->parms[6] = 0;

    buff_fill_len = sizeof(syscall_parmlist);
    stapptr = (STAT_API*) &buffp[buff_fill_len];
    memset( stapptr, &local_req, sizeof(STAT_API) );
    buff_fill_len += sizeof(STAT_API);

    BPX1PCT("ZFS",
    ZFSCALL_STATS, /* Perf statistics operation */
    BUFFER_SIZE, /* Length of Argument */
    buffp, /* Pointer to Argument */
    &bp xr, /* Pointer to Return_value */
    &bp xc, /* Pointer to Return_code */
    &bpxr s); /* Pointer to Reason_code */

    if (bp xr < 0)
    {
        printf("Error querying log cache, BPXRV = %d BPXRC = %d BPXRS = %x\n",
            bpxrv, bp xrc, bpxrs);
        return bpxrc;
    }
```

398 z/OS: Distributed File Service zFS Administration
else
{
    if (stapptr->sa_supported_ver == SA_VER_INIT)
        print_logcache_version1(buffp, buff_fill_len);
    else
        print_logcache_version2(buffp, buff_fill_len);

    if (0 == ctime_r((time_t*) & stapptr->reset_time_info.posix_time_low, buf))
        printf("Could not get timestamp.\n");
    else
    { /* Insert the microseconds into the displayable time value */
        strncpy(&(buf[27]), &(buf[20]), 6);
        sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usec);
        buf[26] = ' ';
        buf[19] = '.';
        printf("Last Reset Time: %s", buf);
    }
}
return 0;

int print_logcache_version2(char *buffp, int buff_fill_len)
{
    int i;
    int whole, decimal;
    double temp_ratio;
    unsigned long long int temp_hits, temp_total;
    API_NL_STATS *nlp = NULL;

    /* Set nlp pointer to the output structure in the buffer */
    nlp = (API_NL_STATS*) &buffp[buff_fill_len];
    print( "%52s\n", "Log File Caching Statistics\n" );
    print("Logs\n");
    print("---------\n");
    print( "%20u : Log files cached \n", nlp->nl_logs );
    print( "%20llu : Log files recoveries performed \n", nlp->nl_recoveries );
    print( "%20llu : Log file syncs (filesys quiesce)\n", nlp->nl_sync ) ;

    printf("Policies\n");
    printf("---------\n");
    printf( "%20u : Reclaim pct. (amount reclaimed at log-full time)\n", nlp->nl_reclaim_pct );

    printf( "%20u : Maximum log pages per IO\n", nlp->nl_blocks_per_pio );

    printf( "%20u : Inactive buffer schedule pct. (of log size)\n", nlp->nl_sched_pct ) ;

    printf("Storage\n");
    printf("---------\n");
    printf( "%20u : Log Cache Size (in 4K pages, fixed=%s)\n", nlp->nl_cachesize, nlp->nl_fixed ? "YES" : "NO" );

    temp_hits = nlp->nl_freeitems;
    temp_total = nlp->nl_cachesize;
    if( temp_hits > temp_total )
        temp_hits = temp_total;
    temp_ratio = ((double)temp_hits) / temp_total;
    temp_ratio *= 100.0;
    CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
    whole = 100 - whole;
    printf("%20u : Pct. of cache in-use\n", whole );
    printf( "%20llu : Free page obtain waits\n", nlp->nl_bufwaits );
    printf( "%20llu : Allocations to avoid deadlock\n", nlp->nl_bufmallocs );

    printf("Transactions\n");
    printf("---------\n");
    printf( "%20u : Transactions started\n", nlp->nl_tran_started );
    printf( "%20u : Transactions merged\n", nlp->nl_tran_merged ) ;

    temp_total = nlp->nl_comp_schedules;
    temp_hits = nlp->nl_comp_transzie;
    temp_ratio = (temp_total == 0) ? 0.0 : ((double)temp_hits) / temp_total;
    CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
    decimal = decimal / 100;
    printf("%18u.%1.1u : Average number of transactions batched together\n", whole, decimal );
    printf( "%20llu : Sync calls to an active transaction\n", nlp->nl_bufwaits );
nlp->nl_tran_active_force);

printf( "%20llu : Sync calls to a completed transaction\n\n", nlp->nl_tran_complete_force);

printf( "IOs and Blocks\n\n");
printf( "-------------------\n");
printf( "%20lu : Log IOs in progress \n", nlp->nl_ios);
printf( "%20lu : Dirty metadata blocks\n", nlp->nl_numblks);
printf( "%20llu : Metadata block kill calls\n", nlp->nl_kills);
printf( "%20llu : Log File writes initiated\n", nlp->nl_comp_schedules);

temp_total = nlp->nl_comp_schedules;
temp_hits = nlp->nl_comp_pages;
temp_ratio = (temp_total == 0) ? 0.0 : ((double)temp_hits) / temp_total;
CONVERT_RATIO_TO_INTS(temp_ratio,whole, decimal);
decimal = decimal / 100; /* Just want tenths */

printf( "%13u.%1.1u : Average number of pages per log write\n", whole, decimal);
printf( "%20llu : Avoided IOs for metadata block due to deallocation\n", nlp->nl_killavoid);
printf( "%20llu : Scheduled not-recently-updated (NRU) metadata blocks\n", nlp->nl_schedules);

temp_total = nlp->nl_schedules;
temp_hits = nlp->nl_bufsched;
temp_ratio = (temp_total == 0) ? 0.0 : ((double)temp_hits) / temp_total;
CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
decimal = decimal / 100; /* Just want tenths */

printf( "%13u.%1.1u : Avergage number of blocks per NRU IO\n", whole, decimal);

printf( "%20llu : Metadata buffers forced to disk\n", nlp->nl_forces);

temp_total = nlp->nl_forces;
temp_hits = nlp->nl_forcecomp;
temp_ratio = (temp_total == 0) ? 0.0 : ((double)temp_hits)/temp_total;
CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
decimal = decimal / 100; /* Just want tenths */

if( temp_hits > temp_total )
temp_hits = temp_total;
temp_ratio = (temp_total == 0) ? 0.0 : ((double)temp_hits)/temp_total;

printf( "%18u.%1.1u : Pct. of metadata buffer forces waited on log IO\n", whole, decimal);

printf( "%20llu : Number of NBS records written\n", nlp->nl_nbswrites);
printf( "%20llu : Number of metadata buffer updates\n", nlp->nl_bufupdates);
printf( "%20llu : Number of updates requiring old-byte copying\n", nlp->nl_act_comp_copies);
printf( "%20llu : Avoided buffer update records due to overlap\n",
    nlp->nl_bufavoid );
printf( "%20llu : Avoided merge update records due to overlap\n\n",
    nlp->nl_endavoid );
}

int print_logcache_version1(char *buffp, int buff_fill_len)
{
    double temp_ratio;
    int whole;
    int decimal;
    API_LOG_STATS *lgstptr = (API_LOG_STATS*) &buffp[buff_fill_len];

    printf("%52s\n", "Log File Caching Statistics");
    printf("\n");
    printf("Buffers (K bytes) Requests Hits Ratio Written \n");
    printf("---------- --------- ---------- ---------- ------ ----------");
    printf("\n");

    temp_ratio = (lgstptr->al_lookups.low == 0) ? 0.0 :
        ((double)lgstptr->al_hits.low) /
        lgstptr->al_lookups.low);
    temp_ratio *= 100.0;
    CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
    decimal = decimal / 100; /* Just want tenths */

    printf("%10u %9u %10u %10u %3u.%1.1u%% %10u\n",
        lgstptr->al_buffers.low,
        lgstptr->al_buffers.low * lgstptr->al_buffsize,
        lgstptr->al_lookups.low, lgstptr->al_hits.low,
        whole, decimal, lgstptr->al_writtenPages.low);

    printf("\n");
    printf("New buffer: log full waits %10u NBS IO waits %10u\n",
        lgstptr->al_fullWaits.low, lgstptr->al_nbsWaits.low);

    printf(" \n");
}
Statistics Metadata Cache Information

Purpose

A performance statistics operation that returns metadata cache counters. It is used to determine the number of requests, hits, and discards from the directory cache.

Format

```c
syscall_parmlist
opcode int 248 STATOP_META_CACHE
parms[0] int Offset to STAT_API
parms[1] int Offset of output following STAT_API
parms[2] int Offset to system name (optional)
parms[3] int 0
parms[4] int 0
parms[5] int 0
parms[6] int 0
STAT_API
  sa_eye char[4] "STAP"
  sa_len int length of buffer following STAT_API
  sa_ver int 1 or 2
  sa_flags char[1] 0x80 - Reset statistics
  sa_fill char[3] Reserved
  sa_supported_ver int Version of data returned
  sa_reserve int[3] Reserved
  posix_time_high unsigned int High order 32 bits since epoch
  posix_time_low unsigned int Low order 32 bits since epoch
  posix_usec unsigned int Microseconds
  pad1 int Reserved
API_META_STATS
  am_eye char[4] "AMET"
  am_size short Size of output
  am_version char Version
  am_reserved1 char Reserved byte
PRIMARY_STATS
  buffers unsigned long long int Number of buffers in the cache
  buffsize int Size of each buffer in K bytes
  amc_res1 int Reserved
  requests unsigned long long int Requests to the cache
  hits unsigned long long int Hits in the cache
  updates unsigned long long int Updates to buffers in the cache
  reserved int[10] Reserved
BACK_STATS
  buffers hyper Number of buffers in the cache
  buffsize int Size of each buffer in K bytes
  amc_res1 int Reserved
  requests_reserved int Reserved
  requests int Requests to the cache
  hits_reserved int Reserved
  hits int Hits in the cache
  discards_reserved int Reserved
  discards int Discards of data from the cache
  reserved int[10] Reserved
  am_reserved3 int Reserved
--- or ---
API_META_STATS2
  am_eye char[4] "AMET"
  am_size short Size of output
  am_version char Version
  am_reserved1 char Reserved byte
PRIMARY_STATS2
  buffers unsigned long long int Number of buffers in the cache
  buffsize int Size of each buffer in K bytes
  amc_res1 int Reserved
  requests unsigned long long int Requests to the cache
  hits unsigned long long int Hits in the cache
  updates unsigned long long int Updates to buffers in the cache
  partialwrites unsigned long long int Times only part of 8K block written
  reserved int[8] Reserved
  amReserved3 int Reserved
```
systemname char[9] Name of system to get stats from

Usage notes
1. Reserved fields and undefined flags must be set to binary zeros.
2. When sa_supported_ver is 0 or 1, the output buffer contains an API_META_STATS structure. The BACK_STATS structure contains zeros because there is no longer a metaback cache in V2R2. When sa_supported_ver is 2, the output buffer contains an API_META_STATS2 structure.

Privilege required
None.

Related services
Statistics Vnode Cache Information
Statistics Metadata Cache Information

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_STATS 0x40000007
#define STATOP_META_CACHE 248 /* Metadata cache (and back cache) stats */
#define CONVERT_RATIO_TO_INTS(RATIO, INTEGER, DECIMAL)                  
{                                                                       
    INTEGER = (int)RATIO;                                               
    DECIMAL = (int)((RATIO - (double)INTEGER) * (double)1000.0);        
}
typedef struct syscall_parmlist_t
{
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused */
} syscall_parmlist;
typedef struct hyper
{
    unsigned int high; /* unsigned int reserved */
    unsigned int low;
} hyper;
/*%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
/* META cache stats, including backing cache. */
/*%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%*/
typedef struct PRIMARY_STATS2_t
{
    unsigned long long int buffers; /* Number of buffers in cache */
    int buffsize; /* Size of each buffer in K bytes */
    int amc_res1; /* Reserved for future use, zero in version 1 */
    unsigned long long int requests; /* Requests to the cache */
    unsigned long long int hits; /* Hits in the cache */
    unsigned long long int updates; /* Updates to buffers in the cache */
    unsigned long long int partialwrites; /* Only part of 8K block written to */
    /* reduce byte transfer. For version 1 */
    /* always set partialwrites to 0 */
    int reserved[8]; /* For future use */
} PRIMARY_STATS2;
```
typedef struct API_META_STATS2_t
{
    char          am_eye[4];          /* Eye catcher = AMET */
#define MS_EYE "AMET"
    short         am_size;            /* Size of output structure */
    char          am_version;         /* Version of stats */
#define MS_VER_INITIAL 1    /* First version of log stats */
    char          am_reserved1;       /* Reserved byte, 0 in version 1 */
    PRIMARY_STATS2 am_primary;        /* Primary space cache statistics */
    int           am_reserved3[10];  /* Reserved for future use */
} API_META_STATS2;

/* reset timestamp */
typedef struct reset_time {
    unsigned int      posix_time_high; /* high order 32 bits since epoch */
    unsigned int      posix_time_low;  /* low order 32 bits since epoch */
    unsigned int      posix_usecs;     /* microseconds */
    int               pad1;
} RESET_TIME;

/* Version 1 Output Structures */
typedef struct PRIMARY_STATS_t {
    hyper buffers;           /* Number of buffers in cache */
    int   buffsize;          /* Size of each buffer in K bytes */
    int   amc_res1;          /* Reserved for future use, zero in version 1 */
    int   requests_reserved; /* Reserved */
    int   requests;          /* Requests to the cache */
    int   hits_reserved;     /* Reserved */
    int   hits;              /* Hits in the cache */
    int   updates_reserved;  /* Reserved */
    int   updates;           /* Updates to buffers in the cache */
    int   reserved[10];      /* For future use */
} PRIMARY_STATS;

typedef struct BACK_STATS_t {
    hyper buffers;           /* Number of buffers in cache */
    int   buffsize;          /* Size of each buffer in K bytes */
    int   amc_res1;          /* Reserved for future use, zero in version 1 */
    int   requests_reserved; /* Reserved */
    int   requests;          /* Requests to the cache */
    int   hits_reserved;     /* Reserved */
    int   hits;              /* Hits in the cache */
    int   discards_reserved; /* Reserved */
    int   discards;          /* Discards of data from backing cache */
    int   reserved[10];      /* For future use */
} BACK_STATS;

typedef struct API_META_STATS_t {
    char  am_eye[4];        /* Eye catcher = AMET */
#define MS_EYE "AMET"
    short am_size;          /* Size of output structure */
    char  am_version;       /* Version of stats */
#define MS_VER_INITIAL 1  /* First version of log stats */
    char  am_reserved1;     /* Reserved byte, 0 in version 1 */
    PRIMARY_STATS am_primary;       /* Primary space cache statistics */
    BACK_STATS    am_back;          /* Backing cache statistics */
    int           am_reserved3[10]; /* Reserved for future use */
} API_META_STATS;

/********************************************************************/
/* The following structure is the api query control block.        */
/* It is used for all api query commands.                         */
/********************************************************************/

typedef struct stat_api_t {
#define SA_EYE "STAP"
    char              sa_eye[4];     /* 4 byte identifier must be */
    int               sa_len;        /* length of the buffer to put data into*/
    int               sa_ver;        /* the version number (1 or 2) */
#define SA_VER_2 0x02
#define SA_VER_INIT 0x01
    char              sa_flags;      /* flags field must be x00 or x80, */
    int               sa_reserve[3];    /* x80 means reset statistics */
#define SA_RESET 0x80
    char              sa_fill[3];       /* spare bytes */
    int               sa_supported_ver; /* version of data returned */
    int               sa_reserve[3];    /* Reserved */
    struct reset_time reset_time_info;
} STAT_API;

typedef struct parmstruct {
    syscall_parmlist myparms;
}
```c
STAT_API myapi;
API_META_STATS mystats;
char systemname[9];
} myparmstruct;

int print_metadata_version1(API_META_STATS *metastptr);
int print_metadata_version2(API_META_STATS2 *metastptr);

int main(int argc, char **argv)
{
    int      bpxrv;
    int      bpxrc;
    int      bpxrs;
    int      i;
    double   temp_ratio;
    int      whole;
    int      decimal;
    myparmstruct parmstruct;
    STAT_API *stapptr = &(parmstruct.myapi);
    char     buf[33];

    parmstruct.myparms.opcode   = STATOP_META_CACHE;
    parmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    parmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
    parmstruct.myparms.parms[2] = 0;
    /* Only specify a non-zero offset for the next field (parms[2]) if */
    /* you are running z/OS 1.7 and above, and you want to query the   */
    /* metadata cache statistics of a different system than this one   */
    /* parmstruct.myparms.parms[2] = sizeof(syscall_parmlist) +        */
    /*                               sizeof(STAT_API) +                */
    /*                               sizeof(API_META_STATS);           */
    parmstruct.myparms.parms[3] = 0;
    parmstruct.myparms.parms[4] = 0;
    parmstruct.myparms.parms[5] = 0;
    parmstruct.myparms.parms[6] = 0;

    memset(stapptr, 0, sizeof(STAT_API));
    memcpy(stapptr->sa_eye, SA_EYE, 4);
    stapptr->sa_ver = SA_VER_2;
    stapptr->sa_len = (int)sizeof(API_META_STATS);
    /* This next field should only be set if parms[2] is non-zero */
    /* strcpy(myparmstruct.systemname,"DCEIMGVQ"); */
    /* BPX1PCT("ZFS     ", */
    /* ZFSCALL_STATS,              /* Perf statistics operation */
    /* sizeof(myparmstruct),       /* Length of Argument */
    /* (char *)&parmstruct,        /* Pointer to Argument */
    &bpxrv,                       /* Pointer to Return_value */
    &bpxrc,                       /* Pointer to Return_code */
    &bpxrs);                      /* Pointer to Reason_code */

    if (bpxrv < 0)
    {
        printf("Error querying meta cache, BPXRV = %d BPXRC = %d BPXRS = %x\n",
               bpxrv, bpxrc, bpxrs);
        return bpxrc;
    }
    else
    {
        if (stapptr->sa_supported_ver == SA_VER_INIT)
        {
            API_META_STATS *metastptr1 = &(parmstruct.mystats);
            print_metadata_version1(metastptr1);
        }
        else
        {
            API_META_STATS2 *metastptr = (API_META_STATS2 *)&(parmstruct.mystats);
            print_metadata_version2(metastptr);
        }

        if (0 == ctime_r((time_t *)&stapptr->reset_time_info.posix_time_low, buf))
            printf("Could not get timestamp.\n\n");
        else
        {
            /* Insert the microseconds into the displayable time value */
            strncpy(&buf[27]), &buf[20], 6);
            sprintf(&buf[20], "%06d", stapptr->reset_time_info.posix_usecs);
            buf[26] = ' ';
            buf[19] = '.';
            printf("Last Reset Time: %s", buf);
        }
    }
```
```c
int print_metadata_version2(API_META_STATS2 *metastptr)
{
    double temp_ratio;
    int whole;
    int decimal;

    /* Primary cache */
    printf("%60s
", "Metadata Caching Statistics");
    printf("\n");
    printf("Buffers (K bytes) Requests \n");
    printf("Hits Ratio Updates \n");
    printf("------------------------ " \n");
    temp_ratio = (metastptr->am_primary.requests == 0) ? 0.0 : ((double)metastptr->am_primary.hits) / metastptr->am_primary.requests;
    temp_ratio *= 100.0;
    CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
    decimal = decimal / 100; /* Just want tenths */
    printf("%20llu %19llu %20llu %20llu %3u.%1.1u%% %20llu
", metastptr->am_primary.buffers,
        metastptr->am_primary.buffers * metastptr->am_primary.buffsize,
        metastptr->am_primary.requests,
        metastptr->am_primary.hits,
        whole, decimal, metastptr->am_primary.updates);
    printf("\n");
    return 1;
}

int print_metadata_version1(API_META_STATS *metastptr)
{
    double temp_ratio;
    int whole;
    int decimal;
    printf("Version 1 output is being displayed\n\n");

    /* Primary cache */
    printf("%44s
", "Metadata Caching Statistics");
    printf("\n");
    printf("Buffers (K bytes) Requests Hits Ratio Updates \n");
    printf("---------- --------- ---------- ---------- ------ ----------
");
    temp_ratio = (metastptr->am_primary.requests == 0) ? 0.0 : ((double)metastptr->am_primary.hits) / metastptr->am_primary.requests;
    temp_ratio *= 100.0;
    CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
    decimal = decimal / 100; /* Just want tenths */
    printf("%10u %9u %10u %10u %3u.%1.1u%% %10u
", metastptr->am_primary.buffers.low,
        metastptr->am_primary.buffers.low * metastptr->am_primary.buffsize,
        metastptr->am_primary.requests,
        metastptr->am_primary.hits,
        whole, decimal, metastptr->am_primary.updates);
    printf("\n");

    /* Backing cache */
    printf("%48s
", "Metadata Backing Caching Statistics");
    printf("\n");
    printf("Buffers (K bytes) Requests Hits Ratio Discards \n");
    printf("---------- --------- ---------- ------ ----------
");
    if( metastptr->am_back.requests == 0 )
        temp_ratio = 0.0;
    else
        temp_ratio = 10000 * (((double)metastptr->am_back.hits) / metastptr->am_back.requests);
    CONVERT_RATIO_TO_INTS(temp_ratio, whole, decimal);
    decimal = decimal / 100; /* Just want tenths */
    printf("%10u %9u %10u %10u %3u.%1.1u%% %10u
", metastptr->am_back.buffers.low,
        metastptr->am_back.buffers.low * metastptr->am_back.buffsize,
        metastptr->am_back.requests,
        metastptr->am_back.hits,
        whole, decimal, metastptr->am_back.updates);
    printf("\n");
    return 1;
}
```
whole, decimal, metastptr->am_back.discard); 
printf(" \n"); 
}
Statistics Server Token Management Information

**Purpose**

Returns the server token manager statistics. These statistics can be used to monitor token-related activity for all file systems that are owned on the local server system. It can also be used to monitor token related activity between this local server system and each individual client system that is accessing the file systems that are owned on the local server system.

**Format**

```plaintext
syscall_parmlist

opcode int 252 STATOP_STKM
parms[0] int offset to STAT_API
parms[1] int Offset of output following STAT_API
parms[2] int 0
parms[3] int 0
parms[4] int 0
parms[5] int 0
parms[6] int 0

STAT_API

sa_eye char[4] "STAP"
sa_len int length of buffer that follows STAT_API
sa_ver int 1
sa_flags char[1] 0x00
SA_RESET 0x00 Reset statistics
sa_fill int[4] 0
sa_reserve int[4] 0
sa_supported_ver int version of data returned
sa_reserved int[3] 0
posix_time_high unsigned int high order 32 bits since epoch
posix_time_low unsigned int low order 32 bits since epoch
posix_usec unsigned int microseconds
pad1 int

STKM_API_STATS

st_eye char[4] "STKM"
st_len short size of STKM_API_STATS structure
st_reserved1 char[2]
st_maxtokens unsigned long long Max num of tokens allowed
st_allocated unsigned long long Number of physically allocated tokens
st_inuse unsigned long long Number of tokens in use
st_files unsigned long long Number of file structures allocated
st_obtains unsigned long long Number of tokens obtained
st_returns unsigned long long Number of tokens returned
st_revokes unsigned long long Number of tokens revoked
st_asyncgrants unsigned long long Number of async grants requests
st_gcs unsigned long long Number of token garbage collections
st_reserved2 char[8]
stThrashing unsigned long long Number of thrashing files
st_resolution unsigned long long Number of thrash resolutions
st_reserved3 char[40]
ss_sysinfo STKM_SYS_STATS[33]

ss_eye char[4] "STSS"
ss_len short size of STKM_SYS_STATS structure
ss_reserved1 char[2]
ss_name char[8] Sysname
ss_token unsigned long long Number of tokens the system currently holds
ss_obtains unsigned long long Number of tokens obtained
ss_returns unsigned long long Number of token returned
ss_revokes unsigned long long Number of token revokes
ss_asyncgrant unsigned long long Number of asynchronously granted tokens
ss_reserved2 char[16]

ssThrashing_objs STKM_THRASHING_FILES[64]
inode unsigned int thrashing file inode
unique unsigned int thrashing file uniqueifer
```
Usage notes

1. Users of the API supply as input a buffer that contains a syscall_parmlist followed by a STAT_API structure. Output is placed in the buffer after the STAT_API structure.
2. The output consists of up to 33 STKM_SYS_STATS and up to 64 STKM_THRASHING_FILES structures.
3. Unused elements of the ss_sysinfo array have an ss_name field that consists of hex zeros.
4. Unused elements of the ss_thrashing_objs array have an inode field with the value 0.

Privilege required

None.

Related services

- Query token_cache_size
- Set token_cache_size
- Statistics Sysplex Client Operations Information
- Statistics Sysplex Owner Operations Information

Restrictions

None.

Example

```c
#define ZFSCALL_STATS 0x40000007
#define STATOP_STKM   252
#define BUFFER_SIZE   1024 * 64

typedef struct syscall_parmlist_t {
  int opcode;                  /* Operation code to perform */
  int parms[7];                /* Specific to type of operation, */
} syscall_parmlist;

typedef struct reset_time {
  unsigned int   posix_time_high;
  unsigned int   posix_time_low;
  unsigned int   posix_usecs;
  int     pad1;
} RESET_TIME;

typedef struct stat_api_t {
  #define SA_EYE "STAP"
  char    sa_eye[4];           /* 4 byte identifier must be */
  int     sa_len;              /* length of the buffer to put data into*/
  char    sa_flags;            /* command field must be x00 or x80, */
  #define SA_VER_INIT 0x81
  int     sa_ver;              /* this buffer area follows this struct*/
  #define SA_VER   0x01
  #define SA_VER_INIT 0x81
  int     sa_ver;              /* the version number currently always 1*/
} stat_api;
```

zFS application programming interface information  409
/* x80 means reset statistics */
#define SA_RESET 0x80
char sa_fill[3]; /* spare bytes */
int sa_reserve[4]; /* Reserved */
struct reset_time reset_time_info;
} STAT_API;

typedef struct stkm_sys_stats_t {
  char ss_eye[4]; /* eye catcher-"STSS" */
#define SS_EYE "STSS"
  short ss_len;
  char ss_reserved1[2];
  char ss_name[8]; /* Sysname */
  unsigned long long ss_token; /* Number of tokens the system */
  unsigned long long ss_obtains; /* Number of token obtained */
  unsigned long long ss_returns; /* Number of token returned */
  unsigned long long ss_revokes; /* Number of token revokes */
  unsigned long long ss_asyncgrant; /* Number of asynchronously */
                     /* granted tokens */
  char ss_reserved2[16];
} STKM_SYS_STATS;

typedef struct stkm_thrashing_files_t {
  unsigned int inode;
  unsigned int unique;
  char name[45];
  char reserved[3];
} STKM_THRASHING_FILES;
#define MAX_THRASHING_FILES 64
#define SYS_MAX_SYSPLEX_SYSTEMS 32     /* Current max # sysplex images*/

typedef struct stkm_api_stats_t {
  char st_eye[4]; /* eye catcher-"STKM" */
#define ST_EYE "STKM"
  short st_len;
  char st_reserved1[2];
  unsigned long long st_maxtokens; /* Max num of tokens allowed */
  unsigned long long st_allocated; /* Num. of physically allocated */
                     /* tokens */
  unsigned long long st_inuse; /* Number of tokens in use */
  unsigned long long st_files; /* Number of file structures */
                     /* allocated */
  unsigned long long st_obtains;
  unsigned long long st_returns;
  unsigned long long st_revokes;
  unsigned long long st_asyncgrants;
  unsigned long long st_gcs;
  char st_reserved2[8];
  unsigned long long st_thrashing;
  unsigned long long st_resolution;
  char st_reserved3[40];
} STKM_API_STATS;

int main(int argc, char** argv)
{
  int buff_fill_len = 0;
  int bpxrv, bpxrc, bpxrs;
  char sysname[9];
  int title_done;
  STAT_API local_req;
  STAT_API *st_req = NULL;
  syscall_parmlist *parmp = NULL;
  STKM_API_STATS *st_stats = NULL;
  STKM_SYS_STATS *ss_stats = NULL;
  STKM_THRASHING_FILES *thrashingp = NULL;
  char *buffp = NULL;

  /* Initialize the local_req to 0s */
  st_req = &local_req;
  memset( st_req, 0x00, sizeof(STAT_API) );
  strcpy( local_req.sa_eye, SA_EYE, sizeof(local_req.sa_eye) );
  local_req.sa_len = sizeof(STKM_API_STATS);
  local_req.sa_ver = SA_VER_INIT;
/* Allocate Buffer */
buffp = (char*) malloc(BUFFER_SIZE);
if( buffp == NULL )
{
    printf("Malloc Error\n");
    return 0;
}
memset( buffp, 0x00, sizeof(syscall_parmlist) + sizeof(STAT_API));
/* Set the run parms */
parmp = (syscall_parmlist*) &buffp[0];
parmp->opcode   = STATOP_STKM;
parmp->parms[0] = buff_fill_len = sizeof(syscall_parmlist);
parmp->parms[1] = buff_fill_len + sizeof(STAT_API);
parmp->parms[2] = 0;
parmp->parms[3] = 0;
parmp->parms[4] = 0;
parmp->parms[5] = 0;
parmp->parms[6] = 0;
st_req = (STAT_API*) &buffp[buff_fill_len];
memcpy( st_req, &local_req, sizeof(STAT_API) );
buff_fill_len += sizeof(STAT_API);
BPX1PCT("ZFS
    ZFS Kernel STATS,              /* Aggregate operation */
    BUFFER_SIZE,                /* Length of Argument */
    (char*) buff,              /* Pointer to Argument */
    &bpxrv,                     /* Pointer to Return_value */
    &bpxrc,                     /* Pointer to Return_code */
    &bpxrs);                    /* Pointer to Reason_code */
if( bpxrv )
{
    /* Bad Return code */
    printf("Error requesting info for stkm stats\n");
    printf("Return Value: %d Return Code: %d Reason Code: %x\n",
           bpxrv, bpxrc, bpxrs);
}
else
{
    /* Success.  Print the information in a table */
st_stats = (STKM_API_STATS*) &buffp[buff_fill_len];
ss_stats = st_stats->ss_sysinfo;
thrashingp = st_stats->ss_thrashing_objs;
printf("Server Token Manager (STKM) Statistics\n");
printf("--------------------------------------\n");
printf("Maximum tokens:   %20llu        Allocated tokens:   %20llu\n", st_stats->st_maxtokens, st_stats->st_allocated);
printf("Tokens In Use:    %20llu        File structures:    %20llu\n", st_stats->st_inuse, st_stats->st_files);
printf("Token obtains:    %20llu        Token returns:      %20llu\n", st_stats->st_obtains, st_stats->st_returns);
printf("Token revokes:    %20llu        Async Grants:       %20llu\n", st_stats->st_revokes, st_stats->st_asyncgrants);
printf("Garbage Collects: %20llu        Thrash Resolutions: %20llu\n", st_stats->st_gcs, st_stats->st_resolution);
printf("Thrashing Files:  %20llu\n", st_stats->st_thrashing);
printf("System Tokens                  Obtains                  ", "
    " );
printf("Tokens                  Revokes                  Async Grt\n");
printf("Returns                  " );
printf("--------------------");
printf("--------------------");
printf("--------------------");
for (int i = 0; i < (SYS_MAX_SYSPLEX_SYSTEMS+1); i++)
{
    if (ss_stats[i].ss_name[0] == '\0')
        break;
    memcpy(&sysname, &ss_stats[i].ss_name, 8);
sysname[8] = '\0';
    printf("%8.8s %20llu %20llu %20llu %20llu\n",
             sysname,
             ss_stats[i].ss_token,
             ss_stats[i].ss_obtains,
             ss_stats[i].ss_returns,
ss_stats[i].ss_revoke,
            ss_stats[i].ss_asyncgrant);
    }
    printf("\n");
    title_done = 0;
    for (int j = 0; j < MAX_THRASHING_FILES; j++)
    {
        if (thrashingp[j].inode == 0)
            break;
        if (title_done == 0)
        {
            printf("              Thrashing Objects:
");
            printf("            Inode      Uniquifier   File system \
");
            printf("               ---------- -------   --------------------\n"");
            title_done = 1;
        }
        printf("%20u %20u %s\n", thrashingp[j].inode,
            thrashingp[j].unique,
            thrashingp[j].name);
    }
    if (title_done)
    printf("\n");
    return 0;
## Statistics Storage Information

### Purpose

A performance statistics operation that returns storage information.

STATOP_STORAGE (241) returns below the 2 G bar information. STATOP_STORAGE (255) returns above the 2 G bar information.

### Format

```plaintext
syscall_parmlist

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>opcode</td>
<td>int</td>
<td>241 STAP_STORAGE or 255 STAP_STORAGE_ABOVE</td>
</tr>
<tr>
<td>parm[0]</td>
<td>int</td>
<td>Offset to STAT_API</td>
</tr>
<tr>
<td>parm[1]</td>
<td>int</td>
<td>Offset of output following STAT_API following STAT_API</td>
</tr>
<tr>
<td>parm[2]</td>
<td>int</td>
<td>Offset to system name (optional)</td>
</tr>
<tr>
<td>parm[3]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parm[4]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parm[5]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>parm[6]</td>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>STAT_API</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sa_eye</td>
<td>char[4]</td>
<td>&quot;STAP&quot;</td>
</tr>
<tr>
<td>sa_len</td>
<td>int</td>
<td>Length of buffer that follows the STAT_API</td>
</tr>
<tr>
<td>sa_ver</td>
<td>int</td>
<td>1 or 2 for STATOP_STORAGE 1 for STATOP_STORAGE_ABOVE</td>
</tr>
<tr>
<td>sa_flags</td>
<td>char</td>
<td>0x80 for reset; 0x00 otherwise</td>
</tr>
<tr>
<td>sa_fill</td>
<td>char[3]</td>
<td>Reserved</td>
</tr>
<tr>
<td>sa_supported_ver</td>
<td>int[3]</td>
<td>Version of data returned</td>
</tr>
<tr>
<td>posix_time_high</td>
<td>int</td>
<td>High order 32 bits since epoch</td>
</tr>
<tr>
<td>posix_time_low</td>
<td>int</td>
<td>Low order 32 bits since epoch</td>
</tr>
<tr>
<td>posix_useconds</td>
<td>int</td>
<td>Microseconds</td>
</tr>
<tr>
<td>pad1</td>
<td>int</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

API_STOR_STATS

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>reserved1</td>
<td>int</td>
<td></td>
</tr>
<tr>
<td>ss_total_bytes_allocated</td>
<td>int</td>
<td>Total bytes allocated</td>
</tr>
<tr>
<td>ss_total_pieces_allocated</td>
<td>int</td>
<td>Total pieces allocated</td>
</tr>
<tr>
<td>ss_total_allocation_requests</td>
<td>int</td>
<td>Total allocation requests</td>
</tr>
<tr>
<td>ss_total_free_requests</td>
<td>int</td>
<td>Total free requests</td>
</tr>
<tr>
<td>ss_number_of_comp_lines</td>
<td>int</td>
<td>Total number of component lines in buffer</td>
</tr>
</tbody>
</table>

COMP_LINE[n]

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ss_comp_bytes_allocated</td>
<td>int</td>
<td>The number of bytes allocated by this component</td>
</tr>
<tr>
<td>ss_comp_pieces</td>
<td>int</td>
<td>The number of pieces allocated</td>
</tr>
<tr>
<td>ss_comp_allocations</td>
<td>int</td>
<td>Number of allocation requests done by this component</td>
</tr>
<tr>
<td>ss_comp_frees</td>
<td>int</td>
<td>The number of storage frees done by this component</td>
</tr>
<tr>
<td>ss_comp_description</td>
<td>char[84]</td>
<td>The component description</td>
</tr>
</tbody>
</table>

DETAIL_LINE[m]

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ss_detail_bytes_allocated</td>
<td>int</td>
<td>Number of bytes allocated</td>
</tr>
<tr>
<td>ss_detail_pieces</td>
<td>int</td>
<td>Number of pieces allocated</td>
</tr>
<tr>
<td>ss_detail_allocations</td>
<td>int</td>
<td>Number of allocation requests</td>
</tr>
<tr>
<td>ss_detail_frees</td>
<td>int</td>
<td>Number of free requests</td>
</tr>
<tr>
<td>ss_detail_description</td>
<td>char[84]</td>
<td>Description</td>
</tr>
</tbody>
</table>
```

-- or --

API_STOR_STATS2

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ss_total_bytes_of_data</td>
<td>unsigned long long int</td>
<td>Total storage allocated. May include storage used by other components in the address space.</td>
</tr>
<tr>
<td>ss_iorefscm_allocated</td>
<td>unsigned long long int</td>
<td>Total bytes allocated by IOEFSCM for STATOP_STORAGE_ABOVE (255)</td>
</tr>
</tbody>
</table>
```
Statistics Storage Information

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ss_ioefscm_heap_allocated</td>
<td>unsigned long long int</td>
<td>Total bytes allocated by the IOEFSCM heap.</td>
</tr>
<tr>
<td>ss_ioefscm_heap_pieces</td>
<td>unsigned long long int</td>
<td>Total storage pieces in the IOEFSCM heap.</td>
</tr>
<tr>
<td>ss_ioefscm_heap_allocations</td>
<td>unsigned long long int</td>
<td>Total allocation requests to IOEFSCM heap.</td>
</tr>
<tr>
<td>ss_ioefscm_heap_frees</td>
<td>unsigned long long int</td>
<td>Total free requests to IOEFSCM heap.</td>
</tr>
<tr>
<td>ss_ioefskn_allocated</td>
<td>unsigned long long int</td>
<td>Total bytes discarded for STATOP_STORAGE (241).</td>
</tr>
<tr>
<td>ss_ioefskn_heap_allocated</td>
<td>unsigned long long int</td>
<td>Total bytes allocated by the IOEFSKN heap.</td>
</tr>
<tr>
<td>ss_ioefskn_heap_pieces</td>
<td>unsigned long long int</td>
<td>Total storage pieces in the IOEFSKN heap.</td>
</tr>
<tr>
<td>ss_ioefskn_heap_allocations</td>
<td>unsigned long long int</td>
<td>Total allocation requests to IOEFSKN heap.</td>
</tr>
<tr>
<td>ss_ioefskn_heap_frees</td>
<td>unsigned long long int</td>
<td>Total free requests to IOEFSKN heap.</td>
</tr>
<tr>
<td>ss_ioefskn_heap_discarded</td>
<td>unsigned long long int</td>
<td>Total bytes discarded for STATOP_STORAGE (241).</td>
</tr>
<tr>
<td>ss_number_of_comp_lines</td>
<td>int</td>
<td>Total number of components lines in buffer</td>
</tr>
<tr>
<td>pad</td>
<td>int</td>
<td>Reserved</td>
</tr>
<tr>
<td>ss_reserved_space</td>
<td>char[56]</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>COMP_LINE2[n]</td>
<td>ss_comp_bytes_allocated</td>
<td>The number of bytes allocated by this component</td>
</tr>
<tr>
<td></td>
<td>ss_comp_pieces</td>
<td>The number of pieces allocated</td>
</tr>
<tr>
<td></td>
<td>ss_comp_allocations</td>
<td>The number of storage allocations requests done by this component</td>
</tr>
<tr>
<td></td>
<td>ss_comp_frees</td>
<td>The number of storage frees done by this component</td>
</tr>
<tr>
<td></td>
<td>ss_comp_description</td>
<td>The component description</td>
</tr>
<tr>
<td>ss_number_of_detail_lines</td>
<td>int</td>
<td>The number of detail lines following this component line</td>
</tr>
<tr>
<td>DETAIL_LINE2[m]</td>
<td>ss_detail_bytes_allocated</td>
<td>Number of bytes allocated</td>
</tr>
<tr>
<td></td>
<td>ss_detail_pieces</td>
<td>Number of pieces allocated</td>
</tr>
<tr>
<td></td>
<td>ss_detail_allocations</td>
<td>Number of allocation requests</td>
</tr>
<tr>
<td></td>
<td>ss_detail_frees</td>
<td>Number of free requests</td>
</tr>
<tr>
<td></td>
<td>ss_detail_description</td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>ss_detail_reserved</td>
<td>Reserved</td>
</tr>
<tr>
<td>systemname</td>
<td>char[9]</td>
<td>System name where the query is ran</td>
</tr>
</tbody>
</table>

Return value: 0 if request is successful, -1 if it is not successful

Return code:
- EINTR: ZFS is shutting down
- EINVAL: Invalid parameter list
- EMVSERR: Internal error occurred
- E2BIG: Information too big for buffer supplied

Reason code:
- 0xEFxxnnnn: See z/OS Distributed File Service Messages and Codes
Usage notes

1. You can specify a buffer that you think might be large enough or you can specify a buffer length of zero. If you get a return code E2BIG, the required size for the buffer is contained in the sa_len field.

2. Reserved fields and undefined flags must be set to binary zeros.

3. When sa_supported_ver is 0 or 1, output consists of API_STOR_STATS, COMP_LINE and DETAIL_LINE. When sa_supported_ver is 2, output consists of API_STOR_STATS2, COMP_LINE2 and DETAIL_LINE2.

4. For STATOP_STORAGE_ABOVE, sa_supported_ver is 1 and output consists of API_STOR_STATS2, COMP_LINE2 and DETAIL_LINE2.

Privilege required

None.

Related services

Statistics Locking Information
Statistics User Cache Information

Restrictions

None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_STATS 0x40000007
#define STATOP_STORAGE 241 /* below-bar storage stats */
#define STATOP_STORAGE_ABOVE 255
#define STATOP_LAST STATOP_STORAGE_ABOVE
#define E2BIG 145
typedef struct syscall_parmlist_t {
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;
typedef struct reset_time {
    unsigned int posix_time_high; /* high order 32 bits since epoc */
    unsigned int posix_time_low; /* low order 32 bits since epoch */
    unsigned int posix_usecs; /* microseconds */
    int pad1;
} RESET_TIME;

typedef struct stat_api_t {
    #define SA_EYE "STAP"
    char sa_eye[4]; /* 4 byte identifier must be */
    int sa_len; /* length of the buffer to put data into*/
    int sa_ver; /* this buffer area follows this struct */
    #define SA_VER_2 0x02
    #define SA_VER_INIT 0x01
    char sa_flags; /* flags field must be x00 or x80, */
    /* x80 means reset statistics */
    #define SA_RESET 0x80
} stat_api_t;
```
Statistics Storage Information

```c
char sa_fill[3]; /* spare bytes */
int sa_supported_ver; /* version of data returned */
int sa_reserve[3]; /* Reserved */
struct reset_time reset_time_info;
} STAT_API;

typedef struct comp_line_2{
  unsigned long long int ss_comp_bytes_allocated; /* Number of bytes */
  /* allocated */
  /* by this component */
  unsigned long int ss_comp_pieces; /* The number of pieces allocated */
  unsigned long int ss_comp_allocations; /* the number of storage */
  /* allocations requests done */
  /* by this component */
  unsigned long int ss_comp_frees; /* number of storage frees */
  /* done by this component */
  char ss_comp_description[84]; /* the component description */
  int ss_number_of_detail_lines; /* the number of detail lines */
  /* before the next component line */
  /* or end of buffer */
} COMP_LINE_2;

typedef struct detail_line_2{
  unsigned long long int ss_detail_bytes_allocated; /* number of bytes */
  /* allocated */
  unsigned long long int ss_detail_pieces; /* number of pieces allocated*/
  unsigned long long int ss_detail_allocations; /*number of allocation */
  /*requests             */
  unsigned long int ss_detail_frees; /*number of free requests*/
  char ss_detail_description[84]; /*description */
  char ss_reserved_pad[4];
} DETAIL_LINE_2;

typedef struct api_stor_stats_2{
  unsigned long long int ss_total_bytes_of_data;
  /* Total storage allocated, this comes from OS data structures */
  /* and is via a query from OS and may include storage */
  /* used by other OS components in the address space */
  /* QUERY,STORAGE equivalent: */
  /* Total Storage Above/Below 2G Bar Allocated */
  unsigned long int ss_ioefscm_allocated;
  /* Total number of bytes allocated by IOEFSCM */
  /* This field valid only for an above-bar storage query */
  /* QUERY,STORAGE equivalent: */
  /* Total Bytes Allocated by IOEFSCM (Stack + Heap) */
  unsigned long int ss_ioefscm_heap_allocated;
  /* Total number of bytes allocated by IOEFSKN */
  /* This field valid only for an above-bar storage query */
  unsigned long int ss_ioefskn_allocated;
  /* Total number of storage pieces in IOEFSCM heap */
  /* The number of pieces of allocated storage from calls to obtain storage */
  /* for IOEFSCM */
  unsigned long int ss_ioefscm_heap_pieces;
  /* Total number of allocation requests to IOEFSCM heap since */
  /* last stats reset */
  unsigned long int ss_ioefscm_heap_allocations;
  /* Total number of free requests for IOEFSCM heap since last stats reset */
  unsigned long int ss_ioefscm_heap_frees;
  /* The number of bytes of allocation for IOEFSCM heap */
  /* This field valid only for an above-bar storage query */
  unsigned long int ss_ioefscm_heap_frees;
} API_STOR_STATS_2;
```

416 z/OS: Distributed File Service zFS Administration
/* Total number of bytes allocated by IOEFSKN heap */
/* The number of bytes allocated via calls to obtain storage for IOEFSKN */
/* QUERY,STORAGE equivalent: */
unsigned long long int ss_ioefskn_heap_allocated;

/* Total number of storage pieces in IOEFSKN heap */
/* The number of pieces of allocated storage from calls to obtain */
/* storage for IOEFSKN */
/* QUERY,STORAGE equivalent: */
unsigned long long int ss_ioefskn_heap_pieces;

/* Total number of allocation requests to IOEFSKN heap since last stats reset */
/* QUERY,STORAGE equivalent: */
unsigned long long int ss_ioefskn_heap_allocations;

/* Total number of free requests for IOEFSKN heap since last stats reset */
/* QUERY,STORAGE equivalent: */
unsigned long long int ss_ioefskn_heap_frees;

/* Total number of bytes discarded via IARV64 DISCARD function */
/* ... valid only for above-bar storage query. */
/* QUERY,STORAGE equivalent: */
unsigned long long int ss_ioefskn_heap_discarded;

/* Total number of components lines in buffer*/
unsigned int ss_number_of_comp_lines;
int pad;
char ss_reserved_space[48]; /* reserved for future use */
char ss_returned_data[1]; /* start of buffer to put data into */
char ss_reserved_pad[7]; /* sizeof() will return size including */
/* these 7 bytes */
}

API_STOR_STATS_2;

/* Version 1 Output Structures */
typedef struct comp_line
{
  int ss_comp_bytes_allocated; /* The number of bytes allocated by this component */
  int ss_comp_pieces; /* The number of pieces allocated*/
  int ss_comp_allocations; /* the number of storage allocations */
  int ss_comp_frees; /* the number of storage frees */
  char ss_comp_description[84]; /* the component description */
  int ss_number_of_detail_lines; /* the number of detail lines following this component line before the next component line or end of buffer */
}

COMP_LINE;

typedef struct detail_line
{
  int ss_detail_bytes_allocated; /*number of bytes allocated*/
  int ss_detail_pieces; /*number of pieces allocated*/
  int ss_detail_allocations; /*number of allocation requests*/
  int ss_detail_frees; /*number of free requests*/
  char ss_detail_description[84]; /*description */
}

DETAIL_LINE;

typedef struct api_stor_stats
{
  int reserved1;
  unsigned int ss_total_bytes_allocated; /* Total bytes allocated*/
  unsigned int ss_total_pieces_allocated; /* Total pieces allocated*/
  unsigned int ss_total_allocation_requests; /*Total allocation requests*/
  unsigned int ss_total_free_requests; /*Total free requests*/
  int ss_number_of_comp_lines; /* Total number of components lines in buffer*/
  char ss_reserved_space[48]; /* reserved for future use */

  /***************************************************************************/
  /* The returned data can contain comp_lines and detail_lines ******/
  /* The first line is a component line ******/
  /* The number of component lines returned is in this structure ******/
  /* Each component line is followed by zero or more detail lines ******/

  /***************************************************************************/
/* The comp_line struct indicates how many detail lines follow ******/
/*...................................................................*/
} API_STOR_STATS;

struct parmstruct {
    syscall_parmlist myparms;
    STAT_API        myapi;
    
    /* output buffer API_STOR_STATS_2 + COMP_LINE_2s and DETAIL_LINE_2s */
    char             systemname[9];
} myparmstruct;

int print_storage_version1(struct parmstruct *buffp, int buflen);
int print_storage_version2(struct parmstruct *buffp, int buflen, int above_bar);

int main(int argc, char **argv)
{
    int               buffer_success = 0;
    int               above_bar      = 0;
    int               bpxrv;
    int               bpxrc;
    int               bpxrs;
    int               i,j,t;
    char              buf[33];
    struct parmstruct *myp      = &myparmstruct;
    int               mypsize;
    int               buflen;
    
    /* Only specify a non-zero offset for the next field (parms[2]) if */
    /* you are running z/OS 1.7 and above, and you want to query the storage */
    /* statistics of a different system than this one: */
    /* myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist) */
    /* + sizeof(STAT_API); */
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    memset(stapptr, 0, sizeof(STAT_API));
    memcpy(stapptr->sa_eye, SA_EYE, 4);
    stapptr->sa_ver = SA_VER_2;
    stapptr->sa_len = 0;
    
    /* This next field should only be set if parms[2] is non-zero */
    /* strncpy(myparmstruct.systemname, "DCEIMGVQ"); */
    
    int               buflen = stapptr->sa_len; /* Get buffer size needed */
    mypsize = sizeof(syscall_parmlist) + sizeof(STAT_API) + buflen +
              sizeof(myparmstruct.systemname);
    
    free(myp);
    
    if (bpxrv < 0) {
        if (bpxrc == E2BIG) {
            buflen = stapptr->sa_len; /* Get buffer size needed */
            mypsize = sizeof(syscall_parmlist) + sizeof(STAT_API) + buflen +
                      sizeof(myparmstruct.systemname);
        }
        
        free(myp);
        myp = (struct parmstruct *)malloc((int)mypsize);
        memset(myp, 0, mypsize);
        printf("Need buffer size of %d, for a total of %d\n\n", 
                buflen, mypsize);
    }
    
    for(t = 0; t < 1000 && buffer_success == 0 && above_bar < 2; t++)
    {
        if (bpxrv < 0) {
            if (bpxrc == E2BIG) {
                buflen = stapptr->sa_len; /* Get buffer size needed */
                mypsize = sizeof(syscall_parmlist) + sizeof(STAT_API) + buflen +
                          sizeof(myparmstruct.systemname);
            }
            
            free(myp);
            myp = (struct parmstruct *)malloc((int)mypsize);
            memset(myp, 0, mypsize);
            printf("Need buffer size of %d, for a total of %d\n\n", 
                    buflen, mypsize);
        }
        
        /* Base the opcode on the type of storage needed*/
        if (above_bar == 0 )
            myp->myparms.opcode = STATOP_STORAGE;
    }
    return(0);
}
else
    myp->myparms.opcode = STATOP_STORAGE_ABOVE;

myp->myparms.parms[0] = sizeof(syscall_parmlist);
myp->myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
myp->myparms.parms[2] = 0;
/* Only specify a non-zero offset for the next field (parms[2]) if */
/* you are running z/OS 1.7 and above, and you want to query the */
/* storage statistics of a different system than this one: */
/* * */
/* + sizeof(STAT_API) + buflen; */
myp->myparms.parms[3] = 0;
myp->myparms.parms[4] = 0;
myp->myparms.parms[5] = 0;
myp->myparms.parms[6] = 0;
stapptr = (STAT_API*) ((char *) myp + sizeof(syscall_parmlist));
memcpy(stapptr->sa_eye, SA_EYE, 4);
stapptr->sa_len = buflen;
/* Above bar storage needs SA_VER_INIT*/
/* stapptr->sa_ver = above_bar == 0 ? SA_VER_2 : SA_VER_INIT; */

BPX1PCT("ZFS", ZFS_CALL_STATS, /* Aggregate operation */
    mypsize, /* Length of Argument */
    (char *)myp, /* Pointer to Argument */
    &bpxrv, /* Pointer to Return_value */
    &bpxrc, /* Pointer to Return_code */
    &bpxrs); /* Pointer to Reason_code */
if( bpxrv != 0 && bpxrc == E2BIG )
    printf("E2BIG: %d times total\n", t++);
else if( bpxrv == 0 )
    {
    buffer_success = 1;
    bpxrv = -1;
    /* If version 1, either above bar stats or downlevel system*/
    if( stapptr->sa_supported_ver == SA_VER_INIT)
    above_bar ? print_storage_version2(myp, buflen, above_bar) :
       print_storage_version1(myp, buflen);
    else if (stapptr->sa_supported_ver == SA_VER_2 )
    {
    /* First pass get below the bar */
    print_storage_version2(myp, buflen, above_bar);
    buffer_success = 0;
    above_bar += 1;
    }

    unsigned int ptl = stapptr->reset_time_info.posix_time_low;
    if (0 == ctime_r((time_t *) & ptl, buf))
        printf("Could not get timestamp.\n");
    else
    {
    /* Insert the microseconds into the displayable time value */
    strncpy(&(buf[27]), &(buf[20]), 6);
    sprintf(&(buf[20]), "%06d", stapptr->reset_time_infoposix_usecs);
    buf[26] = '\';
    buf[19] = '\';
    printf("Last Reset Time: %s", buf);
    } 
    free(myp);
}
else
    {
    /* storage stats failed with large enough buffer */
    printf("Error querying storage stats, \n";
    "BPXRV = %d BPXRC = %d BPXRS = %x\n",
    bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
    }
else
    {
    /* error was not E2BIG */
    printf("Error on storage stats trying to get required size\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    free(myp);
    return bpxrc;
    }
    else
else
{ /* asking for buffer size gave rv = 0; maybe there is no data */
  if (myparmstruct.myapi.sa_len == 0)
  {
    printf("No data\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpvr, bpxrc, bpxrs);
  }
  else
  { /* No, there was some other problem with getting the size needed */
    printf("Error getting size required\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpvr, bpxrc, bpxrs);
  }
  free(myp);
  return bpxrc;
}
}

if( t == 1000 )
  printf("Number of failed buffer resizes exceeded.\n");
free(myp);
return 0;

int print_storage_version2(struct parmstruct *buffp, int buflen, int above_bar)
{
  int                 i,j;
  API_STOR_STATS_2   *stst;
  COMP_LINE_2        *stcl;
  DETAIL_LINE_2      *stdl;
  char              *stsy;

  stst = (API_STOR_STATS_2*) ((char *) buffp +
    sizeof(syscall_parmlist) + sizeof(STAT_API));
  stsy = (char *) ((char *) buffp +
    sizeof(syscall_parmlist) + sizeof(STAT_API) + buflen);

  if (above_bar)
    printf("                 zFS Primary Address Space >2G Stge Usage\n");
  else
    printf("                 zFS Primary Address Space <2G Stge Usage\n");
  printf("                 ----------------------------------------\n");
  if (above_bar)
    printf("Total Storage Above 2G Bar Allocated:          %12llu
", stst->ss_total_bytes_of_data);
  else
    printf("Total Storage Below 2G Bar Allocated:          %12llu

", stst->ss_total_bytes_of_data);
  if (above_bar)
    printf("Total Bytes Allocated by IOEFSCM (Stack+Heap): %12llu
", stst->ss_ioefscm_allocated);
  printf("IOEFSCM Heap Bytes Allocated:                     %12llu
", stst->ss_ioefscm_heap_allocated);
  printf("IOEFSCM Heap Pieces Allocated:                   %12llu
", stst->ss_ioefscm_heap_pieces);
  printf("IOEFSCM Heap Allocation Requests                 %12llu
", stst->ss_ioefscm_heap_allocations);
  printf("IOEFSCM Heap Free Requests                       %12llu
",
    stst->ss_ioefscm_heap_frees);
  printf("\n");
  if (above_bar)
  {
    printf("Total Bytes Allocated by IOEFSKN (Stack+Heap): %12llu
", stst->ss_iodefskn_allocated);
    printf("Total Bytes Discarded (unbacked) by IOEFSKN:   %12llu
",
      stst->ss_iodefskn_heap_discarded);
  }
  printf("IOEFSKN Heap Bytes Allocated:                   %12llu
", stst->ss_iodefskn_heap_allocated);
  printf("IOEFSKN Heap Pieces Allocated:                   %12llu
", stst->ss_iodefskn_heap_pieces);
  printf("IOEFSKN Heap Allocation Requests                 %12llu
", stst->ss_iodefskn_heap_allocations);
  printf("IOEFSKN Heap Free Requests                       %12llu
",
    stst->ss_iodefskn_heap_frees);
}
/* Point the comp_line to the ss_returned_data value */
/* instead of adding sizeof(API_STOR_STATS_2) */
stcl = (COMP_LINE_2*) stst->ss_returned_data;

for (i = 0; i < stst->ss_number_of_comp_lines; i++)
{
    printf("\n");
    printf("Storage Usage By Component\n");
    printf("--------------------------\n");
    printf("Allocated Pieces Allocs Frees Component\n");
    printf("--------------------------\n");
    printf("\n");
    printf("%10llu %6llu %6llu %6llu %s\n",
stcl->ss_comp_bytes_allocated,
stcl->ss_comp_pieces,
stcl->ss_comp_allocations,
stcl->ss_comp_frees,
stcl->ss_comp_description);
    stdl = (DETAIL_LINE_2 * )((char *)stcl + sizeof(COMP_LINE_2));
    for (j = 0; j < stcl->ss_number_of_detail_lines; j++, stdl++)
    {
        if (j == 0)
        {
            printf("\n");
            printf("Storage Details by Component\n");
            printf("--------------------------\n");
            printf("\n");
        }
        printf("%10llu %6llu %6llu %6llu %s\n",
        stdl->ss_detail_bytes_allocated,
        stdl->ss_detail_pieces,
        stdl->ss_detail_allocations,
        stdl->ss_detail_frees,
        stdl->ss_detail_description);
    }
}

stcl = (COMP_LINE_2 *) stdl;

int print_storage_version1(struct parmstruct *buffp, int buflen)
{
    int i,j;
    COMP_LINE *stcl;
    DETAIL_LINE *stdl;
    char *stsy;
    API_STOR_STATS *stst;

    printf("Version 1 Output is being displayed\n\n");
    stst = (API_STOR_STATS * )((char *)buffp + sizeof(syscall_parmlist) +
    sizeof(STAT_API));
    stsy = (char *)((char *)buffp + sizeof(syscall_parmlist) +
    sizeof(STAT_API) + buflen);

    printf("%18czFS Primary Address Space Storage Usage\n", 'z', 'F');
    printf("---------------------------------------\n");
    printf("\n");
    printf("Total Bytes Allocated: %u (%uK) (%uM)\n",
    stst->ss_total_bytes_allocated,
    stst->ss_total_pieces_allocated / 1024,
    stst->ss_total_bytes_allocated / (1024 * 1024));
    printf("Total Pieces Allocated: %u\n",
    stst->ss_total_pieces_allocated);
    printf("Total Allocation Requests: %u\n",
    stst->ss_total_allocation_requests);
    printf("Total Free Requests: %u, %u\n",
    stst->ss_total_free_requests,
    stst->ss_number_of_comp_lines);
    stcl = (COMP_LINE * )((char *)stst + sizeof(API_STOR_STATS));
    for (i = 0; i < stst->ss_number_of_comp_lines; i++)
    {
        printf("\n");
        printf("Storage Usage By Component\n");
        printf("--------------------------\n");
        printf("Allocated Pieces Allocs Frees Component\n");
printf("---------- ------ ------ ------ ---------\n");
printf("\n");
printf("%10u %6u %6u %6u %s\n",
stcl->ss_comp_bytes_allocated,
stcl->ss_comp_pieces,
stcl->ss_comp_allocations,
stcl->ss_comp_frees,
stcl->ss_comp_description);

stdl = (DETAIL_LINE *)((char *)stcl + sizeof(COMP_LINE));
for (j = 0; j < stcl->ss_number_of_detail_lines; j++, stdl++)
{
    if (j == 0)
    {
        printf("\n");
        printf("Storage Details by Component\n");
        printf("--------------------------------\n");
    }
    printf("%10u %6u %6u %6u %s\n",
        stdl->ss_detail_bytes_allocated,
        stdl->ss_detail_pieces,
        stdl->ss_detail_allocations,
        stdl->ss_detail_frees,
        stdl->ss_detail_description);
}
    stcl = (COMP_LINE *)stdl;
    printf("\n");
}
Statistics Sysplex Client Operations Information

Purpose

Returns information about the number of local operations that required the sending of a message to another system.

Format

syscall_parmlist

opcode    int        253     STATOP_CTKC
parms[0]  int        offset to STAT_API
parms[1]  int        Offset of output following STAT_API
parms[2]  int        0
parms[3]  int        0
parms[4]  int        0
parms[5]  int        0
parms[6]  int        0

STAT_API

sa_eye    char[4]   "STAP"
len       int        length of buffer that follows STAT_API
sa_ver    int        1
sa_flags  char[1]   0x00
SA_RESET  0x80      Reset statistics
sa_fill   char[3]   0
sa_supported_ver  int    version of data returned or reserved
sa_reserve int[3]   0
posix_time_high  unsigned int high order 32 bits since epoch
posix_time_low   unsigned int low order 32 bits since epoch
posix_useconds   unsigned int microseconds
pad1      int

CT_HEADER

cr_ey     char[4]   "CTHD"
cr_len   short
ct_version short
number_of_cr_sys unsigned int
number_of_cr_call unsigned int

CT_SYS_STATS[number_of_cr_sys]

cr_ey     char[4]   "CTSY"
cr_len   short
ct_version short
name_of_cr_sys char[9] Name of system. A value of 0 means there is no information in this record and any subsequent record (end of list)
reserved char[7]

CT_CALL_STATS[number_of_cr_call]

cc_ey     char[4]   "CTCL"
cr_length short
cc_version short
cc_count unsigned long long Number of calls of that type since last statistics reset.
cc_xcfreq unsigned long long Indicates if an XCF request was required to process the call. Always equal cc_count.
cc_qwait   unsigned long long Number of times a request had to wait in queue before being dispatched to a processing task at the owner. Invalid for this report, will be equal to 0.
cc_avg_wait_whole int Average time for system to process call in milliseconds. This will be round-trip call time (which includes XCF transmission time). This is the part before the decimal point.
cc_avg_wait_decimal int The part after the decimal point for average wait time.
This is microseconds.

<table>
<thead>
<tr>
<th>cc_name</th>
<th>char[25]</th>
</tr>
</thead>
<tbody>
<tr>
<td>reserved</td>
<td>char[7]</td>
</tr>
</tbody>
</table>

Return_value: 0 if request is successful, -1 if it is not successful

Return_code:
- EINTR: zFS is shutting down
- EINVAL: Invalid parameter list
- EMVSERR: Internal error occurred
- E2BIG: Information too big for buffer supplied

Reason_code:
- 0xEFnnxxxx: See z/OS Distributed File Service Messages and Codes

Usage notes:
1. Users of the API supply as input a buffer that contains a syscall_parmlist, followed by a STAT_API structure, followed by an output buffer.
2. The output consists of a CT_HEADER followed by an array of CT_SYS_STATS structures and an array of CT_CALL_STATS structures. The number of elements in each array is returned in number_of_ct_sys and number_of_ct_call respectively.
3. If the output buffer is not large enough to contain all of the output, E2BIG is returned and the required size is placed in sa_len. The caller can then try the request again with a larger buffer.
4. A CT_SYS_STATS structure is returned only for systems that the local client system sent messages to since the last statistics reset.

Privilege required:
None.

Related services:
- Statistics Sysplex Client Operations Information
- Statistics Sysplex Owner Operations Information
- Statistics Server Token Management Information

Restrictions:
None.

Example:
```c
#pragma linkage(BPX1PCT, OS)
#pragma LANGLEVEL(EXTENDED)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
define ZFS_CALL_STATS 0x40000007
#define STATOP_CTKC 253   /* outbound calls to remote owners */
define E2BIG 145
typedef struct syscall_parmlist_t {
  int opcode;       /* Operation code to perform */
  int parms[7];     /* Specific to type of operation, */
} syscall_parmlist;
typedef struct reset_time {
  unsigned int posix_time_high;
  unsigned int posix_time_low;
  unsigned int posix_usecs;
  int pad1;
} RESET_TIME;
typedef struct stat_api_t {
  #define SA_EYE "STAP"
```
char sa_eye[4]; /* 4 byte identifier must be */
int sa_len; /* length of the buffer to put data into*/
int sa_ver; /* the version number currently always 1*/
#define SA_VER_INIT 0x01
char sa_flags; /* command field must be x00 or x80, */
/* x80 means reset statistics */
#define SA_RESET 0x80
char sa_fill[3]; /* spare bytes */
int sa_reserve[4]; /* Reserved */
struct reset_time reset_time_info;
} STAT_API;

typedef struct CT_CALL_STATS_t {
    char cc_eye[4];
#define CC_EYE "CTCL"
    short cc_length;
    short cc_version;
#define CC_VER_INITIAL 1
    unsigned long long cc_count;
    unsigned long long cc_xcfreq;
    unsigned long long cc_qwait; /* number of waits */
    int cc_avg_wait_whole; /* average wait time for calls */
    int cc_avg_wait_decimal;
    char cc_name[25];
    char reserved[7];
} CT_CALL_STATS;

typedef struct CT_SYS_STATS_t {
    char cs_eye[4];
#define CS_EYE "CTSY"
    short cs_length;
    short cs_version;
#define CS_VER_INITIAL 1
    char cs_sysname[9];
    char reserved[7];
} CT_SYS_STATS;

typedef struct CT_HEADER_t {
    char ct_eye[4];
#define CT_EYE "CTHD"
    short ct_length;
    short ct_version;
#define CT_VER_INITIAL 1
    unsigned int number_of_ct_sys;
    unsigned int number_of_ct_call;
} CT_HEADER;

int main(int argc, char** argv)
{
    int buff_fill_len = 0;
    int buffer_success = 0;
    int bpxrv, bpxrc, bpxrs;
    char sysname[9];
    int num_systems;
    int num_calls;
    int entry_size;
    int mypsize;
    int buflen;
    int i,j,t;

    STAT_API local_req;
    STAT_API* st_req = NULL;
    syscall_parmlist* parmp = NULL;
    CT_HEADER* ct_p = NULL;
    CT_SYS_STATS* ct_sysp = NULL;
    CT_CALL_STATS* ct_callp = NULL;
    char* p = NULL;
    char* buffp = NULL;

    /* Initialize the local_req to 0s */
    st_req = &local_req;
    memset( st_req, 0x00, sizeof(STAT_API ) );
    strcpy( local_req.sa_eye, SA_EYE, sizeof(local_req.sa_eye) );
    local_req.sa_len = 0;
    local_req.sa_ver = SA_VER_INIT;

    /* Allocate Buffer */
    buffp = (char*) malloc(sizeof(syscall_parmlist) + sizeof(STAT_API));
    if( buffp == NULL )
\{ printf("Malloc Error\n");
    return 0;
\}
memset( buffp, 0x00, sizeof(syscall_parmlist) + sizeof(STAT_API));

/* Set the run parms */
parmp = (syscall_parmlist*) &buffp[0];
parmp->opcode = STATOP_CTKC;
parmp->parms[0] = buff_fill_len = sizeof(syscall_parmlist);
parmp->parms[1] = buff_fill_len + sizeof(STAT_API);
parmp->parms[2] = 0;
parmp->parms[3] = 0;
parmp->parms[4] = 0;
parmp->parms[5] = 0;
parmp->parms[6] = 0;

st_req = (STAT_API*) &buffp[buff_fill_len];
memcpy( st_req, &local_req, sizeof(STAT_API) );
buff_fill_len += sizeof(STAT_API);

BPX1PCT("ZFS     ",
    ZFSCALL_STATS,      /* Aggregate operation */
    buff_fill_len,      /* Length of Argument */
    (char*) buffp,      /* Pointer to Argument */
    &bpnr,              /* Pointer to Return_value */
    &bpnc,              /* Pointer to Return_code */
    &bpnr);             /* Pointer to Reason_code */

for(t = 0; t < 1000 && buffer_success == 0; t++)
}\nif( bpxrv < 0 )
\{
    /* Look for E2BIG to get the required file size back in the st_req */
    if( bpxrc == E2BIG )
    \{
        buflen = st_req->sa_len;
        mypsize = sizeof(syscall_parmlist) + sizeof(STAT_API) + buflen;
        free(buffp);
        buffp = (char*) malloc(mypsize);
        if( buffp == NULL )
        \{
            printf("Malloc Error\n");
            return 0;
        \}
        memset( buffp, 0x00, mypsize );
        printf("Need buffer size of %d, for a total of %d \n",
            buflen, mypsize);
        /* Set the run parms */
        parmp = (syscall_parmlist*) &buffp[0];
        parmp->opcode = STATOP_CTKC;
        parmp->parms[0] = buff_fill_len = sizeof(syscall_parmlist);
        parmp->parms[1] = buff_fill_len + sizeof(STAT_API);
        parmp->parms[2] = 0;
        parmp->parms[3] = 0;
        parmp->parms[4] = 0;
        parmp->parms[5] = 0;
        parmp->parms[6] = 0;
        st_req = (STAT_API*) &buffp[buff_fill_len];
        memcpy( st_req->sa_eye, SA_EYE, 4 );
        buff_fill_len += sizeof(STAT_API);
        st_req->sa_ver = SA_VER_INIT;
        BPX1PCT("ZFS     ",
            ZFSCALL_STATS,              /* Aggregate operation */
            mypsize,                    /* Length of Argument */
            (char*) buffp,              /* Pointer to Argument */
            &bpnr,                     /* Pointer to Return_value */
            &bpnc,                     /* Pointer to Return_code */
            &bpnr);                    /* Pointer to Reason_code */
        if( bpxrv != 0 && bpxrc == E2BIG )
            printf("E2BIG: %d times total\n", t++);
        else if( bpxrv == 0 )
        \{
            buffer_success = 1;
            ct_p = (CT_HEADER*) &buffp[buff_fill_len];
        \}
buff_fill_len += ct_p->ct_length;
ct_sysp = (CT_SYS_STATS*) &buffp[buff_fill_len];
buff_fill_len += ct_sysp->cs_length;
ct_callp = (CT_CALL_STATS*) &buffp[buff_fill_len];

/* Make sure there are systems */
num_systems = ct_p->number_of_ct_sys;
if( num_systems == 0 )
{
    printf("Ctkc completed successfully. 
           There is no information to display\n");
    free(buffp);
    return 0;
}
num_calls  = ct_p->number_of_ct_call;
entry_size = ct_sysp->cs_length +
               (ct_callp->cc_length * num_calls);

for (j = 0; j < num_systems; j++)
{
    printf("CS\n%5c          SVI Calls to System %s\n", ' ',
           ct_sysp->cs_sysname );
    printf("\n%15c----------------------------
", ' ');
    printf("SVI Call                   Count" );
    printf("                  Avg. Time\n");
    printf("--------------------       --------------------" );
    printf("   ----------");
}
/* Put out the Totals entry */

for (i = 0; i < num_calls-1; i++)
{
    printf("%-25s  %20llu %8u.%3.3u\n",
           ct_callp[i].cc_name,
           ct_callp[i].cc_count,
           ct_callp[i].cc_avg_wait_whole,
           ct_callp[i].cc_avg_wait_decimal);
}
/* Get the pointers to the next system entry */

/* Second API call failed */
print("Error on next request for ctkc stats\n");
print("Return Value: %d Return Code: %d Reason Code: %x\n",
      bpxrv, bpxrc, bpxrs);
buffer_success = -1;
}
else
{
    /* Expecting E2BIG and it was a different error */
    print("Error on storage stats trying to get requied size\n");
    print("BPXRV = %d BPXRC = %d BPXRS = %x\n",
      bpxrv, bpxrc, bpxrs);
    buffer_success = -1;
}
else
{
    /* If rv is 0, most likely there was no data to get */
    if (st_req->sa_len == 0)
printf("No data\n");
printf("BPXRV = %d BPXRC = %d BPXRS = %x\n",
        bpxrv, bpxrc, bpxrs);
    buffer_success = -1;
} else
    /* No, there was other problem with getting the size needed */
    printf("Error getting size required\n");
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n",
            bpxrv, bpxrc, bpxrs);
    buffer_success = -1;
}
}

if( t == 1000 )
    printf("Number of failed buffer resizes exceeded.\n");

free(buffp);
return 0;
}
## Purpose

Returns information about the number of calls processed on the local system as a result of a message sent from another system. Vnode operation statistics are returned for each client system that accessed a file system owned on the local server.

## Format

```
syscall_parmlist
  opcode   int    253  STATOP_SVI
  parms[0] int    offset to STAT_API
  parms[1] int    Offset of output following STAT_API
  parms[2] int    0
  parms[3] int    0
  parms[4] int    0
  parms[5] int    0
  parms[6] int    0

STAT_API
  sa_eye    char[4]  "STAP"
  sa_len    int     length of buffer that follows STAT_API
  sa_ver    int     1
  SA_RESET  0x80    Reset statistics
  sa_fill   char[3]  0
  sa_supported_ver int  version of data returned or reserved
  sa_reserve int[3]  0
  posix_time_high unsigned int  high order 32 bits since epoch
  posix_time_low unsigned int  low order 32 bits since epoch
  posix_useconds unsigned int  microseconds
  pad1      int

CT_HEADER
  ct_eye    char[4]  "CTHD"
  ct_length short  Length of the structure
  ct_version short  Structure version
  number_of_ct_sys unsigned int  Number of CT_SYS_STATS structures
  number_of_ct_call unsigned int  Number of CT_CALL_STATS structures

CT_SYS_STATS[number_of_ct_sys]
  cs_eye    char[4]  "CTSY"
  cs_length short  Length of the structure
  cs_version short  Structure version
  cs_sysname char[9]  Name of system. A value of 0 means there is no information in this record and any subsequent record (end of list)

reserved char[7]

CT_CALL_STATS[number_of_ct_call]
  cc_eye    char[4]  "CTCL"
  cc_length short  Length of structure
  cc_version short  Structure version
  cc_count unsigned long long  Number of calls of that type since last statistics reset.
  cc_xcfreq unsigned long long  Indicates if an XCF request was required to process the call. Number of XCF requests that were required to make callbacks to one or more clients to process the
requests.
  cc_qwait unsigned long long  Number of times a request had to wait in queue before being dispatched to a processing task at the owner, valid only for SVI report
  cc_avg_waitWhole int  Average time for system to process call in milliseconds. This will be average time for the
```
### Usage notes

1. Users of the API supply as input a buffer that contains a `syscall_parmlist` followed by a `STAT_API` structure, followed by an output buffer.

2. Output consists of a `CT_HEADER` followed by an array of `CT_SYS_STATS` structures and an array of `CT_CALL_STATS` structures. The number of elements in each array is returned in `number_of_ct_sys` and `number_of_ct_call` respectively.

3. If the output buffer is not large enough to contain all of the output, `E2BIG` is returned and the required size is placed in `sa_len`. The caller can then try the request again with a larger buffer.

4. A `CT_SYS_STATS` structure is returned only for client systems that sent the local server system messages since the last statistics reset.

### Privilege required

None.

### Related services

- Statistics Server Token Management Information
- Statistics Sysplex Client Operations Information
- Statistics Sysplex Owner Operations Information
Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANG_LVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>

#define ZFS_CALL_STATS 0x40000007
#define STATOP_SVI 254 /* inbound calls from remote clients */
#define E2BIG 145

typedef struct syscall_parm_list_t {
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
} syscall_parm_list;

typedef struct reset_time {
    unsigned int posix_time_high;
    unsigned int posix_time_low;
    unsigned int posix_usecs;
    int pad1;
} RESET_TIME;

typedef struct stat_api_t {
    #define SA_EYE "STAP"
    char sa_eye[4]; /* 4 byte identifier must be */
    int sa_len; /* length of the buffer to put data into*/
    int sa_ver; /* this buffer area follows this struct*/
    #define SA_VER_INIT 0x01
    char sa_flags; /* command field must be x00 or x80, */
    #define SA_RESET 0x80
    char sa_fill[3]; /* spare bytes */
    int sa_reserve[4]; /* Reserved */
    struct reset_time reset_time_info;
} STAT_API;

typedef struct CT_CALL_STATS_t {
    char cc_eye[4]; /* CC_EYE "CTCL"
    short cc_length;
    short cc_version;
    #define CC_VER_INITIAL 1
    unsigned long long cc_count;
    unsigned long long cc_xcfreq;
    unsigned long long cc_qwait; /* number of waits */
    int cc_avg_wait_whole; /* average wait time for */
    /* calls of this type */
    int cc_avg_wait_decimal;
    char cc_name[25];
    char reserved[7];
} CT_CALL_STATS;

typedef struct CT_SYS_STATS_t {
    char cs_eye[4]; /* CS_EYE "CTSY"
    short cs_length;
    short cs_version;
    #define CS_VER_INITIAL 1
    char cs_sysname[9];
    char reserved[7];
} CT_SYS_STATS;

typedef struct CT_HEADER_t {
    char ct_eye[4]; /* CT_EYE "CTHD"
    short ct_length;
    short ct_version;
    #define CT_VER_INITIAL 1
    unsigned int number_of_ct_sys;
```
unsigned int number_of_ct_call;
} CT_HEADER;

int main(int argc, char** argv)
{
    int buff_fill_len = 0;
    int bpnr, bpxr, bpxs;
    char sysname[9];
    int num_systems;
    int num_calls;
    int entry_size;
    int mysize;
    int buflen;
    int i,j,t;
    int buffer_success = 0;

    STAT_API          local_req;
    STAT_API*         st_req     = NULL;
    syscall_parmlist* parmp      = NULL;
    CT_HEADER*        ct_p       = NULL;
    CT_SYS_STATS*     ct_sysp    = NULL;
    CT_CALL_STATS*    ct_callp   = NULL;
    char*             p          = NULL;
    char*             buffp      = NULL;

    /* Initialize the local_req to 0s */
    st_req = &local_req;
    memset( st_req, 0x00, sizeof(STAT_API) );
    strcpy( local_req.sa_eye, SA_EYE, sizeof(local_req.sa_eye) );
    local_req.sa_len = 0;
    local_req.sa_ver = SA_VER_INIT;

    /* Allocate Buffer */
    buffp = (char*) malloc(sizeof(syscall_parmlist) + sizeof(STAT_API));
    if( buffp == NULL )
    {
        printf("Malloc Error\n");
        return 0;
    }
    memset( buffp, 0x00, sizeof(syscall_parmlist) + sizeof(STAT_API));

    /* Set the run parms */
    parmp = (syscall_parmlist*) &buffp[0];
    parmp->opcode   = STATOP_SVI;
    parmp->parms[0] = buff_fill_len = sizeof(syscall_parmlist);
    parmp->parms[1] = buff_fill_len + sizeof(STAT_API);
    parmp->parms[2] = 0;
    parmp->parms[3] = 0;
    parmp->parms[4] = 0;
    parmp->parms[5] = 0;
    parmp->parms[6] = 0;
    st_req = (STAT_API*) &buffp[buff_fill_len];
    memcpy( st_req, &local_req, sizeof(STAT_API) );
    buff_fill_len += sizeof(STAT_API);

    BPX1PCT("ZFS",
        ZFS_CALL_STATS,  /* Aggregate operation */
        buff_fill_len,   /* Length of Argument */
        (char*) buffp,    /* Pointer to Argument */
        &bpnr,           /* Pointer to Return_value */
        &bpxr,           /* Pointer to Return_code */
        &bpxs);          /* Pointer to Reason_code */

    printf("bpnr %d\n", bpnr);

    for(t = 0; t < 1000 && buffer_success == 0; t++)
    {
        if( bpnr < 0 )
        {
            /* Look for E2BIG to get required file size back in the st_req */
            if( bpxr == E2BIG )
            {
                buflen = st_req->sa_len;
                mysize = sizeof(syscall_parmlist) +
                          sizeof(STAT_API) + buflen;

                free(buffp);
                buffp = (char*) malloc(mysize);
                if( buffp == NULL )
            }
            else
{ printf("Malloc Error\n");
    return 0;
}
memset( buffp, 0x00, mysize );
printf("Need buffer size of %d, for a total of %d\n", 
    buflen, mysize);
/* Set the run parms */
parmp = (syscall_parmlist*) &buffp[0];
parmp->opcode   = STATOP_SVI;
parmp->parms[0] = buff_fill_len = sizeof(syscall_parmlist);
parmp->parms[1] = buff_fill_len + sizeof(STAT_API);
parmp->parms[2] = 0;
parmp->parms[3] = 0;
parmp->parms[4] = 0;
parmp->parms[5] = 0;
parmp->parms[6] = 0;

st_req = (STAT_API*) &buffp[buff_fill_len];
memcpy( st_req->sa_eye, SA_EYE, 4 );
buff_fill_len += sizeof(STAT_API);
st_req->sa_ver = SA_VER_INIT;

BPX1PCT("ZFS     ",
    ZFSCALL_STATS,          /* Aggregate operation */
    mysize,                /* Length of Argument */
    (char*) buffp,          /* Pointer to Argument */
    &bpxrv,                 /* Pointer to Return_value */
    &bpxrc,                 /* Pointer to Return_code */
    &bpxrs);                /* Pointer to Reason_code */

if( bpxrv != 0 && bpxrc == E2BIG )
    printf("E2BIG: %d times total\n", t);
else if( bpxrv == 0 )
{
    buffer_success = 1;
    ct_p = (CT_HEADER*) &buffp[buff_fill_len];
    buff_fill_len += ct_p->ct_length;
    ct_sysp = (CT_SYS_STATS*) &buffp[buff_fill_len];
    buff_fill_len += ct_sysp->cs_length;
    ct_callp = (CT_CALL_STATS*) &buffp[buff_fill_len];
    if( num_systems == 0 )
    {
        printf("Svi stats completed successfully. "
            "There is no information to display\n\n");
        free(buffp);
        return 0;
    }
    num_calls  = ct_p->number_of_ct_call;
    entry_size = ct_sysp->cs_length +
        (ct_callp->cc_length * num_calls);
    for (j = 0; j < num_systems; j++)
    {
        printf("SV") ;
        printf("%30cSVI Calls from System %s\n", ' ', 
            ct_sysp->cs_sysname);
        printf("\n");
        printf("%30c-------------------------------\n", ' ');
        printf("SVI Call "
            "Count "
            "Qwait "
            "XCF Req. "
            "Avg. Time\n\n";
        printf("-----------------------
";
        printf("--------------------  "
            "---------------------  "
            "----------
";
        for (i = 0; i < num_calls-1; i++)
        { 
            printf("%-25s%20llu  %16llu  %16llu%8u.%3.3u\n", 
                ct_callp[i].cc_name, 
                ct_callp[i].cc_count, 
                ct_callp[i].cc_qwait, 
                ct_callp[i].cc_xcfreq, 
                ct_callp[i].cc_avg_wait_whole,
        }
ct_callp[i].cc_avg_wait_decimal);
}

/* Put out the Totals entry */
printf("--------------------     "
"--------------------  ----------------  ----------------  
"----------
"
);
printf("%-25s%20llu  %16llu  %16llu%8u.%3.3u
",
ct_callp[i].cc_name,
ct_callp[i].cc_count,
ct_callp[i].cc_qwait,
ct_callp[i].cc_xcfreq,
ct_callp[i].cc_avg_wait_whole,
ct_callp[i].cc_avg_wait_decimal);

printf("\n");

/* Get the pointers to the next system entry */
p = (char*) ct_sysp;
p += entry_size;
ct_sysp = (CT_SYS_STATS*) p;
p += ct_sysp->cs_length;
ct_callp = (CT_CALL_STATS*) p;
}
else
{
/* Second API call failed */
printf("Error on next request for svi stats\n");
printf("Return Value: %d 
" "Return Code: %d 
" "Reason Code: %x\n",
bpxr, bpxhr, bpxrsc);
buffer_success = -1;
}
else
/* Expecting E2BIG and it was a different error */
printf("Error on storage stats trying to get required size\n");
printf("BPXRV = %d BPXRC = %d BPXRS = %x\n",
bpxrv, bpxhr, bpxrsc);
buffer_success = -1;
}
else
{
/* If rv is 0, most likely there was no data to get */
if (st_req->sa_len == 0)
{
printf("No data\n");
printf("BPXRV = %d BPXRC = %d BPXRS = %x\n",
bpxrv, bpxhr, bpxrsc);
}
else
{
/* There was some other problem with getting required size */
printf("Error getting size required\n");
printf("BPXRV = %d BPXRC = %d BPXRS = %x\n",
bpxrv, bpxhr, bpxrsc);
}
buffer_success = -1;
}
}

if( t == 1000 )
printf("Number of failed buffer resizes exceeded.\n");
free(buffp);
return 0;
# Statistics Transaction Cache Information

## Purpose

A performance statistics operation that returns transaction cache counters. It determines the number of transactions in the transaction cache.

As of z/OS V2R2, this subcommand is no longer used. All output fields from a call to statistics transaction cache information will be filled in with zeros.

## Format

```plaintext
syscall_parmlist
  opcode          int               250   STATOP_TRAN_CACHE
  parms[0]        int               Offset to STAT_API
  parms[1]        int               Offset of output following STAT_API
  parms[2]        int               Offset to system name (optional)
  parms[3]        int               0
  parms[4]        int               0
  parms[5]        int               0
  parms[6]        int               0

STAT_API
  sa_eye          char[4]           "STAP"
  sa_len          int               Length of buffer following STAT_API
  sa_ver          int               1
  sa_flags        char[1]           0x80 - Reset statistics
  sa_fill         char[3]           Reserved
  sa_reserve      int[4]            Reserved
  posix_time_high unsigned int      High order 32 bits since epoch
  posix_time_low  unsigned int      Low order 32 bits since epoch
  posix_useconds unsigned int      Microseconds
  pad1            int               Reserved

STAT_TRAN_CACHE
  sttr_started_high unsigned int      Transactions started high 32 bits
  sttr_started     unsigned int      Transactions started
  sttr_lookups_high unsigned int      Lookups on transaction high 32 bits
  sttr_lookups     unsigned int      Lookups on transaction
  sttr_ec_merges_high unsigned int    Equivalence class merges high 32 bits
  sttr_ec_merges   unsigned int      Equivalence class merges
  sttr_alloc_trans_high unsigned int  Allocated transactions high 32 bits
  sttr_alloc_trans unsigned int      Allocated transactions
  sttr_trans_act_high unsigned int    Transactions active high 32 bits
  sttr_trans_act   unsigned int      Transactions active
  sttr_trans_pend_high unsigned int   Transactions pending high 32 bits
  sttr_trans_pend  unsigned int      Transactions pending
  sttr_trans_comp_high unsigned int   Transactions completed high 32 bits
  sttr_trans_comp  unsigned int      Transactions completed
  sttr_trans_free_high unsigned int   Free transactions high 32 bits
  sttr_trans_free  unsigned int      Free transactions
  reserved         char[60]          Reserved
  systemname       char[9]           System name to get stas from

Return_value  0 if request is successful, -1 if it is not successful

Return_code
  EINTR          zFS is shutting down
  EINVAL         Invalid parameter list
  EMVSERR        Internal error occurred
  E2BIG          Information too big for buffer supplied

Reason_code
  0xEFnnxxxx     See z/OS Distributed File Service Messages and Codes
```

## Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.
Privilege required
None.

Related services
   Statistics Vnode Cache Information
   Statistics Metadata Cache Information

Restrictions
None.

Examples

```c
#pragma linkage(BPX1PCT, OS)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

/* #include <stdlib.h> */
#include <stdio.h>
#define ZFSCALL_STATS     0x40000007
#define STATOP_TRAN_CACHE 250 /* Performance API queries */

typedef struct syscall_parmlist_t
{
   int opcode;   /* Operation code to perform            */
   int parms[7]; /* Specific to type of operation,     */
                   /* provides access to the parms       */
                   /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist_t;

typedef struct stat_tran_cache_t
{
   unsigned int      sttr_started_high;
   unsigned int      sttr_started;
   unsigned int      sttr_lookups_high;
   unsigned int      sttr_lookups;
   unsigned int      sttr_ec_merges_high;
   unsigned int      sttr_ec_merges;
   unsigned int      sttr_alloc_trans_high;
   unsigned int      sttr_alloc_trans;
   unsigned int      sttr_trans_act_high;
   unsigned int      sttr_trans_act;
   unsigned int      sttr_trans_pend_high;
   unsigned int      sttr_trans_pend;
   unsigned int      sttr_trans_comp_high;
   unsigned int      sttr_trans_comp;
   unsigned int      sttr_trans_free_high;
   unsigned int      sttr_trans_free;
   char              reserved[60];
} STAT_TRAN_CACHE;

/* reset timestamp */
typedef struct reset_time
{
   unsigned int      posix_time_high; /* high order 32 bits since epoch */
   unsigned int      posix_time_low;  /* low order 32 bits since epoch */
   int               posix_usecs;     /* microseconds */
   int               pad1;
} RESET_TIME;

/******************************/
```

Statistics Transaction Cache Information
/* The following structure is the api query control block. */
/* It is used for all api query commands. */
/**************************************************************************/

typedef struct stat_api_t
{
#define SA_EYE "STAP"
    char              sa_eye[4];     /* 4 byte identifier must be */
    int               sa_len;        /* length of the buffer to put data */
    /* this buffer area follows this */
    int               sa_ver;        /* the version number currently always 1 */
#define               SA_VER_INITIAL 0x01
    char              sa_flags;      /* flags field must be x00 or x80, x80 means reset statistics */
#define               SA_RESET 0x80
    char              sa_fill[3];    /* spare bytes */
    int               sa_reserve[4]; /* Reserved */
    struct reset_time reset_time_info;
} STAT_API;

struct parmstruct {
    syscall_parmlist myparms;
    STAT_API         myapi;
    STAT_TRAN_CACHE  mystats;
    char             systemname[9];
} myparmstruct;

int main(int argc, char **argv)
{
    int             bpxrv;
    int             bpxrc;
    int             bpplx;
    int             i;
    STAT_API       *stapptr = &(myparmstruct.myapi);
    STAT_TRAN_CACHE *sttcptr = &(myparmstruct.mystats);
    char            buf[33];

    myparmstruct.myparms.opcode      = STATOP_TRAN_CACHE;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;

    memset(stapptr, 0, sizeof(STAT_API));
    memcpy(stapptr->sa_eye, SA_EYE, 4);
    stapptr->sa_ver = SA_VER_INITIAL;
    stapptr->sa_len = (int) sizeof(STAT_TRAN_CACHE);

    /* This next field should only be set if parms[2] is non-zero */
    /* strcpy(myparmstruct.systemname,"DCEIMGVQ"); */
}
BPX1PCT("ZFS     ",
ZFSCALL_STATS,              /* Perf statistics operation */
sizeof(myparmstruct),       /* Length of Argument */
(char *)&myparmstruct,      /* Pointer to Argument */
&bpxrv,                     /* Pointer to Return_value */
&bpxrc,                     /* Pointer to Return_code */
&bpxrs);                    /* Pointer to Reason_code */

if (bpxrv < 0)
{  
    printf("Error querying tran cache, BPXRV = %d BPXRC = %d BPXRS = %x
\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
{
    printf("\n%52s\n", "Transaction Cache Statistics");
    printf("%52s\n", "-----------------------------");
    printf("Trans started: %8u Lookups on Tran: %8u EC Merges: %8u\n",
           myparmstruct.mystats.sttr_started,
           myparmstruct.mystats.sttr_lookups,
           myparmstruct.mystats.sttr_ec_merges);

    printf("Allocated Trans: %8u \n(Act= %7u, Pend= %7u, ",
           myparmstruct.mystats.sttr_alloc_trans,
           myparmstruct.mystats.sttr_trans_act,
           myparmstruct.mystats.sttr_trans_pend);

    printf("Comp=%7u, Free= %7u)\n",
           myparmstruct.mystats.sttr_trans_comp,
           myparmstruct.mystats.sttr_trans_free);

    if (0 == ctime_r((time_t *)&stapptr->reset_time_info.posix_time_low,
                     buf))
        printf("Could not get timestamp.\n");
    else
    {  /* Insert the microseconds into the displayable time value */
        strncpy(&(buf[27]), &(buf[20]), 6);  
        sprintf(&(buf[20]), "%06d", stapptr-
                     >reset_time_info.posix_usecs);
        buf[26] = ' ';
        buf[19] = '.';
        printf("Last Reset Time: %s\n", buf);
    }
    return 0;
}
Statistics User Cache Information

Purpose

A performance statistics operation that returns user cache information.

Prior to V2R3, the user data was kept in data spaces. In V2R3, the data is kept in chunks of memory called cache spaces.

Format

syscall_parmlist

opcode int 242 STATOP_USER_CACHE
parm[0] int Offset to STAT_API
parm[1] int Offset of output following STAT_API
parm[2] int Offset to system name (optional)
parm[3] int 0
parm[4] int 0
parm[5] int 0
parm[6] int 0

STAT_API

sa_eye char[4] "STAP"
sa_len int Length of buffer that follows STAT_API
sa_ver int 1 or 2
sa_flags char[1] 0x80 for reset; 0x00 otherwise
sa_fill char[3] Reserved
sa_supported_ver int Version of data returned when sa_ver is 2
sa_reserve int[3] Reserved
posix_time_high unsigned int High order 32 bits since epoch
posix_time_low unsigned int Low order 32 bits since epoch
posix_useconds unsigned int Microseconds
pad1 int Reserved

STAT_USER_CACHE[2]

VM_STATS[2]

vm_schedules unsigned int Number of I/O requests
vm_setattrs unsigned int Number of setattr requests
vm_fsyncs unsigned int Number of fsync operations
vm_unmaps unsigned int Number of file deletions
vm_reads unsigned int Number of read operations
vm_readasyncs unsigned int Number of readahead
vm_getatts unsigned int Number of getattrs requests
vm_flushes unsigned int Number of cache flushes
vm_scheduled_deletes unsigned int Number of times an I/O is canceled because the file was deleted
vm_reads_faulted unsigned int Number of times I/O needed to satisfy read operation (data was not in cache)
vm_writesFaulted unsigned int Number of times I/O needed to read data before data can be written to cache
vm_read_ios unsigned int Total number of file system reads for any reason
vm_scheduled_writes unsigned int Number of data write I/Os issued
vm_error_writes unsigned int Number of data writes done when flushing a file from the cache after an I/O error or canceled user
vm_reclaim_writes unsigned int Number of data writes during space reclaim
vm_read_waits unsigned int Number of times a read had to wait for pending I/O
vm_write_waits unsigned int Number of waits for pending I/O so that new data could be written to the file
vm_fsync_wait unsigned int Number of waits for pending I/O fsync operations did
vm_error_waits unsigned int Number of waits when flushing a file from the cache after an I/O error or canceled user
vm_reclaim_waits unsigned int Number of waits done during reclaim processing for I/O
vm_reclaim_steal unsigned int Number of pages stolen during space reclaim processing
vm_waits_for_reclaim unsigned int Number of waits for reclaim processing to complete
vm_reserved int[10] Reserved
suc dataspaces int Number of dataspaces in user data cache
suc pages_per_dataspaces int Number of pages per dataspaces
suc seg_size_local int Local segment size (in K)
suc seg_size_remote int Remote segment size (in K)
suc page_size int Page size (in K)
suc cache_pages int Number of pages in user cache
### Statistics User Cache Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>suc_total_free</code></td>
<td><code>int</code></td>
<td>Number of free pages</td>
</tr>
<tr>
<td><code>suc_segment_cachesize</code></td>
<td><code>int</code></td>
<td>Number of segments</td>
</tr>
<tr>
<td><code>stuc_reserved</code></td>
<td><code>int[5]</code></td>
<td>Reserved</td>
</tr>
<tr>
<td><code>ds_name</code></td>
<td><code>char[9]</code></td>
<td>Dataspace name</td>
</tr>
<tr>
<td><code>pad1</code></td>
<td><code>char[3]</code></td>
<td>Reserved</td>
</tr>
<tr>
<td><code>ds_alloc_segs</code></td>
<td><code>int</code></td>
<td>Number of used (allocated) segments in the dataspace</td>
</tr>
<tr>
<td><code>ds_free_pages</code></td>
<td><code>int</code></td>
<td>Number of free dataspace pages</td>
</tr>
<tr>
<td><code>ds_reserved</code></td>
<td><code>int[5]</code></td>
<td>Reserved</td>
</tr>
</tbody>
</table>

**VM_STATS2**

- `vm_schedules` `unsigned long long int` Number of I/O requests
- `vm_setattraits` `unsigned long long int` Number of setattraits
- `vm_unmaps` `unsigned long long int` Number of fsync operations
- `vm_reads` `unsigned long long int` Number of file deletions
- `vm_readsasyncs` `unsigned long long int` Number of read operations
- `vm_writes` `unsigned long long int` Number of write operations
- `vm_getattrs` `unsigned long long int` Number of getattraits
- `vm_flushes` `unsigned long long int` Number of times the user cache was flushed
- `vm_scheduledDeletes` `unsigned long long int` Number of times an I/O is canceled because the file was deleted
- `vm_writes_faulted` `unsigned long long int` Number of times I/O needed to satisfy read operation (data was not in cache)
- `vm_read_ios` `unsigned long long int` Total number of file system reads for any reason
- `vm_error_writes` `unsigned long long int` Number of data writes when flushing a file from the cache after an I/O error or a canceled user
- `vm_reclaim_writes` `unsigned long long int` Number of data writes during space reclaim
- `vm_read_wait` `unsigned long long int` Number of times a read had to wait for pending I/O
- `vm_write_wait` `unsigned long long int` Number of waits for a pending I/O to satisfy new data could be written to the file
- `vm_fsync_wait` `unsigned long long int` Number of waits for pending I/O fsync operations did not complete
- `vm_error_wait` `unsigned long long int` Number of waits in user cache error processing
- `vm_reclaim_wait` `unsigned long long int` Number of waits done during the reclaim processing for I/O
- `vm_reclaim_steal` `unsigned long long int` Number of user cache pages stolen during reclaim processing
- `vm_waits_for_reclaim` `unsigned long long int` Number of waits for space reclaim process to complete
- `suc_reserved` `unsigned long long int[10]` Reserved
- `suc_dataspaces` `int` Number of dataspaces in user data cache
- `suc_pages_per_dataspaces` `int` Number of pages per dataspace
- `suc_seg_size_local` `int` Local segment size (in K)
- `suc_seg_size_remote` `int` Remote segment size (in K)
- `suc_page_size` `int` Page size (in K)
- `suc_cache_pages` `int` Number of pages in cache
- `suc_total_free` `int` Number of free pages
- `suc_segment_cachesize` `int[5]` Number of segments

**DS_ENTRY[32]**

- `ds_name` `char[9]` Dataspace name
- `pad1` `char[2]` Reserved
- `ds_fixtype` `char` Indicates if cache space is one of the following:
  - 0 - cache space is not fixed
  - 1 - cache space fixed via IARV64
  - 2 - cache space fixed via FPZ4RMR
- `ds_alloc_segs` `int` Number of used segments in dataspace
- `ds_free_pages` `int` Number of free pages in dataspace
- `ds_total_pages` `int` Number of 8K pages in the cache space
- `ds_addr` `hyper` Number of cache space in zFS memory
- `dsReserved` `int[2]` Reserved
- `systemname` `char[9]` Name of system to get statistics from

**Return value**

- 0 if request is successful, -1 if it is not successful

**Return code**

- `EINVAL` Invalid parameter list
- `EINTR` ZFS is shutting down
- `EMVSERR` Internal error occurred

**Reason code**

---

440  z/OS: Distributed File Service zFS Administration
**Usage notes**

1. Reserved fields and undefined flags must be set to binary zeros.
2. When `sa_supported_ver` is 0 or 1, the output consists of `STAT_USER_CACHE[2]` and `DS_ENTRY`.
3. When `sa_supported_ver` is 2 the output consists of `STAT_USER_CACHE2` and `DS_ENTRY`.

**Privilege required**

None.

**Related services**

- Statistics Locking Information
- Statistics Storage Information

**Restrictions**

None.

**Examples**

```c
#pragma linkage(BPX1PCT, OS)
#pragma LANG_LVL(EXTENDED)

extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
#include <stdio.h>
#define ZFSCALL_STATS 0x40000007
#define STATOP_USER_CACHE 242 /* Performance API queries */
#define NUM_DATASACES 32
#define REMOTE 1
#define LOCAL 0

typedef struct hyper {
    unsigned int high;
    unsigned int low;
} hyper;

typedef struct syscall_parmlist_t{
    int opcode;  /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist_t;

typedef struct ds_entry {
    char ds_name[9];
    char pad1[3];
    int ds_alloc_segs;
    int ds_free_pages;
    int ds_reserved[5];  /*reserved for future use*/
} DS_ENTRY;

typedef struct ds_entry2 {
    char ds_name[9];
    char pad2[2];
    char ds_fixtype;  /* Fix type of the cache space, one of the
                      following:
                      0 - cache space is not fixed
                      1 - cache space is fixed via the IARV64
                           page fix services
                      2 - cache space is fixed via the zEDC
                           FPZ4RMR page fix services */
} DS_ENTRY2;
```

441

zFS application programming interface information
Statistics User Cache Information

```c
int ds_alloc_segs;  // Total number of pages in the cache space */
int ds_free_pages;  // */ Address of cache space region */
int ds_total_pages; /* Reserved for future use */
} DS_ENTRY2;

typedef struct reset_time {
  unsigned int  posix_time_high; /* High order 32 bits since epoch */
  unsigned int  posix_time_low;  /* Low order 32 bits since epoch */
  unsigned int  posix_usecs;     /* microseconds */
  int          pad1;
} RESET_TIME;

typedef struct reset_time {
  unsigned int  posix_time_high; /* High order 32 bits since epoch */
  unsigned int  posix_time_low;  /* Low order 32 bits since epoch */
  unsigned int  posix_usecs;     /* microseconds */
  int          pad1;
} RESET_TIME;

/* The following structure is the user data cache statistics */
typedef struct vm_stats_2_t {
  unsigned long long int vm_schedules;
  unsigned long long int vm_setattrs;
  unsigned long long int vm_fsyncs;
  unsigned long long int vm_unmaps;
  unsigned long long int vm_reads;
  unsigned long long int vm_unmaps;
  unsigned long long int vm_readasyncs;
  unsigned long long int vm_writes;
  unsigned long long int vm_getattrs;
  unsigned long long int vm_flushes;
  unsigned long long int vm_scheduled_deletes;
  unsigned long long int vm_reads_faulted;
  unsigned long long int vm_writes_faulted;
  unsigned long long int vm_read_ios;
  unsigned long long int vm_scheduled_writes;
  unsigned long long int vm_error_writes;
  unsigned long long int vm_reclaim_writes; /* Wrote dirty data for reclaim */
  unsigned long long int vm_read_waits;
  unsigned long long int vm_write_waits;
  unsigned long long int vm_fsync_waits;
  unsigned long long int vm_error_waits;
  unsigned long long int vm_reclaim_waits; /* Waited for pending I/O for reclaim */
  unsigned long long int vm_reclaim_steal; /* Number of times steal from others function invoked */
  unsigned long long int vm_waits_for_reclaim; /* Waits for reclaim thread */
} VM_STATS_2;

typedef struct stat_user_cache_2_t {
  /* Various statistics for both LOCAL and REMOTE systems */
  VM_STATS_2 stuc;
  int        stuc_dataspaces;     /* Number of dataspaces in user data cache */
  int        stuc_pages_per_ds;   /* Pages per dataspaces */
  int        stuc_seg_size_loc;   /* Local Segment Size (in K) */
  int        stuc_seg_size_rmt;   /* Remote Segment Size (in K) */
  int        stuc_page_size;      /* Page Size (in K) */
  int        stuc_cache_pages;    /* Total number of pages */
```
typedef struct vm_stats_t {
    unsigned int vm_schedules;
    unsigned int vm_setattrs;
    unsigned int vm_fsyncs;
    unsigned int vm_unmaps;
    unsigned int vm_reads;
    unsigned int vm_readasyncs;
    unsigned int vm_writes;
    unsigned int vm_getattrs;
    unsigned int vm_flushes;
    unsigned int vm_scheduled_deletes;
    unsigned int vm_reads_faulted;
    unsigned int vm_writes_faulted;
    unsigned int vm_read_ios;
    unsigned int vm_scheduled_writes;
    unsigned int vm_error_writes;
    unsigned int vm_reclaim_writes;
    unsigned int vm_read_waits;
    unsigned int vm_write_waits;
    unsigned int vm_fsync_waits;
    unsigned int vm_error_waits;
    unsigned int vm_reclaim_waits;
    unsigned int vm_reclaim_steal;
    unsigned int vm_waits_for_reclaim;
    unsigned int vm_reserved[10];
} VM_STATS;

typedef struct stat_user_cache_t {
    VM_STATS stuc[2];
    int stuc_dataspaces; /* Number of dataspaces in user data cache */
    int stuc_pages_per_ds; /* Pages per dataspace */
    int stuc_seg_size_loc; /* Local Segment Size (in K) */
    int stuc_seg_size_rmt; /* Remote Segment Size (in K) */
    int stuc_page_size; /* Page Size (in K) */
    int stuc_cache_pages; /* Total number of pages */
    int stuc_total_free; /* Total number of free pages */
    int stuc_vmSegTable_cachesize; /* Number of segments */
    int stuc_reserved[5]; /* reserved */
    DS_ENTRY stuc_ds_entry[32]; /* Array of dataspace entries */
} STAT_USER_CACHE;

Statistics User Cache Information
typedef struct stat_api_t {
  #define SA_EYE "STAP"
  char sa_eye[4];    /* 4 byte identifier must be */
  int sa_len;    /* length of the buffer to put data into*/
  int sa_ver;    /* the version number currently always 1*/
  #define SA_VER_2 0x02
  #define SA_VER_INIT 0x01
  char sa_flags;    /* flags field must be x00 or x80, */
  /* x80 means reset statistics */
  #define SA_RESET 0x80
  char sa_fill[3];    /* spare bytes */
  int sa_supported_ver; /* version of data returned */
  int sa_reserve[3];    /* Reserved */
  struct reset_time reset_time_info;
} STAT_API;

struct parmstruct {
  syscall_parmlist myparms;
  STAT_API       myapi;
  STAT_USER_CACHE_2 mystats;
  char          systemname[9];
} myparmstruct;

int print_user_cache_version1(STAT_USER_CACHE   *stcacheptr);
int print_user_cache_version2(STAT_USER_CACHE_2 *stcacheptr);

int main(int argc, char **argv) {
  int bpxrv;
  int bpxrc;
  int bpxrs;
  int i,j;
  char buf[33];
  STAT_API *stapptr = &(myparmstruct.myapi);

  myparmstruct.myparms.opcode = STATOP_USER_CACHE;
  myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
  myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
  myparmstruct.myparms.parms[2] = 0;

  /* Only specify a non-zero offset for the next field (parms[2]) if */
  /* you are running z/OS 1.7 and above, and you want to query the user cache */
  /* statistics of a different system than this one */
  /* myparmstruct.myparms.parms[2] = sizeof(syscall_parmlist) + */
  /*     sizeof(STAT_API) + */
  /*     sizeof(STAT_USER_CACHE_2); */
  myparmstruct.myparms.parms[2] = 0;
  myparmstruct.myparms.parms[3] = 0;
  myparmstruct.myparms.parms[4] = 0;
  myparmstruct.myparms.parms[5] = 0;
  myparmstruct.myparms.parms[6] = 0;
  memset(stapptr, 0, sizeof(STAT_API));
  memcpy(stapptr->sa_eye, SA_EYE, 4);
  stapptr->sa_ver = SA_VER_2;
  stapptr->sa_len = (int) sizeof(STAT_USER_CACHE_2);

  /* This next field should only be set if parms[2] is non-zero */
  /* stcppmy(parmstruct.systemname,"DCEIMGVQ"); */

  BPX1PCT("ZFS",
           ZFSCALL_STATS, /* Perf statistics operation */
           sizeof(myparmstruct), /* Length of Argument */
           (char *)&myparmstruct, /* Pointer to Argument */
           &bpxrv, /* Pointer to Return_value */
           &bpxrc, /* Pointer to Return_code */
           &bpxrs); /* Pointer to Reason_code */

  if (bpxrv < 0) {
    printf("Error querying user cache stats, "
           "BPXRV = %d BPXRC = %d BPXRS = %x\\n",
           bpxrv, bpxrc, bpxrs);
    return bpxrc;
  } else {
    if (stapptr->sa_supported_ver == SA_VER_INIT )
    {

  

STAT_USER_CACHE *stcacheptr_v1;
stcacheptr_v1 = (STAT_USER_CACHE*) &(myparmstruct.mystats);
print_user_cache_version1(stcacheptr_v1);
}
else
{
STAT_USER_CACHE_2 *stcacheptr = &(myparmstruct.mystats);
print_user_cache_version2(stcacheptr);
}
if (0 == ctime_r((time_t*) & stapptr->reset_time_info.posix_time_low, buf))
print("Could not get timestamp.\n");
else
/* Insert the microseconds into the displayable time value */
strncpy((buf[20]), (buf[27]), 6);
sprintf(buf[20], "%06d", stapptr->reset_time_info.posix_usecs);
buf[26] = ' ';
buf[19] = '.';
print("Last Reset Time: %s", buf);
}
return 0;
}
int print_user_cache_version2(STAT_USER_CACHE_2* stcacheptr)
{
int i;
double   ratio1, ratio2, ratio3, ratio4;
printf("                   User File (VM) Caching System Statistics\n");
printf("                   ----------------------------------------\n");
printf("                   Direct Statistics\n");
printf("                   ----------------\n\nExternal Requests:\n------------------\n" "Reads" , stcacheptr->stuc.vm_reads,
"Fsyncs" , stcacheptr->stuc.vm_fsyncs,
"Schedules", stcacheptr->stuc.vm_schedules);
printf("%9s %20llu     %9s %20llu     %9s %20llu\n",
"Reads" , stcacheptr->stuc.vm_reads,
"Fsyncs" , stcacheptr->stuc.vm_fsyncs,
"Schedules", stcacheptr->stuc.vm_schedules);
printf("%9s %20llu     %9s %20llu     %9s %20llu\n",
"Writes" , stcacheptr->stuc.vm_writes,
"Setattrs", stcacheptr->stuc.vm_setattrs,
"Unmaps" , stcacheptr->stuc.vm_unmaps);
printf("%9s %20llu     %9s %20llu     %9s %20llu\n",
"Asy Reads", stcacheptr->stuc.vm_readasyncs,
"Getattrs", stcacheptr->stuc.vm_getattrs,
"Flushes" , stcacheptr->stuc.vm_flushes);
printf("\n");
printf("File System Reads:\n------------------\nratio1 = ratio2 = ratio3 = ratio4 = 0.0;
if (stcacheptr->stuc.vm_reads > 0)
{ 
ratio1 = 100 * (((double)stcacheptr->stuc.vm_reads_faulted)
/ ((double)stcacheptr->stuc.vm_reads));
}
if (stcacheptr->stuc.vm_writes > 0)
{ 
ratio2 = 100 * (((double)stcacheptr->stuc.vm_writes_faulted)
/ ((double)stcacheptr->stuc.vm_writes));
}
if (stcacheptr->stuc.vm_reads > 0)
{ 
ratio3 = 100 * (((double)stcacheptr->stuc.vm_read_waits)
/ ((double)stcacheptr->stuc.vm_reads));
}
printf("%14s %20llu (%s Ratio %.2f%%)\n",
"Reads Faulted", stcacheptr->stuc.vm_reads_faulted,
"Fault", ratio1);
printf("%14s %20llu (%s Ratio %.2f%%)\n",
"Writes Faulted", stcacheptr->stuc.vm_writes_faulted,
"Fault", ratio2);
printf("%14s %20llu (%s Ratio %.2f%%)\n",
"Read Waits", stcacheptr->stuc.vm_read_ios,
"Wait", ratio3);
printf("\n");
printf("File System Writes:\n");
printf("-------------------\n");
printf("%-19s %20llu %-13s %20llu\n",
"Scheduled Writes" ,stcacheptr->stuc.vm_scheduled_writes,
"Sync Waits" ,stcacheptr->stuc.vm_sync_waits);
printf("%-19s %20llu %-13s %20llu\n",
"Error Writes" ,stcacheptr->stuc.vm_error_writes,
"Error Waits" ,stcacheptr->stuc.vm_error_waits);
printf("%-19s %20llu %-13s %20llu\n",
"Page Reclaim Writes", stcacheptr->stuc.vm_reclaim_writes,
"Reclaim Waits" , stcacheptr->stuc.vm_reclaim_waits);
if (stcacheptr->stuc.vm_writes > 0)
{
  ratio4 = 100 * (((double)stcacheptr->stuc.vm_write_waits)
  / ((double)stcacheptr->stuc.vm_writes));
}
printf("%-19s %20llu (Wait Ratio %.2f%%)\n",
"Write Waits", stcacheptr->stuc.vm_write_waits,
ratio4);
printf("\n");
printf("Page Management (Segment Size = (%dK Local %dK Remote) ) ",(Page Size = %dK)
", stcacheptr->stuc_seg_size_loc,
stcacheptr->stuc_seg_size_rmt,
stcacheptr->stuc_page_size);
printf("----------------------------------------
----------
Total Pages       %10u     Free               %10u
", stcacheptr->stuc_cache_pages,
stcacheptr->stuc_total_free);
printf("Segments          %10u\n", stcacheptr->stuc_vmSegTable_cachesize);
printf("Steal Invocations %20llu     Waits for Reclaim %21llu\n",
stcacheptr->stuc.vm_reclaim_steal,
stcacheptr->stuc.vm_waits_for_reclaim);
printf("Number of dataspaces used: %5d ",
stcacheptr->stuc_dataspaces);
printf("Pages per dataspace: %11d\n",
stcacheptr->stuc_pages_per_ds);
printf("\n");
printf("Space         Total 8K      Free          Assigned\n";
printf("Address          Pages         Pages         Segments      Fix Type\n";
printf("----------    ----------    ----------    ----------    --------
----------
for (i = 0; i < stcacheptr->stuc_dataspaces; i++)
{
  char fixtype[10];
  if (stcacheptr->stuc_ds_entry[i].ds_fixtype == 0)
    strcpy(fixtype, "Not Fixed");
  else if (stcacheptr->stuc_ds_entry[i].ds_fixtype == 1)
    strcpy(fixtype, "IARV64");
  else
    strcpy(fixtype, "FPZ4RMR");
  printf("%2.2X%8.8X %10u %10u %s",
stcacheptr->stuc_ds_entry[i].ds_addr.high,
stcacheptr->stuc_ds_entry[i].ds_addr.low,
stcacheptr->stuc_ds_entry[i].ds_total_pages,
stcacheptr->stuc_ds_entry[i].ds_free_pages,
stcacheptr->stuc_ds_entry[i].ds_alloc_segs,
fixtype);
}
return 0;
}
printf("                   ----------------------------------------
");
printf("                   \n");
for (i = 0; i <= REMOTE; i++)
{
    if (i == 0)
    {
        printf(" Direct Statistics\n");
        printf(" -----------------
");
    } else
    {
        printf(" Client Statistics\n");
        printf(" -----------------
");
    }
    printf("External Requests:\n");
    printf("------------------\n");
    printf("%-9s %10u     %-9s %10u     %-9s %10u\n", 
            "Reads"  , stcacheptr->stuc[i].vm_reads, 
            "Fsyncs" , stcacheptr->stuc[i].vm_fsyncs, 
            "Schedules", stcacheptr->stuc[i].vm_schedules);
    printf("%-9s %10u     %-9s %10u     %-9s %10u\n", 
            "Writes" , stcacheptr->stuc[i].vmWrites, 
            "Setattrs", stcacheptr->stuc[i].vm_setattrs, 
            "Unmaps"  , stcacheptr->stuc[i].vm_unmaps);
    printf("%-9s %10u     %-9s %10u     %-9s %10u\n", 
            "Asy Reads", stcacheptr->stuc[i].vm_readasyncs, 
            "Getattrs", stcacheptr->stuc[i].vm_getattrs, 
            "Flushes", stcacheptr->stuc[i].vm_flushes);
    printf("\n");
    printf("File System Reads:\n");
    printf("------------------\n");
    ratio1 = ratio2 = ratio3 = ratio4 = 0.0;
    if (stcacheptr->stuc[i].vm_reads > 0)
    {
        ratio1 = 100 * (((double)stcacheptr->stuc[i].vm_reads_faulted) 
            / ((double)stcacheptr->stuc[i].vm_reads));
    }
    if (stcacheptr->stuc[i].vm_writes > 0)
    {
        ratio2 = 100 * (((double)stcacheptr->stuc[i].vm_writes_faulted) 
            / ((double)stcacheptr->stuc[i].vm_writes));
    }
    if (stcacheptr->stuc[i].vm_reads > 0)
    {
        ratio3 = 100 * (((double)stcacheptr->stuc[i].vm_read_ios) 
            / ((double)stcacheptr->stuc[i].vm_read_ios));
    }
    printf("%-14s %10u (%s Ratio %.2f%%)\n", 
            "Reads Faulted", stcacheptr->stuc[i].vm_reads_faulted, 
            "Fault", ratio1);
    printf("%-14s %10u (%s Ratio %.2f%%)\n", 
            "Writes Faulted", stcacheptr->stuc[i].vm_writes_faulted, 
            "Fault", ratio2);
    printf("%-14s %10u (%s Ratio %.2f%%)\n", 
            "Read Waits", stcacheptr->stuc[i].vm_read_ios, 
            "Wait", ratio3);
    printf("\n");
    printf("File System Writes:\n");
    printf("-------------------\n");
    printf("%-19s %10u %-13s %10u\n", 
            "Scheduled Writes" , stcacheptr->stuc[i].vm_scheduled_writes, 
            "Sync Waits" , stcacheptr->stuc[i].vm_sync_waits);
    printf("%-19s %10u %-13s %10u\n", 
            "Error Writes" , stcacheptr->stuc[i].vm_error_writes, 
            "Error Waits" , stcacheptr->stuc[i].vm_error_waits);
    printf("%-19s %10u %-13s %10u\n", 
            "Page Reclaim Writes", stcacheptr->stuc[i].vm_reclaim_writes, 
            "Reclaim Waits", stcacheptr->stuc[i].vm_reclaim_waits);
    if (stcacheptr->stuc[i].vm_writes > 0)
ratio4 = 100 * ((double)stcacheptr->stuc[j].vm_write_waits) / ((double)stcacheptr->stuc[j].vm_writes));
   }

printf("%-19s %10u (Wait Ratio %.2f%%)\n", "Write Waits", stcacheptr->stuc[j].vm_write_waits, ratio4);
}

printf("\n");
printf("Page Management (Segment Size = (%dK Local %dK Remote) ) " "(Page Size = %dK)\n", stcacheptr->stuc_seg_size_loc, stcacheptr->stuc_seg_size_rmt, stcacheptr->stuc_page_size);
printf("--------------------------\n");
printf("Total Pages       %10u     Free               %10u\n", stcacheptr->stuc_cache_pages, stcacheptr->stuc_total_free);
printf("Segments          %10u\n", stcacheptr->stuc_vmSegTable_cachesize);
printf("Steal Invocations %10u     Waits for Reclaim %11u\n", stcacheptr->stuc[0].vm_reclaim_steal, stcacheptr->stuc[0].vm_waits_for_reclaim);
printf("Number of dataspaces used: %5d ", stcacheptr->stuc_dataspaces);
printf("Pages per datasource: %11d\n", stcacheptr->stuc_pages_per_ds);
printf("\n");
printf("Dataspace Allocated Free\n");
printf("Name Segments Pages\n");
printf("--------  ----------  ----------\n");

for (i = 0; i < stcacheptr->stuc_dataspaces; i++)
{
   printf("%-8s    %10u    %10u\n", stcacheptr->stuc_ds_entry[i].ds_name, stcacheptr->stuc_ds_entry[i].ds_alloc_segs, stcacheptr->stuc_ds_entry[i].ds_free_pages);
}
return 0;
}
## Purpose

A performance statistics operation that returns vnode cache counters. It determines the number of requests, hits, and discards from the vnode cache.

## Format

```c
syscall_parmlist
opcode int 251 STATOP_VNODE_CACHE
parms[0] int Offset to STAT_API
parms[1] int Offset of output following STAT_API
parms[2] int Offset to system name (optional)
parms[3] int 0
parms[4] int 0
parms[5] int 0
parms[6] int 0

STAT_API
sa_eye char[4] "STAP"
sa_len int Length of buffer that follows
the STAT_API
sa_ver int 1 or 2
sa_flags char[1] 0x80 - Reset statistics
sa_fill char[3] Reserved
sa_supported_ver int Version of data returned
sa_reserve int[3] Reserved
posix_time_high unsigned int High order 32 bits since epoch
posix_time_low unsigned int Low order 32 bits since epoch
posix_useconds unsigned int Microseconds
pad1 int Reserved

STAT_VNODE_CACHE
VNM_STATS_API_STRUCT
reserved unsigned int Reserved
Vnodes unsigned int Number of vnodes
Requests unsigned int Number of requests
Hits unsigned int Number of hits
RatioWhole hyper Ratio of hits to requests
(whole number part)
RatioDecimal hyper Ratio of hits to requests
(decimal part). Decimal part is
in thousandths (3 means .003 and
300 means .3)
Allocates hyper Allocates
Deletes hyper Deletes
VnodeStructSize hyper Base vnode structure size
ExtendedVnodes hyper Number of extended vnodes
extensionSize hyper Size of vnode extension
USSHeldVnodes hyper Number of held vnodes
USSHeldVnodesHi hyper Held vnodes high watermark
OpenVnodes hyper Number of open vnodes
OpenVnodesHi hyper Open vnodes high watermark
OpenVnodesReuse hyper Number vnodes that can be reused
reserved2 hyper[12] Reserved

EFS_STATS_API_STRUCT
reserved hyper Reserved
grand_total_vnodes hyper Total count of vnode ops
total_ops hyper Number of vnode op counts
convert_namecount unsigned int Count of names processed during
conversion
reserved int Reserved
reserved1 hyper[11] Reserved

ZFSVNODEOECOUNTS[50]
opname char[26] vnode operation name
pad1 char[2] reserved
opcount hyper count of vnode op requests
reserved hyper[2] reserved
reserved hyper[10] reserved

-- or --

STAT_VNODE_CACHE2
VNM_STATS_API_STRUCT2
reserved unsigned long long int Reserved
Vnodes unsigned long long int Number of vnodes
```
### Statistics Vnode Cache Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requests</td>
<td>unsigned long long int</td>
<td>Number of requests</td>
</tr>
<tr>
<td>Hits</td>
<td>unsigned long long int</td>
<td>Number of hits</td>
</tr>
<tr>
<td>RatioWhole</td>
<td>hyper</td>
<td>Ratio of hits to requests (whole number part)</td>
</tr>
<tr>
<td>RatioDecimal</td>
<td>hyper</td>
<td>Ratio of hits to requests (decimal part). Decimal part is in thousandths (3 means .003, 300 is .3)</td>
</tr>
<tr>
<td>Allocates</td>
<td>unsigned long long int</td>
<td>Allocates</td>
</tr>
<tr>
<td>Deletes</td>
<td>unsigned long long int</td>
<td>Deletes</td>
</tr>
<tr>
<td>VnodeStructSize</td>
<td>unsigned long long int</td>
<td>Base vnode structure size</td>
</tr>
<tr>
<td>ExtendedVnodes</td>
<td>unsigned long long int</td>
<td>Number of extended vnodes</td>
</tr>
<tr>
<td>extensionSize</td>
<td>unsigned long long int</td>
<td>Size of vnode extension</td>
</tr>
<tr>
<td>USHeldVnodes</td>
<td>unsigned long long int</td>
<td>Number of held vnodes</td>
</tr>
<tr>
<td>USHeldVnodesHi</td>
<td>unsigned long long int</td>
<td>Held vnode high water mark</td>
</tr>
<tr>
<td>OpenVnodes</td>
<td>unsigned long long int</td>
<td>Number of open vnodes</td>
</tr>
<tr>
<td>OpenVnodesHi</td>
<td>unsigned long long int</td>
<td>Open vnode high water mark</td>
</tr>
<tr>
<td>OpenVnodesReuse</td>
<td>unsigned long long int</td>
<td>Number of vnodes that can be reused</td>
</tr>
<tr>
<td>extCleans</td>
<td>unsigned long long int</td>
<td>Number of vnodes extensions that were cleaned</td>
</tr>
<tr>
<td>grand_total_vnodes</td>
<td>unsigned long long int</td>
<td>Total count of vnode ops</td>
</tr>
<tr>
<td>convert_namecount</td>
<td>unsigned long long int</td>
<td>Count of names processed during auto conversion for version 2, reserved for version 1.</td>
</tr>
<tr>
<td>v2dir_splits</td>
<td>unsigned long long int</td>
<td>V5 directory bucket splits</td>
</tr>
<tr>
<td>v2dir_merges</td>
<td>unsigned long long int</td>
<td>V5 directory bucket merges</td>
</tr>
<tr>
<td>_Packed ZFSVNODEOPCOUNTS[50]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>opname</td>
<td>char[26]</td>
<td>Vnode operation name</td>
</tr>
<tr>
<td>pad1</td>
<td>char[2]</td>
<td>Reserved</td>
</tr>
<tr>
<td>opcount</td>
<td>unsigned long long int</td>
<td>Count of vnode op requests</td>
</tr>
<tr>
<td>reserved</td>
<td>hyper[2]</td>
<td>Reserved</td>
</tr>
<tr>
<td>reserved1</td>
<td>hyper[9]</td>
<td>Reserved</td>
</tr>
<tr>
<td>reserved2</td>
<td>hyper[10]</td>
<td>Reserved</td>
</tr>
<tr>
<td>systemname</td>
<td>char[9]</td>
<td>Name of system to get stats</td>
</tr>
</tbody>
</table>

**Return value**

0 if request is successful, -1 if it is not successful

**Return code**

- EINTR: zFS is shutting down
- EINVAL: Invalid parameter list
- EMVSERR: Internal error occurred
- E2BIG: Information too big for buffer supplied

**Reason code**

- 0xEFnnxxxx: See z/OS Distributed File Service Messages and Codes

### Usage notes

1. Reserved fields and undefined flags must be set to binary zeros.
2. Version 1 provided 8-byte counters but only used the low order 4-bytes. Version 2 uses full 8-byte counters.
3. Same named fields in version 1 and 2 that are not reserved start at the same offset.

### Privilege required

None.

### Related services

Statistics Metadata Cache Information

### Restrictions

None.
Examples

```c
#pragma linkage(BPX1PCT, OS)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);

/* #include <stdlib.h> */
#include <stdio.h>
#define ZFSCALL_STATS 0x40000007
#define STATOP_VNODE_CACHE 251 /* vnode cache stats */
#define CONVERT_RATIO_TO_INTS(RATIO, INTEGER, DECIMAL) {
    INTEGER = (int)RATIO;
    DECIMAL = (int)((RATIO - (double)INTEGER) * (double)1000.0);
}

typedef struct syscall_parmlist_t {
    int opcode; /* Operation code to perform */
    int parms[7]; /* Specific to type of operation, */
    /* provides access to the parms */
    /* parms[4]-parms[6] are currently unused */
} syscall_parmlist;

typedef struct hyper {
    unsigned int high; /* unsigned int reserved */
    unsigned int low;
} hyper;

/* reset timestamp */
typedef struct reset_time {
    unsigned int posix_time_high; /* high order 32 bits since epoc */
    unsigned int posix_time_low; /* low order 32 bits since epoch */
    unsigned int posix_usecs; /* microseconds */
    int pad1;
} RESET_TIME;

/* API STATOP_VNODE_CACHE storage structures */
typedef struct VNM_STATS_API_STRUCT_T {
    hyper reserved;
    hyper Vnodes;
    hyper Requests;
    hyper Hits;
    hyper RatioWhole;
    hyper RatioDecimal; /* decimal part is in thousandths */
    /* 3 means .003 and 300 means .3 */
    hyper Allocates;
    hyper Deletes;
    hyper VnodeStructSize;
    hyper ExtendedVnodes;
    hyper extensionSize; /* (minimum) in bytes */
    hyper USHeldVnodes;
    hyper USHeldVnodesHi;
    hyper OpenVnodes;
    hyper OpenVnodesHi;
    hyper OpenVnodesReuse;
    int reserved1[3];
    int pad1;
    hyper reserved2[10];
} VNM_STATS_API_STRUCT;

typedef struct ZFSVNODEOPCOUNTS_T {
```
Statistics Vnode Cache Information

```
char opname[26]; /* Operation being counted */
char pad1[2];
hyper opcount; /* Number of operations performed */
hyper reserved[2]; /* reserved for future use */
} ZFSVNODEOPCOUNTS;

typedef struct EFS_STATS_API_STRUCT_T {
    hyper reserved;
    hyper grand_total_vnodes;
    hyper total_ops;
    int convert_namecount;
    int reserved1[3];
    hyper reserved2[10];
    ZFSVNODEOPCOUNTS zFSOpCounts[50];
} EFS_STATS_API_STRUCT;

typedef struct stat_vnode_cache_t {
    VNM_STATS_API_STRUCT_T vnm_stats_info;
    EFS_STATS_API_STRUCT efs_stats_info;
    hyper reserved[10];
} STAT_VNODE_CACHE;

typedef struct VNM_STATS_API_STRUCT2_T {
    unsigned long long int reserved;
    unsigned long long int Vnodes;
    unsigned long long int Requests;
    unsigned long long int Hits;
    hyper RatioWhole;
    hyper RatioDecimal; /* decimal part is in thousandths */
    /* 3 means .003 and 300 means .3 */
    unsigned long long int Allocates;
    unsigned long long int Deletes;
    unsigned long long int VnodeStructSize;
    unsigned long long int ExtendedVnodes;
    unsigned long long int extensionSize; /* (minimum) in bytes */
    unsigned long long int USSHeldVnodes;
    unsigned long long int USSHeldVnodesHi;
    unsigned long long int OpenVnodes;
    unsigned long long int OpenVnodesHi;
    unsigned long long int OpenVnodesReuse;
    unsigned long long int extCleans;
    int reserved1[2];
    hyper reserved2[10];
} VNM_STATS_API_STRUCT2;

typedef _Packed struct zFSVnodeOpCounts_t {
    char opname[26]; /* Operation being counted */
    char pad1[2];
    unsigned long long int opcount; /* Number of operations performed */
    hyper reserved[2]; /* reserved for future use */
} _Packed zFSVnodeOpCounts;

typedef struct EFS_STATS_API_STRUCT2_T {
    unsigned long long int reserved;
    unsigned long long int grand_total_vnodes;
    unsigned long long int total_ops;
    unsigned long long int convert_namecount;
    unsigned long long int v5dir_splits;
    unsigned long long int v5dir_merges;
    hyper reserved2[9];
    _Packed zFSVnodeOpCounts zFSOpCounts[50];
```
typedef struct stat_vnode_cache2_t {
    VNM_STATS_API_STRUCT2 vnm_stats_info;
    EFS_STATS_API_STRUCT2 efs_stats_info;
    char reserved[10];
} STAT_VNODE_CACHE2;

/**************************
/* The following structure is the api query control block */
/* It is used for all api query commands */
/**************************
typedef struct stat_api_t {
    #define SA_EYE "STAP"
    char sa_eye[4]; /* 4 byte identifier must be */
    int sa_len; /* length of the buffer to put data into */
    /* this buffer area follows this struct. */
    int sa_ver; /* the version number currently always 1 */
    #define SA_VER_INITIAL 0x01
    #define SA_VER_2 0x02
    char sa_flags; /* flags field, x80 means reset stats */
    char sa_fill[3]; /* spare bytes */
    int sa_supported_ver; /* version of data returned */
    int sa_reserve[3]; /* Reserved */
    struct reset_time reset_time_info;
} STAT_API;

struct parmstruct {
    syscall_parmlist myparms;
    STAT_API myapi;
    STAT_VNODE_CACHE2 mystats;
    char systemname[9];
} myparmstruct;

int main(int argc, char **argv) {
    int bpxrv;
    int bpxrc;
    int bpxrs;
    int i;
    double temp_ratio;
    int whole;
    int decimal;
    STAT_API *stapptr = &(myparmstruct.myapi);
    char buf[33];

    myparmstruct.myparms.opcode = STATOP_VNODE_CACHE;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    memset(stapptr, 0, sizeof(STAT_API));
    memcpy(stapptr->sa_eye, SA_EYE, 4);
stapptr->sa_ver = SA_VER_2;
stapptr->sa_len = (int)sizeof(STAT_VNODE_CACHE2);

BPX1PCT("ZFS ",
    ZFSCALL_STATS,    /* Perf statistics operation */
    sizeof(myparmstruct), /* Length of Argument */
    (char *)&myparmstruct, /* Pointer to Argument */
    &bpxrv,
    &bpxrc,
    &bpxrs); /* Pointer to Return_value */

if (bpxrv < 0)
{
    printf("Error querying vnode cache, BPXRV = %d BPXRC = %d BPXRS = %x
\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
}
else
{
    if (stapptr->sa_supported_ver == SA_VER_INITIAL)
    {
        /* Print the version 1 ouput */
        STAT_VNODE_CACHE *mystatsp = (STAT_VNODE_CACHE *)&myparmstruct.mystats;
        i = 0;
        printf("%50s
", "zFS Vnode Op Counts");
        printf(" 
");
        printf("Vnode Op                  Count       "
              "Vnode Op                  Count \
              "
        );
        printf("------------------------  ----------  
               ------------------------  ---------- 
");
        while (i < mystatsp->efs_stats_info.total_ops.low)
        {
            printf("%-25s %10u  ",
                   mystatsp->efs_stats_info.zFSOpCounts[i].opname,
                   mystatsp->efs_stats_info.zFSOpCounts[i++].opcount.low);
            if (i < mystatsp->efs_stats_info.total_ops.low)
            {
                printf("%-25s %10u\n", mystatsp->efs_stats_info.zFSOpCounts[i].opname,
                       mystatsp->efs_stats_info.zFSOpCounts[i+1].opcount.low);
            }
        }
        printf("\nTotal zFS Vnode Ops       %10u\n\n", mystatsp->efs_stats_info.grand_total_vnodes.low);
        printf("%52s
", "zFS Vnode Cache Statistics");
        printf(" 
");
        printf(" Vnodes     Requests   Hits       Ratio   "
                "Allocates  Deletes")
        printf(" ---------- ---------- ---------- ------- 
               ---------- ----------
");
        printf("%10u %10u %10u %3u.%1.1u%% %10u %10u
", mystatsp->vnm_stats_info.Vnodes.low,
               mystatsp->vnm_stats_info.Requests.low,
               mystatsp->vnm_stats_info.Hits.low,
               mystatsp->vnm_stats_info.RatioWhole.low,
               mystatsp->vnm_stats_info.Allocates.low,
               mystatsp->vnm_stats_info.Deletes.low);
    }
    printf(" \n");
    printf("zFS Vnode structure size: %u bytes\n", Statistics Vnode Cache Information

454 z/OS: Distributed File Service zFS Administration
Statistics Vnode Cache Information
mystatsp->vnm_stats_info.VnodeStructSize.low);
\n",

printf("zFS extended vnodes: %u, extension size %u bytes (minimum)
mystatsp->vnm_stats_info.ExtendedVnodes.low,
mystatsp->vnm_stats_info.extensionSize.low);
printf("Held zFS vnodes: %10u (high %10u) \nOpen zFS vnodes: %10u "
"(high %10u) Reusable: %u\n",
mystatsp->vnm_stats_info.USSHeldVnodes.low,
mystatsp->vnm_stats_info.USSHeldVnodesHi.low,
mystatsp->vnm_stats_info.OpenVnodes.low,
mystatsp->vnm_stats_info.OpenVnodesHi.low,
mystatsp->vnm_stats_info.OpenVnodesReuse.low);
printf(" \n");

if (0 == ctime_r((time_t * )&stapptr->reset_time_info.posix_time_low,
buf))
printf("Could not get timestamp.\n");
else
{
/* Insert the microseconds into the displayable time value */
strncpy(&(buf[27]), &(buf[20]), 6);
sprintf(&(buf[20]), "%06d", stapptr>reset_time_info.posix_usecs);
buf[26] = ' ';
buf[19] = '.';
printf("Last Reset Time: %s", buf);
}
}
else
{
/* Print the version 2 ouput */
STAT_VNODE_CACHE2 *mystatsp = &myparmstruct.mystats;
i = 0;
printf("%50s\n", "zFS Vnode Op Counts");
printf(" \n");
printf("Vnode Op
Count
"
"Vnode Op
Count \n");
printf("------------------------ ---------- "
"------------------------ ---------- \n");
while (i < mystatsp->efs_stats_info.total_ops)
{
printf("%-25s %10llu ",
mystatsp->efs_stats_info.zFSOpCounts[i].opname,
mystatsp->efs_stats_info.zFSOpCounts[i++].opcount);
if (i < mystatsp->efs_stats_info.total_ops)
{
printf("%-25s %10llu\n",
mystatsp->efs_stats_info.zFSOpCounts[i].opname,
mystatsp->efs_stats_info.zFSOpCounts[i++].opcount);
}
}
printf("\nTotal zFS Vnode Ops
%10llu\n\n",
mystatsp->efs_stats_info.grand_total_vnodes);
printf("%52s\n", "zFS Vnode Cache Statistics");
printf(" \n");
printf(" Vnodes
Requests
Hits
Ratio
"
"Allocates Deletes\n");
printf(" ---------- ---------- ---------- ------- "
"---------- ----------\n");
printf("%10llu %10llu %10llu %3llu.%1.1llu%% %10llu %10llu\n",
mystatsp->vnm_stats_info.Vnodes,
mystatsp->vnm_stats_info.Requests,
mystatsp->vnm_stats_info.Hits,
zFS application programming interface information 455


mystatsp->vnm_stats_info.RatioWhole,
mystatsp->vnm_stats_info.RatioDecimal,
mystatsp->vnm_stats_info.Allocates,
mystatsp->vnm_stats_info.Deletes);

printf(" \n");
printf("zFS Vnode structure size: %llu bytes\n",
mystatsp->vnm_stats_info.VnodeStructSize);

printf("zFS extended vnodes: %llu, extension size %llu "
"bytes (minimum)\n",
mystatsp->vnm_stats_info.ExtendedVnodes,
mystatsp->vnm_stats_info.extensionSize);

printf("Held zFS vnodes: %10llu (high %10llu) \nOpen zFS vnodes: 
" "%10llu (high %10llu) Reusable: %11lu\n",
mystatsp->vnm_stats_info.USSHeldVnodes,
mystatsp->vnm_stats_info.USSHeldVnodesHi,
mystatsp->vnm_stats_info.OpenVnodes,
mystatsp->vnm_stats_info.OpenVnodesHi,
mystatsp->vnm_stats_info.OpenVnodesReuse);
printf(" \n");

if (0 == ctime_r((time_t *) &stapptr->reset_time_info.posix_time_low,
buf))
    printf("Could not get timestamp.\n");
else
    /* Insert the microseconds into the displayable time value */
    strncpy(&(buf[27]), &(buf[20]), 6);
    sprintf(&(buf[20]), "%06d", stapptr->reset_time_info.posix_usecs);
    buf[26] = ' ';
    buf[19] = '.';
    printf("Last Reset Time: %s", buf);
}
return 0;
Unquiesce Aggregate

Purpose
An aggregate operation that unquiesces a zFS compatibility mode aggregate on a system. This subcommand call allows activity on the aggregate and its file system to resume.

Format
syscall_parmlist
  opcode int 133 AGOP_UNQUIESCE_PARMDATA
  parms[0] int offset to AGGR_ID
  parms[1] int quiesce handle
  parms[2] int 0
  parms[3] int 0
  parms[4] int 0
  parms[5] int 0
  parms[6] int 0
AGGR_ID
  aid_eye char[4] "AGID"
  aid_len char sizeof(AGGR_ID)
  aid_ver char 1
  aid_name char[45] "OMVS.PRVS.AGGR001.LDS0001"
  aid_reserved char[33] 0
Return_value 0 if request is successful, -1 if it is not successful

Return_code
  EINTR ZFS is shutting down
  EMVSERR Internal error using an osi service
  ENOENT Aggregate is not attached
  EPERM Permission denied to perform request

Reason_code
  0xEFnnxxxx See z/OS Distributed File Service Messages and Codes

Usage notes
1. The unquiesce call must supply the quiesce handle that was returned by the quiesce call. The aggregate is typically quiesced before backing up the aggregate. After the backup is complete, the aggregate can be unquiesced.
2. Reserved fields and undefined flags must be set to binary zeros.

Privilege required
The issuer must be logged in as a root user (UID=0) or have READ authority to the SUPERUSER.FILESYS.PFSCTL resource in the z/OS UNIXPRIV class.

Related services
Quiesce Aggregate

Restrictions
None.

Examples

```
#pragma linkage(BPX1PCT, OS)
#pragma LANGLVL(EXTENDED)
extern void BPX1PCT(char *, int, int, char *, int *, int *, int *);
```
#include <stdio.h>
#include <stdlib.h>

#define ZFSCALL_AGGR 0x40000005
#define AGOP_UNQUIESCE_PARMDATA 133

typedef struct syscall_parmlist_t {
  int opcode; /* Operation code to perform */
  int parms[7]; /* Specific to type of operation, provides access to the parms */
  /* parms[4]-parms[6] are currently unused */
} syscall_parmlist;

#define ZFS_MAX_AGGRNAME 44

typedef struct aggr_id_t {
  char aid_eye[4]; /* Eye catcher */
#define AID_EYE "AGID"
  char aid_len; /* Length of this structure */
#define AID_LEN_INITIAL 1 /* Initial version */
  char aid_ver; /* Version */
#define AID_VER_INITIAL 1 /* Initial version */
  char aid_name[ZFS_MAX_AGGRNAME+1]; /* Name, null terminated */
  char aid_reserved[33]; /* Reserved for the future */
} AGGR_ID;

typedef struct parmstruct {
  syscall_parmlist myparms;
  AGGR_ID aggr_id;
} parmstruct;

int main(int argc, char **argv) {
  int               bpxrv;
  int               bpxrc;
  int               bpxrs;
  char              aggrname[45] = "PLEX.DCEIMGQX.FS";
  int               save_quiesce_handle;

  parmstruct myparmstruct;

  if (argc != 2) {
    printf("This unquiesce program requires a quiesce handle from the quiesce program as a parameter\n");
    return 1;
  }

  save_quiesce_handle = atoi(argv[1]);

  myparmstruct.myparms.opcode = AGOP_UNQUIESCE_PARMDATA;
  myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
  myparmstruct.myparms.parms[1] = save_quiesce_handle;
  myparmstruct.myparms.parms[2] = 0;
  myparmstruct.myparms.parms[3] = 0;
  myparmstruct.myparms.parms[4] = 0;
  myparmstruct.myparms.parms[5] = 0;
  myparmstruct.myparms.parms[6] = 0;

  /* Ensure reserved fields are 0 */
  memset(&myparmstruct.aggr_id, 0, sizeof(AGGR_ID));
  memcpy(&myparmstruct.aggr_id.aid_eye, AID_EYE, 4);
  myparmstruct.aggr_id.aid_len = sizeof(AGGR_ID);
  myparmstruct.aggr_id.aid_ver = AID_VER_INITIAL;
  strcpy(myparmstruct.aggr_id.aid_name, aggrname);

  BPX1PCT("ZFS     ",
    ZFSCALL_AGGR,       /* Aggregate operation */
    sizeof(myparmstruct), /* Length of Argument */
    (char *)&myparmstruct, /* Pointer to Argument */
    &bpxrv, /* Pointer to Return_value */
    &bpxrc, /* Pointer to Return_code */
    &bpxrs); /* Pointer to Reason_code */

  if (bpxrv < 0) {
    printf("Error unquiescing aggregate %s\n", aggrname);
    printf("BPXRV = %d BPXRC = %d BPXRS = %x\n", bpxrv, bpxrc, bpxrs);
    return bpxrc;
  }
  else {
    /* Return from unquiesce was successful */
    printf("Aggregate %s unquiesced successfully\n", aggrname);
  }
}
return 0;
}
Appendix A. Running the zFS pfsctl APIs in 64-bit mode

The pfsctl (BPX1PCT) application programming interface can be invoked in a 64-bit environment. To do this, you must take the following steps:

1. Replace the BPX1PCT with BPX4PCT
2. Replace the 
   
   ```
   #pragma linkage(BPX1PCT, OS)
   ```
   
   with
   
   ```
   #pragma linkage(BPX4PCT, OS64_NOSTACK)
   ```
3. Ensure that there are appropriate includes for function calls
4. Ensure all functions that require 64-bit parameters are passing 64-bit numbers (for example, ctime_r).

The remaining code is, or can remain, unchanged. “Statistics Iocounts Information (64-bit mode)” on page 461 shows example code that were updated to be invoked in a 64-bit environment.

Statistics Iocounts Information (64-bit mode)

Examples

```c
#pragma linkage(BPX4PCT, OS64_NOSTACK)
extern void BPX4PCT(char *, int, int, char *, int *, int *, int *);

#include <stdio.h>
#include <time.h>

#define ZFSCALL_STATS 0x40000007
#define STATOP_IOCOUNTS 243 /* Performance API queries */
#define TOTAL_TYPES 3
#define TOTAL_CIRC 19

typedef struct syscall_parmlist_t {
    int opcode;               /* Operation code to perform       */
    int parms[7];              /* Specific to type of operation, */
                               /* provides access to the parms */
                               /* parms[4]-parms[6] are currently unused*/
} syscall_parmlist;

typedef struct reset_time {  
    u_int posix_time_high;    /* high order 32 bits since epoch */
    u_int posix_time_low;     /* low order 32 bits since epoch */
    u_int posix_usecs;        /* microseconds */
    int      pad1;
} RESET_TIME;

typedef struct stat_api_t {
    #define SA_EYE    "STAP"     /* 4 byte identifier must be */
    char sa_eye[4];
    int sa_len;               /* length of the buffer to put data into*/
    int sa_ver;               /* this buffer area follows this struct*/
    int sa_reserve[4];        /* the version number currently always 1*/
    #define SA_VER_INITIAL 0x01
    char sa_flags;             /* flags field must be x00 or x80, x80 means reset statistics*/
    #define SA_RESET 0x80
    char sa_fill[3];           /* spare bytes */
    int sa_reserve[4];        /* Reserved */
    struct reset_time reset_time_info;
```
typedef struct API_IO_BY_TYPE_t {
    unsigned int number_of_lines;
    unsigned int count;
    unsigned int waits;
    unsigned int cancels; /* Successful cancels of IO */
    unsigned int merges; /* Successful merges of IO */
    char reserved1[6];
    char description[51];
    char pad1[3];
} API_IO_BY_TYPE;

typedef struct API_IO_BY_CIRC_t {
    unsigned int number_of_lines;
    unsigned int count;
    unsigned int waits;
    unsigned int cancels;
    unsigned int merges;
    char reserved1[6];
    char description[51];
    char pad1[3];
} API_IO_BY_CIRC;

/********************************************************************
/* The following structures are used to represent cfgop queries        */
/* for iocounts                                                        */
/********************************************************************/

struct parmstruct {
    syscall_parmlist myparms;
    STAT_API myapi;
    API_IO_BY_TYPE mystatsbytype[TOTAL_TYPES];
    API_IO_BY_CIRC mystatsbycirc[TOTAL_CIRC];
} myparmstruct;

int main(int argc, char **argv) {
    int bpxrv;
    int bpxrc;
    int bpxrs;
    int i;
    STAT_API *stapptr = &(myparmstruct.myapi);
    API_IO_BY_TYPE *stiotptr = &(myparmstruct.mystatsbytype[0]);
    API_IO_BY_CIRC *stiocptr = &(myparmstruct.mystatsbycirc[0]);
    char buf[33];
    myparmstruct.myparms.opcode = STATOP_IOCOUNTS;
    myparmstruct.myparms.parms[0] = sizeof(syscall_parmlist);
    myparmstruct.myparms.parms[1] = sizeof(syscall_parmlist) + sizeof(STAT_API);
    myparmstruct.myparms.parms[2] = 0;
    myparmstruct.myparms.parms[3] = 0;
    myparmstruct.myparms.parms[4] = 0;
    myparmstruct.myparms.parms[5] = 0;
    myparmstruct.myparms.parms[6] = 0;
    memset(stapptr,0,sizeof(STAT_API));
    memcpy(stapptr->sa_eye,SA_EYE,4);
    stapptr->sa_ver=SA_VER_INITIAL;
    stapptr->sa_len=(int) (TOTAL_TYPES * sizeof(API_IO_BY_TYPE))
                   + (TOTAL_CIRC * sizeof(API_IO_BY_CIRC));
    BPX4PCT("ZFS         
ZFSCALL_STATS,     /* Perf statistics operation */
(sizeof(myparmstruct), /* Length of Argument */
(char *) &myparmstruct, /* Pointer to Argument */
&bpxrv, /* Pointer to Return_value */
&bpxrc, /* Pointer to Reason_code */
&bpxrs);
    if( bpxrv < 0 ) {
        printf("Error querying iocounts, BPXRV = %d BPXRC = %d BPXRS = %x\n",bpxrv,bpxrc,bpxrs);
        return bpxrc;
    } else {
        if( stiotptr->number_of_lines != TOTAL_TYPES )
            /* Statistics iocounts information (64-bit) mode */

462 z/OS: Distributed File Service zFS Administration
```c
{  printf("Unexpected number of I/O Types, %d instead of TOTAL_TYPES\n", stiotptr->number_of_lines);
  return 1;
}  
if( stiocptr->number_of_lines != TOTAL_CIRC )
{  printf("Unexpected number of I/O Circumstances, %d instead of TOTAL_CIRC\n", stiocptr->number_of_lines);
  return 2;
}  
printf("                  I/O Summary By Type\n");
printf("                  -------------------\n");
printf("Count       Waits       Cancels     Merges      Type\n");
printf("----------  ----------  ----------  ----------  ----------\n");
for( i=0; i<TOTAL_TYPES; i++ )
{  printf("%10u  %10u  %10u  %10u  %s\n", stiotptr->count, stiotptr->waits,
   stiotptr->cancels, stiotptr->merges, stiotptr->description);
   stiotptr = stiotptr + 1;
}  
printf("\n");
printf("                  I/O Summary By Circumstance\n");
printf("                  ---------------------------\n");
printf("Count       Waits       Cancels     Merges      Circumstance\n");
printf("----------  ----------  ----------  ----------  ------------\n");
for( i=0; i<TOTAL_CIRC; i++ )
{  printf("%10u  %10u  %10u  %10u  %s\n", stiocptr->count, stiocptr->waits,
   stiocptr->cancels, stiocptr->merges, stiocptr->description);
   stiocptr = stiocptr + 1;
}  
printf("\n");
if (0==ctime_r((time_t *) &stapptr->reset_time_info, buf))
{  printf("Could not get timestamp.\n");
}  
else   
{  /* Insert the microseconds into the displayable time value */
   strncpy(&(buf[27]),&(buf[20]),6);
   sprintf(&(buf[20]),"%06d",stapptr->reset_time_info.posix_usecs);
   buf[26]='.';
   buf[19]='.';
   printf("Last Reset Time: %s",buf);
}  
return 0;
}  
```

Statistics iocounts information (64-bit) mode

Running the zFS pfsctl APIs in 64-bit mode 463
Appendix B. Accessibility

Accessible publications for this product are offered through IBM Knowledge Center (www.ibm.com/support/knowledgecenter/SSLTBW/welcome).

If you experience difficulty with the accessibility of any z/OS information, send a detailed email message to mhvrdfs@us.ibm.com.

Accessibility features

Accessibility features help users who have physical disabilities such as restricted mobility or limited vision use software products successfully. The accessibility features in z/OS can help users do the following tasks:

• Run assistive technology such as screen readers and screen magnifier software.
• Operate specific or equivalent features by using the keyboard.
• Customize display attributes such as color, contrast, and font size.

Consult assistive technologies

Assistive technology products such as screen readers function with the user interfaces found in z/OS. Consult the product information for the specific assistive technology product that is used to access z/OS interfaces.

Keyboard navigation of the user interface

You can access z/OS user interfaces with TSO/E or ISPF. The following information describes how to use TSO/E and ISPF, including the use of keyboard shortcuts and function keys (PF keys). Each guide includes the default settings for the PF keys.

• z/OS TSO/E Primer
• z/OS TSO/E User’s Guide
• z/OS ISPF User’s Guide Vol I

Dotted decimal syntax diagrams

Syntax diagrams are provided in dotted decimal format for users who access IBM Knowledge Center with a screen reader. In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), they can appear on the same line because they are considered a single compound syntax element.

Each line starts with a dotted decimal number; for example, 3 or 3.1 or 3.1.1. To hear these numbers correctly, make sure that the screen reader is set to read out punctuation. All the syntax elements that have the same dotted decimal number (for example, all the syntax elements that have the number 3.1) are mutually exclusive alternatives. If you hear the lines 3.1 USERID and 3.1 SYSTEMID, your syntax can include either USERID or SYSTEMID, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number 3 is followed by a series of syntax elements with dotted decimal number 3.1, all the syntax elements numbered 3.1 are subordinate to the syntax element numbered 3.
Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, it is preceded by the backslash (\) character. The * symbol is placed next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element *FILE with dotted decimal number 3 is given the format 3 \* FILE. Format 3* FILE indicates that syntax element FILE repeats. Format 3* \* FILE indicates that syntax element \* FILE repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol to provide information about the syntax elements. For example, the lines 5.1*, 5.1 LASTRUN, and 5.1 DELETE mean that if you use more than one of the LASTRUN and DELETE syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the % symbol, it indicates a reference that is defined elsewhere. The string that follows the % symbol is the name of a syntax fragment rather than a literal. For example, the line 2.1 %OP1 means that you must refer to separate syntax fragment OP1.

The following symbols are used next to the dotted decimal numbers.

? indicates an optional syntax element
The question mark (?) symbol indicates an optional syntax element. A dotted decimal number followed by the question mark symbol (?) indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element, (for example 5? NOTIFY). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you know that the syntax elements NOTIFY and UPDATE are optional. That is, you can choose one or none of them.

The ? symbol is equivalent to a bypass line in a railroad diagram.

! indicates a default syntax element
The exclamation mark (!) symbol indicates a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicate that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the dotted decimal number can specify the ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and 2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword. In the example, if you include the FILE keyword, but do not specify an option, the default option KEEP is applied. A default option also applies to the next higher dotted decimal number. In this example, if the FILE keyword is omitted, the default FILE (KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1! (KEEP), and 2.1.1 (DELETE), the default option KEEP applies only to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.

* indicates an optional syntax element that is repeatable
The asterisk or glyph (*) symbol indicates a syntax element that can be repeated zero or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data area, you know that you can include one data area, more than one data area, or no data area. If you hear the lines 3*, 3 HOST, 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

Notes:
1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you can write HOST STATE, but you cannot write HOST HOST.
3. The symbol is equivalent to a loopback line in a railroad syntax diagram.

**+ indicates a syntax element that must be included**

The plus (+) symbol indicates a syntax element that must be included at least once. A dotted decimal number followed by the + symbol indicates that the syntax element must be included one or more times. That is, it must be included at least once and can be repeated. For example, if you hear the line 6.1+ data area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. Similar to the symbol, the + symbol can repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the symbol, is equivalent to a loopback line in a railroad syntax diagram.
Notices

This information was developed for products and services that are offered in the USA or elsewhere.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not grant you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive, MD-NC119
Armonk, NY 10504-1785
United States of America

For license inquiries regarding double-byte character set (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

Intellectual Property Licensing
Legal and Intellectual Property Law
IBM Japan Ltd.
19-21, Nihonbashi-Hakozakicho, Chuo-ku
Tokyo 103-8510, Japan

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law: INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

This information could include missing, incorrect, or broken hyperlinks. Hyperlinks are maintained in only the HTML plug-in output for the Knowledge Centers. Use of hyperlinks in other output formats of this information is at your own risk.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

IBM Corporation
Site Counsel
2455 South Road
Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this document and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement or any equivalent agreement between us.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

All statements regarding IBM’s future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs. The sample programs are provided "AS IS", without warranty of any kind. IBM shall not be liable for any damages arising out of your use of the sample programs.

Terms and conditions for product documentation

Permissions for the use of these publications are granted subject to the following terms and conditions.

Applicability

These terms and conditions are in addition to any terms of use for the IBM website.

Personal use

You may reproduce these publications for your personal, noncommercial use provided that all proprietary notices are preserved. You may not distribute, display or make derivative work of these publications, or any portion thereof, without the express consent of IBM.

Commercial use

You may reproduce, distribute and display these publications solely within your enterprise provided that all proprietary notices are preserved. You may not make derivative works of these publications, or
reproduce, distribute or display these publications or any portion thereof outside your enterprise, without
the express consent of IBM.

Rights

Except as expressly granted in this permission, no other permissions, licenses or rights are granted, either
express or implied, to the publications or any information, data, software or other intellectual property
contained therein.

IBM reserves the right to withdraw the permissions granted herein whenever, in its discretion, the use of
the publications is detrimental to its interest or, as determined by IBM, the above instructions are not
being properly followed.

You may not download, export or re-export this information except in full compliance with all applicable
laws and regulations, including all United States export laws and regulations.

IBM MAKES NO GUARANTEE ABOUT THE CONTENT OF THESE PUBLICATIONS. THE PUBLICATIONS ARE
PROVIDED "AS-IS" AND WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED,
INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT,
AND FITNESS FOR A PARTICULAR PURPOSE.

IBM Online Privacy Statement

IBM Software products, including software as a service solutions, ("Software Offerings") may use cookies
or other technologies to collect product usage information, to help improve the end user experience, to
tailor interactions with the end user, or for other purposes. In many cases no personally identifiable
information is collected by the Software Offerings. Some of our Software Offerings can help enable you to
collect personally identifiable information. If this Software Offering uses cookies to collect personally
identifiable information, specific information about this offering's use of cookies is set forth below.

Depending upon the configurations deployed, this Software Offering may use session cookies that collect
each user's name, email address, phone number, or other personally identifiable information for purposes
of enhanced user usability and single sign-on configuration. These cookies can be disabled, but disabling
them will also eliminate the functionality they enable.

If the configurations deployed for this Software Offering provide you as customer the ability to collect
personally identifiable information from end users via cookies and other technologies, you should seek
your own legal advice about any laws applicable to such data collection, including any requirements for
notice and consent.

For more information about the use of various technologies, including cookies, for these purposes, see
IBM's Privacy Policy at ibm.com/privacy and IBM’s Online Privacy Statement at ibm.com/privacy/details in
the section entitled “Cookies, Web Beacons and Other Technologies,” and the “IBM Software Products
and Software-as-a-Service Privacy Statement” at ibm.com/software/info/product-privacy.

Policy for unsupported hardware

Various z/OS elements, such as DFSMS, JES2, JES3, and MVS, contain code that supports specific
hardware servers or devices. In some cases, this device-related element support remains in the product
even after the hardware devices pass their announced End of Service date. z/OS may continue to service
element code; however, it will not provide service related to unsupported hardware devices. Software
problems related to these devices will not be accepted for service, and current service activity will cease if
a problem is determined to be associated with out-of-support devices. In such cases, fixes will not be
issued.
Minimum supported hardware

The minimum supported hardware for z/OS releases identified in z/OS announcements can subsequently change when service for particular servers or devices is withdrawn. Likewise, the levels of other software products supported on a particular release of z/OS are subject to the service support lifecycle of those products. Therefore, z/OS and its product publications (for example, panels, samples, messages, and product documentation) can include references to hardware and software that is no longer supported.

- For information about software support lifecycle, see: IBM Lifecycle Support for z/OS (www.ibm.com/software/support/systemsz/lifecycle)
- For information about currently-supported IBM hardware, contact your IBM representative.

Programming Interface Information

This information, z/OS Distributed File Service zFS Administration, primarily documents information that is NOT intended to be used as Programming Interfaces of the Distributed File Service.

z/OS Distributed File Service zFS Administration also documents intended Programming Interfaces that allow the customer to write programs to obtain the services of the Distributed File Service. This information is identified where it occurs by an introductory statement to a chapter or section or by the following marking.

--- NOT Programming Interface information ---
--- End of NOT Programming Interface information ---

Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the Web at Copyright and Trademark information (www.ibm.com/legal/copytrade.shtml).

UNIX is a registered trademark of The Open Group in the United States and other countries.
This glossary includes terms and definitions for Distributed File Service z/OS File System. The following cross-references are used in this glossary:

1. See refers the reader from a term to a preferred synonym, or from an acronym or abbreviation to the defined full form.
2. See also refers the reader to a related or contrasting term.

**aggregate**
A structured collection of data objects that form a data type.

**attach**
In z/OS, to create a task that can execute concurrently with the attaching code.

**audit identifier**
In zFS, a 16-byte value associated with each z/OS UNIX file or directory that provides identity in an SMF audit record or in certain authorization failure messages.

**bitmap**
In zFS, a file listing the blocks that are free on disk. The file size is dependent on the size of the aggregate.

**catch-up mount**
A local mount that z/OS UNIX automatically issues to every other system’s physical file system that is running sysplex-aware for that mode (read-write or read-only) when a sysplex-aware file system mount is successful on a system in a shared file system environment.

**compatibility mode aggregate**
A Virtual Storage Access Method linear data set (VSAM LDS) that contains a single read-write zFS file system.

**DFS**
See Distributed File Service.

**Distributed File Service (DFS)**
A base element of z/OS that allows users to access and share data in a distributed environment across a wide range of IBM and non-IBM platforms.

**EAV**
See extended address volume.

**extended address volume (EAV)**
DASD storage that can contain more than 65,521 cylinders per volume.

**file handle**
A number that is used by the client and server sides of the Network File System (NFS) or the Server Message Block (SMB) to specify a particular file or prefix.

**file system owner**
In z/OS, the system that coordinates sysplex activity for a particular file system.

**function shipping**
The process of requesting function from to the owning file system and returning the response to the requester through XCF communications.

**global resource serialization**
A component of z/OS that serializes the use of system resources and converts hardware reserves on direct access storage device (DASD) volumes to data set enqueues.

**global resource serialization complex**
A group of systems that use global resource serialization to serialize access to shared resources such as data sets on shared direct access storage device (DASD) volumes.

**hang**
To become unresponsive to user commands and to stop or appear to stop processing.
i-node  
The internal structure that describes the individual files in the UNIX file system. An i-node contains the node, type, owner, and location of a file.

local mount  
A mount that is known to the physical file system.

metadata  
Data that describes the characteristics of data; descriptive data.

non-sysplex aware  
A mounted file system that has file requests handled by remotely function shipping requests through z/OS UNIX.

root file system  
The basic file system onto which all other file systems can be mounted. The root file system contains the operating system files that run the rest of the system.

thrashing  
A condition, caused by a high level of memory over-commitment, in which the system is spending all of its time writing out virtual-memory pages and reading them back in. The application programs make no progress because their pages don't stay in memory long enough to be used. Memory load control is intended to avoid or stop thrashing.

salvager  
In zFS, a program that examines a zFS aggregate to determine if there are any inconsistencies in the structure of the aggregate.

Server Message Block (SMB)  
A protocol that manages requests and responses in a client/server environment so that clients on a network can share files, directories, and devices.

SMB  
See Server Message Block.

sysplex  
A set of z/OS systems that communicate with each other through certain multisystem hardware components and software services.

sysplex-aware  
A mounted file system that has file requests handled locally instead of function shipping requests through z/OS UNIX.

version file system  
See root file system.

zFS  
See z/OS file system.

zFS aggregate  
A Virtual Storage Access Method Linear Data Set (VSAM LDS) that contains a zFS file system.

z/OS File System (zFS)  
A type of file system that resides in a Virtual Storage Access Method (VSAM) linear data set (LDS) and has a hierarchical organization of files and directories with a root directory.
Index

Special Characters
\ (backslash) xiii
# (pound sign) xiii

A
abort command 92, 100
accessibility
  contact IBM 465
  features 465
ACL (access control lists) 3
active file system 20
active increase 40
address space
  determining usage 81
  OMVS 6
  zFS 6
aggregate
  adding volumes 29
  back up 59
  converting
    from v4 to v5 25
    to version 1.5 24
  copying files and directories to a larger data set 30
  corruption 92
  creating
    version 1.5 23
  decreasing size of 39
  determining state 98
  diagnosing disabled 101
  handling disabled 101
  increasing size of 29
  movement 4
  restore 60
  version 1.5 23
AGGRFULL
  MOUNT 140
AGGROW
  MOUNT 141
allocation
  blocked 44
  fragmented 44
  inline 44
anode 124
APARS 14
application programming interface (API)
  File Snapshot 261
application programming interface (API)
  Attach Aggregate 246
  BPX1PCT (pfsctl) 239, 240
  Change Aggregate Attributes 249
  Define Aggregate 252, 256
  Encrypt (decrypt, compress, or decompress) aggregate 258
  Format Aggregate 266
  Grow Aggregate 270
application programming interface (API) (continued)
  List Aggregate Status (Version 1) 273
  List Aggregate Status (Version 2) 276
  List Attached Aggregate Names (Version 1) 283
  List Attached Aggregate Names (Version 2) 286
  List Detailed File System Information 290
  List File Information 304
  List File System Names (Version 1) 312
  List File System Names (Version 2) 316
  List File System Status 320
  List Systems 328
  Query Config Option 331
  Quiesce Aggregate 336
  Reset Backup Flag 338
  Salvage Aggregate 341
  Set Auditfid 343
  Set Config Option 346
  Shrink Aggregate 349
  Statistics Compression Information 352
  Statistics Directory Cache Information 356
  Statistics Iobaggr Information 360
  Statistics Iobyasds Information 367
  Statistics Iocounts Information 373
  Statistics Kernel Information 379
  Statistics Locking Information 385
  Statistics Log Cache Information 393
  Statistics Metadata Cache Information 402
  Statistics Server Token Management Information 408
  Statistics Storage Information 413
  Statistics Sysplex Client Operations Information 423
  Statistics Sysplex Owner Operations Information 429
  Statistics Transaction Cache Information 435
  Statistics User Cache Information 439
  Statistics Vnode Cache Information 449
  Unquiesce Aggregate 457
applying required 14
ASID, determining 97
assistive technologies 465
attach
definition of 4
Attach Aggregate
  examples 247
attributes, changing 41
auditfid
  converting 104
  function 103
  set subcommand 343
auditid
  contents 104
  enabling 104
  overview 103

B
back up
  how to 59
  restore 60
back up (continued)
using DFSMSdss logical dump 59
zFS aggregate 60
backup change activity flag 61
balancing I/O 67
blocked file allocation 44
BPX1PCT (pfscnt) 239, 240
bpxmtext 117

C

cache
debugging 81
log file 67
metadata 66
user file 66
vnode 66
cache report
VM 86
cache size
IOEFSPRM 66
storage shortage 100
total 66
cache space 86, 439
catch-up mount
definition of 4
Change Aggregate Attributes
set subcommand 249
checking zFS storage 81
command suite, zfsadm 143
commands
bpxmtext 117
ioeagfmt 118
ioeaslv 122
ioefsutil converttov4 128
ioefsutil converttov5 130
ioefsutil format 132
ioefsutil salvage 136
man 117
MODIFY ZFS PROCESS 108
mount 23
MOUNT 140
SETOMVS RESET 115
z/OS system 107
zfsadm 152
zfsadm aggrinfo 26, 147
zfsadm apropos 150
zfsadm chaggr 155
zfsadm compress 158
zfsadm config 160
zfsadm configquery 165
zfsadm convert 169
zfsadm decompress 172
zfsadm decrypt 174
zfsadm define 176
zfsadm delete 179
zfsadm detach 181
zfsadm encrypt 183
zfsadm fileinfo 186
zfsadm format 192
zfsadm fsinfo 195
zfsadm grow 26, 205
zfsadm help 206
zfsadm lsaggr 208
commands (continued)
zfsadm lsfs 210
zfsadm lssys 212
zfsadm query 213
zfsadm quiesce 216
zfsadm salvage 220
zfsadm setauditfid 218
zfsadm shrink 222
zfsadm unquiesce 225
compatibility mode aggregate
adding volumes 29
changing attributes 41
creating 27
decreasing size of 39
deleting 41
disabled 101
dynamically growing 26
growing 26
increasing size of 29
renaming 40
size 47
compatibility mode file system
maximum size 47
minimum size 46
mounting 23
compressing
existing file system data 37
compressing file system data 32
concepts 4
configuring
zFS (z/OS File System) 11
contact
z/OS 465
contention, lock 79
conversion 25
converting auditfids 104
CONVERTTOV5
MOUNT 141
copying
using an intermediate archive file 64
without using an intermediate archive file 64
correction, namespace 95
creating
compatibility mode aggregate 21
compatibility mode file system 21
zFS file system 21
creating an encrypted zFS file system 34
CTKC report 69

D
data sets
IOEFSPRM 227
data space 86, 439
DATASET report 70
debugging
storage 81
storage shortage 100
Define Aggregate
examples 253, 256
definitions
anode 124
attach 4
catch-up mount 4
definitions (continued)
file system ownership 4
function shipping 5
local mount 5
non-sysplex aware 5
OMVS address space
definition 6
read-only file system 6
read-write file system 6
shared file system environment 6
sysplex 6
sysplex-aware 6
sysplex-aware file system 6
sysplex-aware PFS 6
z/OS UNIX file system owner 5
zFS address space 6
zFS aggregate 6
zFS file system owner 4
zFS physical file system 7
ZFS PROC 7
delays
in a shared file system environment 96
troubleshooting 95
Detach Aggregate 256
DFS information
references xiv
dfs_cphiles program 12
DFSMSdss logical dump
using for backup 59
directory
creating 13
determining size 48
extended (v5) 23
size 47
directory space
how to reclaim 48
disabled aggregates
compatibility mode aggregate 101
handling 101
disk space allocation
understanding 43
dumps
obtaining 93
understanding 93
dynamic movement 54
dynamically growing compatibility mode aggregates 26
examples (continued)
backing up zFS aggregates 60
Change Aggregate Attributes 251
creating compatibility mode file system 21
Define Aggregate 253
detach aggregate 256
encrypt (decrypt, compress, or decompress) aggregate 259
File Snapshot 262
Format Aggregate 267
Grow Aggregate 271
ioeagfmt 120
ioeagslv command 126
IOEFSPRM sample file 237
ioefsutl converttov4 129
ioefsutl converttov5 131
ioefsutl format 134
ioefsutl salvage 138
List Aggregate Status (Version 1) 274
List Aggregate Status (Version 2) 278
List Attacked Aggregate Names (Version 1) 284
list attached aggregate names (version 2) 287
List File Information 307
List File System Names (Version 1) 313
List File System Names (Version 2) 317
List File System Status 322
List Systems 328
logical restore 61
MODIFY ZFS FSINFO 114
MODIFY ZFS PROCESS 113
Query Config Option 331
Quiesce Aggregate 336
replace 61
Reset Backup Flag 339
restore 60
Salvage Aggregate 342
salvager utility 138
Set Auditfid 344
Set Config Option 347
SETOMVS RESET 115
Shrink Aggregate 350
Statistics Compression 353
Statistics Directory Cache Information 357
Statistics Iobyaggr Information 361
Statistics Iobydasd Information 368
Statistics Iocounts Information 374
Statistics Kernel Information 380
Statistics Locking Information 387
Statistics Log Cache Information 395
Statistics Metadata Cache Information 403
Statistics Server Token Management Information 409
Statistics Storage Information 415
Statistics Sysplex Owner Operations Information
examples 431
Statistics Transaction Cache Information 436
Statistics User Cache Information 441
Statistics Vnode Cache Information 451
Unquiesce Aggregate 457
zFS aggregate restore 60
zfsadm aggrinfo command 148
zfsadm apropos command 151
zfsadm attach command 153
zfsadm chaggr command 156
zfsadm compress command 159

E
encrypt (decrypt, compress, or decompress) aggregate 258
Encrypt (decrypt, compress, or decompress) aggregate examples 259
encrypting file system data
defining new file systems 37
displaying status 36, 38
existing 35, 37
formatting an encryption-eligible VSAM data set 34
monitoring status 36, 38
new file system that’s always encrypted on DASD 33
process 33, 36
ENQs, displaying 95
examples
Attach Aggregate 247
examples (continued)
- `zfsadm config` command 163
- `zfsadm configquery` command 168
- `zfsadm convert` command 170
- `zfsadm decompress` command 173
- `zfsadm decrypt` command 175
- `zfsadm define` command 178
- `zfsadm delete` command 180
- `zfsadm detach` command 182
- `zfsadm encrypt` command 184
- `zfsadm fileinfo` command 190
- `zfsadm format` command 194
- `zfsadm grow` command 202
- `zfsadm help` command 207
- `zfsadm lsaggr` command 209
- `zfsadm lsfs` command 211
- `zfsadm lslysys` command 212
- `zfsadm query` command 215
- `zfsadm quiesce` command 217
- `zfsadm salvage` command 221
- `zfsadm setauditfid` command 219
- `zfsadm shrink` command 224
- `zfsadm unquiesce` command 226

Explanation of 42
- extended (v5) aggregate
  - converting to version 1.5 24
- extended (v5) directories 23
- extended director XCF communications protocol 94

F

Fast Response Cache Accelerator restriction 14
- features
  - zFS 3
  - feedback xv
- file allocation
  - blocked 44
  - fragmented 44
  - inline 44
- FILE report 71
- File Snapshot
  - examples 262
- file system
  - active 20
  - corruption 92
  - definition of zFS file system 7
  - determining owner 52
  - dynamic movement 54
  - maximum size 46
  - minimum size 46
  - ownership 52, 53
  - read-/write with different levels of sysplex-awareness 50
  - read-only sysplex-aware 49
  - status 20
  - sysplex-aware 6
  - z/OS UNIX owner 53
- file system information
  - displaying 114
  - usage notes for displaying 112
- file system owner
  - z/OS UNIX 51
  - zFS 51
- file system ownership
  - definition of 4
- files
  - IOEFSprm 227
  - fixed storage 67
  - Format Aggregate
    - example 267
  - fragmented file allocation 44
  - FSFULL
    - MOUNT 141
  - function shipping
    - definition of 5

G

Grow Aggregate
- examples 271
- guidelines for v4 to v5 conversion 25

H

hang detector 95
  - hangs
    - in a shared file system environment 96
    - steps for resolving 96
    - troubleshooting 95
  - HFS to zFS migration tool
    - using the 63

I

I/O
  - balancing 67
  - statistics 72
- initialization messages, saving in a data set 94
- inline file allocation 44
- installing
  - zFS (z/OS File System) 11
  - intermediate archive file 64
  - internal restart 92, 100
  - IOBYDASD
    - related subcommand 367
    - report 72
- ioeagfmt
  - creating a compatability mode aggregate 21
- ioeagslv
  - example 126
  - understanding the utility 92
- IOEFSprm
  - example 237
  - processing options 228
  - sharing 56
  - total cache size 66
- ioefsutl converttov4
  - example 129
- ioefsutl converttov5
  - example 131
- ioefsutl format
  - example 134
- ioefsutl salvage
  - command 136
  - example 138
  - understanding the utility 92
PFS (physical file system) (continued)
  sysplex-aware 6
  pfsctl (BPX1PCT) 239, 240
Policy Agent Server (Pagent) restriction 14
post installation processing 11

Q
Query Config Option
  examples 331
QUERY,KN report 72
QUERY,STOR report 81
Quiesce Aggregate
  examples 336
quota 22

R
read-only file system
definition of 6
read/write file system
definition of 6
reason codes, using bpXmtext 117
Reset Backup Flag
  examples 339
resetting performance data 69
restart 3
restart, internal 100
restore
  from back up 60, 61
root, large directory 48
running in 16
RWSHARE
  MOUNT 141
  zfsadm config 162

S
Salvage Aggregate
  examples 342
salvager
  definition of 122
salvager utility
  understanding the 92
scrubbing unused areas in file system 184
security label 3
sending to IBM
  reader comments xv
service level, determining 94
Set Auditfid
  examples 344
Set Config Option
  examples 347
SETOMVS RESET command
  examples 115
shared file system
  overview 49
shared file system environment
  definition of 6
  hangs and delays 96
  z/OS UNIX consideration 55
sharing zfs data between systems 46
shortcut keys 465
Shrink Aggregate
  examples 350
SMB
  effect on user file cache hit ratio 67
  restriction 14
  running dfs_cpfiles program 12
SMF record
  auditid 103
source file 64
Statistics Compression
  examples 353
Statistics Compression Information 352
Statistics Directory Cache Information
  examples 357
Statistics Iobyaqgr Information
  examples 361
Statistics Iobydadasd Information
  examples 368
Statistics Iocounts Information
  examples 374
Statistics Iocounts Information (64-bit mode)
  examples 461
Statistics Kernel Information
  examples 380
Statistics Locking Information
  examples 387
Statistics Log Cache Information
  examples 395
Statistics Metadata Cache Information
  examples 395
Statistics Server Token Management Information 408
Statistics Server Token Management Information
  examples 409
Statistics Storage Information
  examples 415
Statistics Sysplex Client Operations Information
  examples 424
Statistics Sysplex Owner Operations Information 429
Statistics Transaction Cache Information
  examples 436
Statistics User Cache Information
  examples 441
Statistics Vnode Cache Information
  examples 451
STKM report 80
STOR report 81
storage
  shortage 100
striped VSAM linear data set 23
summary of changes
  zFS
    V2R2 xx
    V2R3 xvi
Summary of changes xxii
SVI report 85
sysplex
  considerations 49
  definition of 6
  z/OS UNIX consideration 55
sysplex-aware
  changing, of a mounted zFS read/write file system 16
  definition of 6
  file system 6, 49
sysplex-aware (continued)
   file system, with different levels of sysplex-awareness
50
overview 49
PFS 6
   specifying 14
using read/write 15
zFS-enhanced 51
system commands
   MODIFY ZFS PROCESS 108
   SETOMVS RESET 115
system management facilities (SMF)
   obtaining data 89
   record type 92 89
SYSZIOEZ 95

T
   terminology 4
   thrashing
      definition of 81
   token manager statistics 80
   total cache size 66
   trace options 91
   tracing zFS
      steps for 91
   trademarks 472
   TYPE
      MOUNT 140
   type 30 SMF record
      support for 46
   typographic conventions xiii

U
   unquiesce
      operator command 112
   Unquiesce Aggregate
      examples 457
   user file cache 66
   user interface
      ISPF 465
      TSO/E 465

V
   v4 directory
      considerations 48
      converting to extended (v5) 25
   v5 directory
      converting from v4 25
   valid characters in aggregate name 118
   version 1.4 aggregates
      maximum size 47
   version 1.5 aggregates
      creating 23
      maximum size 47
   VM cache report 86
   vnode cache 66
   volume
      adding to an aggregate 29
   VSAM linear data set
      formatting 118

VSAM linear data set (continued)
   restriction 6
   striped 23

W
   what's new in V2R1 8
   what's new in V2R2 7
   what's new in V2R3 7

X
   XCF protocol interface level, determining 94

Z
   z/OS
      system commands 107
   UNIX commands
      pax 63
   z/OS UNIX address space 16
   z/OS UNIX file system owner
      definition of 5
   z/OS UNIX owner 53
   zFS
      summary of changes for V2R2 xx
      summary of changes for V2R3 xvi
   zFS (z/OS file system)
      determining status 20
   zFS (z/OS File System)
      back up 59
      disk space allocation 44
      installing 11
      managing processes 19
      overview 3
      starting 19
      stopping 19
   zFS address space
      definition of 6
   zFS aggregate
      backing up 60
      definition of 6, 195
   zFS file system
      definition of 7
   zFS file system owner
      definition of 4
   zFS file systems
      creating 21
      managing 21
      specifying as sysplex-aware 14
      unmounting 42
   ZFS PROC
      definition of 7
   zFS QUERY reports
      list of sample reports 69
   zFS reason codes 117
   zfsadm aggrinfo command
      example 148
   zfsadm apropos command
      example 151
   zfsadm attach command
      example 153
   zfsadm chaggr 155
zfsadm chaggr command
  example 156
zfsadm commands 143
zfsadm compress 158
zfsadm compress command
  example 159
zfsadm config command
  example 163
zfsadm configquery command
  example 168
zfsadm convert command
  example 170
zfsadm decompress 172
zfsadm decompress command
  example 173
zfsadm decrypt 174
zfsadm decrypt command
  example 175
zfsadm define command
  example 178
zfsadm delete command
  example 180
zfsadm detach command
  example 182
zfsadm encrypt 183
zfsadm encrypt command
  example 184
zfsadm fileinfo command
  example 190
zfsadm format command
  example 194
zfsadm fsinfo command
  example 202
zfsadm grow command
  example 206
zfsadm help command
  example 207
zfsadm lsaggr command
  example 209
zfsadm lsfs command
  example 211
zfsadm lssys command
  example 212
zfsadm query command
  example 215
zfsadm quiesce command
  example 217
zfsadm salvage 220
zfsadm salvage command
  example 221
zfsadm setauditfid command
  example 219
zfsadm shrink command
decreasing size of compatibility mode aggregates 39
  example 224
zfsadm unquiesce command
  example 226