Oracle Database 12c R1
Oracle Database 12c R1 RAC on IBM AIX

Tips and Considerations

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Abstract

This paper consolidates the information necessary for planning and implementing Oracle Database 12c Release 1 (12.1) single instance database or Oracle Database 12c Release 1 Real Application Cluster (RAC) on the IBM AIX® operating system.

This paper summarizes the information available at the time of publication. It will be updated as changes (eg. new certifications) occur. It is meant to be used only as a guide. For any official Oracle certification information, please consult Oracle’s “My Oracle Support” website.

This paper is written to a level of detail that assumes readers have an in-depth knowledge of Oracle Database 11g R2 and Oracle RAC 11g R2 on IBM AIX: Tips and Considerations.

Introduction

There are many technical topics to consider when running Oracle Database 12c Release 1 and Oracle Database 12c Release 1 RAC on AIX such as: status of Oracle certifications, 12c Release 1 patch sets, AIX code levels, tuning and related software components - just to name a few. The documentation for these topics is spread across many websites, documents, presentations and forums. This paper consolidates that information for easy reference.

This paper focuses on AIX 6.1 and AIX 7.1, since these are the AIX versions supported for Oracle Database 12c Release 1 (Stand alone) and Oracle Database 12c Release 1 RAC.

This is a companion paper to three other papers.

- For 9i and 10gR1, Oracle 9i & 10gR1 on IBM AIX5L: Tips and Considerations, http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100556
- For 10gR2, Oracle Database 10gR2 and Oracle RAC 10gR2 on IBM AIX: Tips and Considerations, http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101089
- For 11g, Oracle Database 11g R2 and Oracle RAC 11g R2 on IBM AIX: Tips and Considerations, http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101176

The IBM Oracle International Competency Center (ICC) works closely with the IBM Oracle Center (IOC) in Montpellier, France and the IBM Oracle Competency Center in Tokyo, Japan.

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Note: Some of the “My Oracle Support” notes and web links referenced in this document for Oracle Database 12c Release 1 on IBM Power Systems/AIX are still being updated to reflect the up-to-date information.

For question or feedback, please send a note to the IBM Oracle International Competency Center at ibmoracle@us.ibm.com.
Terminology

In 2008, the System p™ and System i™ product families were combined to create the IBM Power™ Systems product family. The IBM Power Systems product family includes systems previously referred to as System p, System p5™, eServer™ pSeries®, RS6000®, System i™, System i5™, eServer iSeries®, AS/400®, Flex System, IBM PureFlex and IBM PureSystems.

The brand name of “AIX 5L™” is no longer used. The term “AIX 5L” will still appear in some places in this document, mostly in document titles which have yet to be updated.

High Availability Cluster Multi-Processing (HACMP™) has been renamed to the PowerHA™ and PowerHA SystemMirror. This version of the document will use the name HACMP for version up to 5.4.1, PowerHA for version 5.5 and PowerHA SystemMirror for the version 6.1 and up.

IBM AIX

IBM AIX is an open standards-based, UNIX operating system. AIX in combination with IBM’s virtualization offerings provides new levels of flexibility and performance to allow you to consolidate workloads on fewer servers, which can increase efficiency and conserve energy. AIX delivers high levels of security, integration, flexibility, scalability and reliability—essential for meeting the demands of today’s information technology environments. AIX operates on IBM Systems based on Power Architecture technology. For more information about AIX, see this web page: http://www-03.ibm.com/systems/power/software/aix/

IBM and Oracle are advancing to focus on supporting AIX6.1 and AIX7.1 for Oracle Database 12c Release 1.

IBM’s latest version of AIX is 7.1. It contains new features for virtualization, security, availability and manageability. AIX 7.1 is binary compatible with AIX 6.1 and AIX 5.x. AIX 7.1 includes supporting high-end POWER7 server with 256 CPUs, which can provide up to 1024 logical processors with use of SMT 4.

For additional information about AIX 7.1, visit this web page:

http://www-03.ibm.com/systems/power/software/aix/v71/index.html

Most of the new features of AIX 7.1 are available on earlier POWER™ platforms. However, the best capabilities are delivered on systems based on POWER6™, POWER7™ and POWER7+™ processors. POWER7 and later processors built for Smarter Planet and automatically optimize workload performance and capacity. New intelligent threads technology in POWER7 and POWER7+ dynamically switches the processor threading mode to deliver optimal performance—either the highest per-thread performance or the maximum system throughput based on application requirements.

POWER7+ Hardware Accelerator improves the efficiency of memory expansion even more effectively allowing more memory expansion.

The POWER6 processor has ultra high-frequency dual-core processor technology and two integrated hardware accelerators. POWER7 and later processors built for Smarter Planet and automatically optimize workload performance and capacity. For information about the POWER7 and POWER6 processors, see this web page:

http://www-03.ibm.com/systems/power/advantages/power.html.
On April 11, 2012 IBM has introduced a new Hardware product called Flex System, which is an expert integrated system where servers (POWER7, POWER7+ and/or x86), networking, SAN, virtualization, enterprise storage (Flex System components) are combined and installed in an Enterprise Chassis. The chassis and its components are managed by unified management software called Flex System Manager (FSM).

The binary compatibility of IBM Flex System and AIX 6.1 and 7.1 was verified and the interoperability of Flex System components with AIX 6.1/7.1, PowerVM features and Oracle Database 12c Release 1 RAC was successfully verified.

For more information on IBM Flex System, refer the following web link,
http://www-03.ibm.com/systems/flex/index.html

The following web link has additional information of AIX versions and their Technology Levels (TL) supported on Power System servers.

IBM AIX “From Strength to Strength – A summary of upgrade benefits for each release of AIX”

Large IBM Power Systems POWER7 server can have up to 256 cores and supports up to 1024 logical processors.
Power Systems with POWER7 and later processors requires minimum level of IBM SDK as specified in the following link

IBM also produces benchmark reports that demonstrate the performance results of Power Systems running AIX. These benchmarks are run using Oracle E-Business Suite, yet they provide valuable data about Oracle Database and Oracle RAC. The benchmark results are published at

IBM will also provide sizing estimations to help predict the system resources necessary to support a given workload. To start the sizing process, visit this web page, http://www.ibm.com/erp/sizing.

Additional documentation resources for AIX can be found at:

- IBM Power Systems and AIX Information Center,
- IBM developerWorks AIX,
  https://www.ibm.com/developerworks/aix/
- IBM AIX Wiki,
  http://www-941.ibm.com/collaboration/wiki/display/WikiPtype/Home

**AIX support**

The latest fixes and updates for your system’s hardware and operating system can be found at the Fix Central web page:  https://www-933.ibm.com/support/fixcentral/.

Be sure to review My Oracle Support note 282036.1, “Minimum Software Versions and Patches Required to Support Oracle Products on IBM pSeries”, for the latest, up-to-date issues regarding AIX and Oracle
Database. This My Oracle Support note is the primary mechanism used to broadcast any breaking news, such as PTF's or bug fixes, about AIX and Oracle Database.

In general, the ICC recommends that you keep your TL’s and SP’s up to date for your AIX installation. Monitor My Oracle Support note 282036.1 and Fix Central for the latest issues. Always perform thorough testing on an OS update before deploying to production.

**Oracle Database 12c Release 1 software Online Patching (Hot Patching) on AIX 6.1 and AIX 7.1**

From Oracle Database 11g Release 2, Oracle introduced a new feature called “online patching” for some qualified interim Oracle DB patches. This “online patching” integrated with OPatch tool and provides the ability to patch the running processes of an Oracle instance without bringing down it. Each process associated with the Oracle instance checks for the patched code at a safe execution point, and then copies the code into its process space.

The “online patching” of Oracle Database 12c Release 1 is also available for AIX 6.1 TL07 SP03 with APAR IV16716 and AIX 7.1 TL01 SP03 with APAR IV16737.

For more detailed information on the “online patching” on AIX, refer the following flash document, http://w3-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102085

**Recommended Code Levels**

There are two tools to help determine the recommended code levels among AIX and Power Systems related components.

1. The Fix Level Recommendation Tool (FLRT) can determine the recommended code levels among a mixture of AIX, HMC, Server firmware, VIOS, GPFS™ and PowerHA®. The FLRT web page is: http://www14.software.ibm.com/webapp/set2/flrt/home. Note, the FLRT recommendation provides a minimum acceptable level of compatibility.

2. The POWER code matrix indicates the recommended code levels for the HMC and Server firmware. The POWER code matrix web page is: http://www14.software.ibm.com/webapp/set2/sas/f/power5cm/home.html. Note, the POWER code matrix recommendation provides the maximum stability code combinations.

**Service Strategy**


**C and C++ compilers**

XL C/C++ is a standards-based, high performance C and C++ compiler with advanced optimizing and debugging features. It gives you the ability to optimize and tune applications for optimal execution on systems using PowerPC®, POWER3™, POWER4™, POWER5™, POWER6™ and the latest POWER7™ processors from IBM. The compiler supports IBM Power Systems servers capable of running IBM AIX 5.2, 5.3, 6.1 and 7.1.
To determine the current certifications for compilers on 12c Release 1, please review My Oracle Support note 43208.1, “Certified Compilers”. Currently, XL C/C++ 11.1.0.4 and later are supported for Oracle Database 12c. If necessary, read My Oracle Support note 335569.1, “How to Find C or C++ version on AIX Platform” to determine your XL C/C++ compiler version.

The XL C/C++ runtime environment is installed during the installation of base AIX. To update to the latest runtime environment, go to the XL C/C++ web page, http://www-306.ibm.com/software/awdtools/xlcpp/features/aix/ and click on the “Latest XL C/C++ Updates (PTFs)” link. Then select the “Runtime Environment Components” in the AIX section.

If the XL C/C++ Enterprise Edition for AIX compiler is installed, to get the latest updates, visit the product's web page, http://www-306.ibm.com/software/awdtools/xlcpp/features/aix/ and click on the “Latest XL C/C++ Updates (PTFs)” link and select the appropriate link in the AIX section.

**Oracle Database 12c Release 1 (Non RAC)**

This section contains the Oracle Database 12c non-RAC technical information that needs to be considered in an AIX installation. Oracle 11g Release 2 introduced the Grid Infrastructure installation for both stand alone and Real Application Cluster (RAC) databases. In Oracle Database 12c Release 1, Grid Infrastructure is also an option which includes Automatic Storage Management (ASM) and Oracle Restart. Oracle Restart is a new feature that provides the ability to monitor, manage, and automatically restart the Oracle components, including the Oracle database Single Instance, Oracle Net Listener, database services and Oracle ASM.

Grid infrastructure is needed for the stand alone database server if the ASM is selected as a storage option for the database files.

These are the basic documents to refer for an Oracle Database 12c installation on AIX.

- My Oracle Support note 282036.1, “Minimum Software Versions and Patches Required to Support Oracle Products on IBM pSeries” for the latest, up-to-date issues regarding Oracle Database 12c Release 1 and AIX.

**Current certifications**

To determine the current certifications for Oracle Database 12c Release 1 on AIX,

- Sign into Oracle’s My Oracle Support website (UserID/Password is required ) at https://support.oracle.com/CSP/ui/flash.html and click on “Certifications” tab, look for “Certification Search” section. In the “Product” field, type “Oracle Database”, the second field is “Release”. Select one of them from the list. It has the release 12.1.0.1.0. next field is “Platform”, select “IBM AIX on POWER Systems (64-bit) 7.1” or “IBM AIX on POWER Systems (64-bit) 6.1. Then click “Search” but-

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IBM and Oracle recommend using the following versions of the AIX to minimize the number of AIX patches for Oracle Database 12c Release 1.

<table>
<thead>
<tr>
<th>OS</th>
<th>Product</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIX 6.1 TL09 or later *</td>
<td>Oracle Database 12c Release 1 (64-bit)</td>
<td>Certified</td>
</tr>
<tr>
<td>AIX 7.1 TL03 or later *</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Oracle Database Enterprise Edition 12c Release 1 certifications of AIX as of publication date

* The minimum recommended AIX version which is supported to use with Oracle Database 12c Release 1 is AIX6.1 TL07 SP03 or AIX7.1 TL01 SP03.

The same certifications are in place for Standard Edition (SE) as Enterprise Edition (EE).

If you are using AIX 7.1 TL02 SP03 for Oracle 12c Database, obtain and apply the APARs IV48895 and IV48898.

The following table shows the APARs (column 1) which are shown in the output of Oracle 12c Grid Infrastructure’s “runcluvfy.sh” and “runInstaller” (OUI). The column 2 shows the APARs which are corresponding to the same APARs in column 1, but available and included as part of AIX7.1 TL02 SP03 except the APARs IV48895 and IV48898.

<table>
<thead>
<tr>
<th>Oracle GI / DB “runInstaller” Warning for AIX APARs</th>
<th>Fix included in AIX7.1 TL02 SP03</th>
<th>Description of the APAR</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV19836</td>
<td>IV38845</td>
<td>'ifconfig' MONITOR option stopped working</td>
<td></td>
</tr>
<tr>
<td>IV39136</td>
<td>IV40005</td>
<td>LINK FAILS WITH UNDOCUMENTED COMPILER FLAG AND THREAD-LOCAL STG</td>
<td></td>
</tr>
<tr>
<td>IV41415</td>
<td>IV39987</td>
<td>RUNTIME LINKING FAILED TO BIND THE BSS SYMBOL EXPORTED FROM MAIN</td>
<td></td>
</tr>
<tr>
<td>IV34869</td>
<td>IV30318</td>
<td>THREAD_CPUTIME() RETURNS INCORRECT VALUES</td>
<td></td>
</tr>
<tr>
<td>IV35057</td>
<td>IV30320</td>
<td>LOADING 5.3 TLS ENABLED LIBS BY 5.2 APPS CAUSED CORE DUMP IN 32B</td>
<td></td>
</tr>
<tr>
<td>IV21116</td>
<td>IV21878</td>
<td>SYSTEM HANGS OR CRASHES WHEN APP USES SHARED SYMTAB CAPABILITY</td>
<td></td>
</tr>
<tr>
<td>IV21235</td>
<td>IV19357</td>
<td>SYSTEM CRASH DUE TO FREED SOCKET WHEN SOCKET-ETPAIR() CALL USED APPLIES</td>
<td></td>
</tr>
<tr>
<td>IV16737</td>
<td>IV38857</td>
<td>JAVA WALN'T INSTANTIATE IF PROT_NONE USED FOR SHARED MMAP REGION</td>
<td></td>
</tr>
<tr>
<td>IV28925</td>
<td>IV27105</td>
<td>SHLAP PROCESS FAILS WHEN SHARED SYMBOL TABLE FEATURE IS USED</td>
<td></td>
</tr>
<tr>
<td>IV45072</td>
<td>Apply IV48895</td>
<td>A SPECIAL-PURPOSE LINKER FLAG WORKS INCORRECTLY</td>
<td>Get the Fix from IBM Support portal</td>
</tr>
<tr>
<td>IV45073</td>
<td>Apply IV48895</td>
<td>ADD ABILITY TO REORDER TOC SYMBOLS IN LIMITED CIRCUMSTANCES</td>
<td>Get the Fix from IBM Support portal</td>
</tr>
<tr>
<td>IV33857</td>
<td>N/A</td>
<td>NSLOOK SHOULD NOT MAKE REVERSE NAME RESOLUTION OF NAME SERVERS</td>
<td>IV33857 is specific to AIX7.1 in TL01 SP03, this is fixed in SP04 and later releases.</td>
</tr>
<tr>
<td>IV45070</td>
<td>N/A</td>
<td>NEW FUNCTION</td>
<td>Fix included in AIX7.1 TL03</td>
</tr>
<tr>
<td>IV51534</td>
<td>N/A</td>
<td>SUPPORT FOR FUTURE TL/SP - United States</td>
<td>Fix included in AIX7.1 TL03</td>
</tr>
<tr>
<td>IV30579</td>
<td>N/A</td>
<td>SUPPORT FOR FUTURE TL/SP - United States</td>
<td>This APAR warning shows in OUI of Oracle 12c Database, this fix is included in AIX7.1 TL03</td>
</tr>
</tbody>
</table>

Table 2: Warnings shown in Oracle 12c OUI of Grid Infrastructure and the fixes for AIX7.1 TL02 SP03
The AIX version AIX6.1 TL09 and later or AIX 7.1 TL03 and later includes all of the above APAR mentioned in the table 2.

Here are some certification details to be aware of:

- These products are certified for AIX 6.1 and 7.1 on all Power Systems servers supported by those versions of AIX.
- 64-bit hardware is required for a 64-bit application such as Oracle Database 12c for AIX.
- Servers capable of more than 4 processors are certified only for EE.
- Logical Partitioning (LPARs) and Micro-Partitioning™ are supported.
- Virtual IO Server (VIOS) is supported.

**Latest patch set**

At the time of publishing this document no patch set or patch(es) were available for Oracle Database 12c (12.1) on AIX. To find the documentation for the latest Oracle Database 12c Release 1 patch set, sign into Oracle’s My Oracle Support website at https://support.oracle.com/CSP/ui/flash.html. In the Quick Find pull down, specify “Document ID”. Then specify Document Number. As mentioned in the Current Certifications sub-section (see above) for Oracle Database 12c the Critical Patch Update schedule.

For more information about CPUs and watch for Critical Patch Updates at this site: http://www.oracle.com/technology/deploy/security/alerts.htm.

**Patch Set Update (PSU)**

Beginning with October 2009 Critical Patch Update release, Oracle delivers Patch Set Updates for all platforms on the release date. PSUs are proactive cumulative patches containing recommended bug fixes that are released on a regular and predictable schedule. PSUs are on the same quarterly schedules as the Critical Patch Update (CPU). PSUs consist of CPU, generic patch bundles, RAC patch bundle, and Data Guard patch bundles.

The Patch Set Update at the time of publication of this document was not available for IBM AIX.

Also refer the note 756671.1 for Oracle recommended patches for Oracle Database.

**Virtualization for Oracle Database 12c Release 1**

As mentioned in the Current Certifications sub-section (see above) for Oracle Database 12c Release 1, IBM PowerVM™ features such as LPARs, Micro-Partitioning and VIOS are supported. PowerVM is the
family of technologies, capabilities and offerings that deliver industry-leading virtualization on IBM POWER processor-based systems. The PowerVM capabilities supported in Oracle Database 12c Release 1 are:

- **Logical Partitions** subdivide a computer's processors, memory, and hardware resources into multiple environments so that each environment can be operated independently with its own operating system and applications.
  - Dedicated processor partitions are LPARs that use dedicated processors.
  - Dedicated processors are whole physical processors that are assigned to a single LPAR.
  - Shared Processor partitions are LPARs that use Micro-Partitioning in conjunction with a shared processor pool.
    - Micro-Partitioning divides a physical processor’s computing power into fractions of a processing unit and shares them among logical partitions. Processing capacity can be configured in fractions of 1/100 of a processor. The minimum amount of processing capacity that has to be assigned to a partition is 1/10 of a processor.
    - A shared processor pool is a group of physical processors that are not dedicated to any LPAR.
  - Virtual I/O Server allows sharing of physical resources between logical partitions (LPARs) including virtual SCSI and virtual networking. This allows more efficient utilization of physical resources through sharing between LPARs and facilitates server consolidation.

VIOS 2.2.2.3 and above is recommended with AIX 7.1 and AIX 6.1 for Oracle Database 12c R1.

With certified VIOS combinations customers may use virtual SCSI with or without “N Port ID virtualization (NPIV) to attach disk for data storage and associated voting files or OCR. This may be done for both ASM and GPFS.


These are some PowerVM features still being evaluated for support on Oracle Database 12c Release 1 stand-alone database.

- **Dynamic LPARs** (DLPAR) are a shared or dedicated LPAR to which changes can be made to the amount of processors, memory and virtual or physical adapters without requiring a reboot.
  - For dedicated processor partitions, it is only possible to dynamically add, move or remove whole processors. When a processor is removed from a dedicated processor partition, it is then assigned to the shared processor pool.
  - For a shared processor partition, it is also possible to dynamically change the shared processor capacity, the weight of the uncapped attribute, virtual processors and capped/uncapped mode.

- **Workload Partition** (WPAR) is a software-based virtualization feature. WPARs subdivide an AIX instance into multiple environments, each hosting applications and providing isolation from applications executing in other environments. **Live Application Mobility** allows you to relocate running WPARs from one LPAR to another. For more information on WPARs, see the *Introduction to Work-
Live Partition Mobility allows you to migrate running AIX and Linux LPARs and their hosted applications from one physical server to another without disrupting infrastructure services. The migration transfers the entire partition state, including the processor context, memory, attached virtual devices, and connected users. For more information on LPM, see the PowerVM Live Partition Mobility on IBM System p Redbook, http://www.redbooks.ibm.com/abstracts/sg247460.html?Open

Active Memory™ Expansion (AME)
AME is feature introduced in IBM AIX on IBM Power7 servers, a technology for expanding system’s effective memory capacity. It compresses in-memory data and allowing more data to be placed into memory. Utilizing AME can improve system utilization and increase overall workload’s throughput.

Customers should monitor the latest Oracle Certification information to be aware of the ongoing certification of new features.

For additional, detailed PowerVM information, see these documents and websites:
http://www.oracle.com/technetwork/database/virtualizationmatrix-172995.html

- PowerVM webpage,
  http://www-03.ibm.com/systems/power/software/virtualization/index.html
- PowerVM Virtualization on IBM System p: Introduction and Configuration Fourth Edition,
- IBM System p PowerVM Best Practices,

Oracle Database 12c Release 1 RAC

This section contains the Oracle Database 12c Release 1 RAC technical information that needs to be considered in an AIX installation. Starting with Oracle Database 11g Release 2, Oracle has packaged Oracle Clusterware, Automatic Storage Management and the listener as a single package called “Oracle Grid Infrastructure”. The following are the basic documents to review for an Oracle Database 12c Release 1 RAC installation on AIX.

- Oracle Grid Infrastructure Installation Guide 12c Release 1 (12.1) for IBM AIX Based Systems (64-bit) E38943-05 http://docs.oracle.com/cd/E16655_01/install.121/e38943/toc.htm
- My Oracle Support note 282036.1, “Minimum Software Versions and Patches Required to Support Oracle Products on IBM pSeries” for the latest, up-to-date issues regarding Oracle Database 12c and AIX.

Note, these documents apply equally well to AIX 6.1 and 7.1.
Consider the following additional requirement for a successful installation of Oracle 12c Grid infrastructure software.

- Install “bash” tool on all of the RAC nodes prior to Oracle GI installation.
  - bash-4.2-1  (This can be downloaded from the following link, http://www-03.ibm.com/systems/power/software/aix/linux/toolbox/date.html)
- For setting up “Pluggable Authentication Module (PAM)” in AIX environment, do the following steps.
  - To prevent denial of service attacks, Oracle recommends changing the default security resource limits.
    Edit the file “/etc/security/login.cfg” to change auth_type under the “usw” stanza from STD_AUTH to “PAM_AUTH”.
    Make sure the presence of the line “login session required pam_aix” in /etc/pam.conf file and add the following lines.

      ```
      sshd auth required pam_aix
      sshd account required pam_aix
      sshd password required pam_aix
      sshd session required pam_aix
      ```

    - Restart the “sshd”.
      ```
      # stopsrc -s sshd
      # startsrc -s sshd
      ```

### Current certifications

To determine the **current certifications** for Oracle Database 12c Release 1 RAC on AIX,

Sign into Oracle’s My Oracle Support website (UserID and Password required) at https://support.oracle.com/CSP/ui/flash.html and click on “Certifications” tab, look for “Certification Search” section. In the “Product” field, type “Oracle Real Application Clusters”, the second field is “Re-lease”. Select one of them from the list, 12.1.0.1.0, next field is “Platform”, select “IBM AIX on POWER Systems (64bit) 7.1”, it actually lists the AIX versions from 5.3 to 7.1. Choose one of them. Then click “Search” button. The search result will show the certification status in the link “See Certification Details for Notes and Support information” in the search result page.

This lists the information with Certification status for the above input.

The following table shows high level information on the certification of Oracle 12c R1 with AIX.

<table>
<thead>
<tr>
<th>OS</th>
<th>Product</th>
<th>Certified With</th>
<th>Version</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIX6.1 and 7.1</td>
<td>12cR1 64-bit</td>
<td>Oracle Clusterware</td>
<td>12c</td>
<td>Certified</td>
</tr>
<tr>
<td>AIX 6.1 and 7.1</td>
<td>12cR1 64-bit</td>
<td>PowerHA System Mirror</td>
<td>7.1</td>
<td>Certified *</td>
</tr>
</tbody>
</table>
AIX 6.1 and 7.1  12cR1 64-bit | IBM General Parallel File System (GPFS) | 3.5 | Certified

AIX 6.1 and 7.1  12cR1 64-bit | IBM General Parallel File System (GPFS) | 3.4 | Certified

Table 3: Oracle Database 12c Release 1 RAC certifications of AIX as of publication date.

* With the release of 12cR1 Oracle no longer certifies the use of raw logical volumes with the DB and RAC see My Oracle Support note “Announcement of De-Support of using RAW devices in Oracle Database Version 12.1” (Doc ID 578455.1). Oracle continues to support the coexistence of PowerHA with Oracle clusterware.

**Note:** IBM and Oracle recommend using AIX6.1 TL09 (or later) or AIX7.1 TL03 (or later) which have all the required OS patches.

Also, refer Table 2 for AIX patches if you are installing Oracle Database 12c RAC software on AIX 7.1 TL02 SP03.

Here are some certification details to be aware of:

- The products mentioned in the above table (table 3) are certified with AIX 6.1 and 7.1 on all Power Systems servers supported by those versions of AIX.
- AIX on System i partitions are also supported.
- 64-bit hardware and 64-bit AIX are required for Oracle Database 12c Release 1 RAC.
- IBM HACMP is renamed to PowerHA up to version 5.5, from 6.1, it is called PowerHA System Mirror.
- Logical Partitioning (LPARs), and Micro-Partitioning are supported in Oracle RAC environments.
- Virtual IO Server (VIOS) features:
  - See the Virtualization sub-section below for details.

By following the navigation instructions in the first paragraph of this sub-section, the RAC Technologies Compatibility Matrix will also be visible. This matrix supplies details about storage technologies, network interconnect technologies and other platform-specific information.


For Oracle Database and Server virtualization features support, look at the information for “IBM AIX Power Systems” in the following link.

http://www.oracle.com/technetwork/database/virtualizationmatrix-172995.html

**Oracle Redundant Interconnect usage feature**

Oracle 12c Release 1 continues to support Oracle’s integrated Redundant Interconnect Usage feature, which provides a Highly Available (HA) IP network functionality for the Oracle interconnect. Previous to the version 11g Release 2, Oracle RAC and Oracle Clusterware depended on AIX and respective OS features to provide a highly available network interface for the Oracle interconnect. With Oracle Database 11g Release 2 Patch Set One and later, customers have the choice to either continue to use the AIX provided HA network interface, or to use Oracle’s integrated Redundant Interconnect Usage feature, which will provide full high availability for an Oracle RAC Database and Oracle ASM of version 11.2.0.2 or higher.
Oracle’s Redundant Interconnect Usage feature will protect production RAC databases where instances of the same database are not co-located on the same physical frame.

For upgrade customers, it is recommended to maintain their current, typically Etherchannel based, configuration as with pre-11.2.0.2 releases during upgrades. This will allow the Redundant Interconnect Usage to allocate an (HA)IP on top of the Etherchannel device, but will not enable load balancing or network failover based on the Oracle Redundant Interconnect Usage feature. Load balancing as well as network failover will continue to be managed by Etherchannel in this case; no further configuration steps required.

In order to fully enable Redundant Interconnect Usage to manage load balancing and network failover for the Oracle cluster interconnect, the Etherchannel configuration used for the Oracle interconnect should be removed and Oracle Redundant Interconnect Usage should be enabled directly on the devices formerly managed by Etherchannel. For more information refer to the Oracle Documentation on how to enable Redundant Interconnect Usage.

Hosting more than one instance of a production Oracle RAC in the same physical environment or frame with a single point of failure (sharing components required for network connectivity, storage access, common Hypervisor, or other critical components) at the same time is generally not recommended by Oracle for a complete High Availability solution, as a failure of any of those shared components inevitably affects more than one instance of the production Oracle RAC database. Under certain circumstances, virtualization solutions and other techniques provided by the hardware or OS vendor may mitigate these negative effects, however, for critical and production deployments, clustering within the same frame, if it has a single point of failure, is discouraged. Furthermore, at this point in time, when enabling Redundant Interconnect Usage, avoid co-location of Oracle RAC instances belonging to the same production database on the same frame as described above, when configured with virtual Ethernet, as certain failures (e.g. the loss of a physical network and one VIO server) in the frame could lead to losing the majority of the Oracle RAC database instances. Oracle and IBM are working to integrate the Redundant Interconnect Usage feature so that optimized high availability can be ensured. Alternatively, physical devices (as opposed to virtual or VIO based devices) can be used and managed by the Redundant Interconnect Usage feature directly to avoid such scenarios.

**Oracle Clusterware**

In a RAC environment Oracle Clusterware provides the high availability functionality. This includes monitoring or restarting the nodes of the cluster, for the database instances, for the listeners and for the database services. Oracle Clusterware is required for Oracle Database 12c Release 1 RAC. For more information on Oracle Clusterware, visit: http://www.oracle.com/technology/products/database/clustering/index.html.

**IBM PowerHA (formerly High Availability Cluster Multi-Processing)**

Note: High Availability Cluster Multi-Processing (HACMP) has been renamed to the PowerHA System Mirror for the version 7.1. This version of the document will use the term PowerHA.

With the release of 12cR1 Oracle no longer supports the use of raw logical volumes with the DB and RAC see My Oracle Support note “Announcement of De-Support of using RAW devices in Oracle Database
Version 12.1” (Doc ID 578455.1). Oracle continues to support the coexistence of PowerHA with Oracle clusterware.

**General Parallel File System**

If using a file system for your Oracle Database 12c Release 1 RAC data files (rather than ASM), you’ll need to use a cluster file system (CFS). A CFS allows file system access by all members in a cluster at the same time. That requirement precludes JFS and JFS2 from being used for Oracle Database 12c RAC data files. The IBM General Purpose File System (GPFS) is an Oracle RAC 12c certified CFS.

GPFS is a high-performance shared-disk file system that can provide fast, reliable data access from all nodes in a homogenous or heterogeneous cluster of IBM UNIX servers running either the AIX or the Linux® operating system.

To determine the *current certifications* for GPFS on Oracle RAC, browse to the “General Notes for RAC for Unix on IBM AIX based Systems (RAC only)” web page, as described in the beginning of the Current Certifications sub-section (see above).

**GPFS 3.5** is certified to Oracle 12c R1 with AIX 6.1 and AIX 7.1.

The following stacks are recommended

- GPFS 3.5.0.15
- Oracle Database 12c R1 RAC version 12.1.0.1.0
- AIX 7.1 TL01 SP03 and later
- AIX 6.1 TL07 SP03 and later
- VIOS 2.2.2.3 or later

**GPFS 3.4** is certified with Oracle 12c R1 with AIX 6.1 and 7.1.

The following stacks are supported.

- GPFS 3.4.0.24
- Oracle Database 12c R1 RAC version 12.1.0.1.0
- AIX 7.1 TL01 SP03 or later
- AIX 6.1 TL07 SP03 or later
- VIOS 2.2.2.3 or later

Refer the “My Oracle support” note 1376369.1 for more information on GPFS for Oracle RAC.

The GPFS web site is [http://www-03.ibm.com/systems/clusters/software/gpfs.html](http://www-03.ibm.com/systems/clusters/software/gpfs.html). Make sure to review the *current GPFS advisories* in the GPFS FAQ available from the GPFS web site.

See the GPFS sub-section in the Tuning Tips section (below) for GPFS tuning information.

**Virtualization for Oracle Database 12c Release 1 RAC**

As mentioned in the Current Certifications sub-section (see above) for Oracle Database 12c Release 21 RAC; LPARs and Micro-Partitioning are supported in Oracle Database 12c Release 1 RAC environments.
LPARs, Micro-Partitioning and VIOS are part of IBM PowerVM. PowerVM is the family of technologies, capabilities and offerings that deliver industry-leading virtualization on IBM POWER processor-based systems. The PowerVM capabilities supported in Oracle Database 12c Release 1 RAC are:

- **Logical Partitions** subdivide a computer’s processors, memory, and hardware resources into multiple environments so that each environment can be operated independently with its own operating system and applications.
  - **Dedicated processor partitions** are LPARs that use dedicated processors.
  - **Dedicated processors** are whole processors that are assigned to a single LPAR.
  - **Shared Processor partitions** are LPARs that use Micro-Partitioning in conjunction with a shared processor pool.
    - **Micro-Partitioning** divides a physical processor’s computing power into fractions of a processing unit and shares them among logical partitions. Processing capacity can be configured in fractions of 1/100 of a processor. The minimum amount of processing capacity that has to be assigned to a partition is 1/10 of a processor.
    - A **shared processor pool** is a group of physical processors that are not dedicated to any LPAR.

- **Virtual I/O Server** allows sharing of physical resources between logical partitions (LPARs) including virtual SCSI and virtual networking. This allows more efficient utilization of physical resources through sharing between LPARs and facilitates server consolidation. These VIOS features are specifically supported in Oracle Database 12c Release 1 RAC:
  - Virtual LAN for public and private interconnects and all supported data storage options.
  - Two VIO servers are necessary to improve serviceability and provide the availability required for an Oracle Database 12c Release 1 RAC implementation.
  - VIOS can be used for non-RAC functions such as Virtual SCSI based root volume groups (rootvg), and Virtual SCSI & NPIV (N port ID Virtualization) for ASM data storage.
  - VIOS with ASM and GPFS in Oracle Database 12c Release 1 RAC is supported

In VIOS environment, NPIV feature allows multiple N_Port IDs to share a single Physical N_Port, which means multiple client LPARs can access external storage LUNs through the same Fibre channel adapter assigned to VIOS LPAR.

Note: With certified VIOS combinations customers may use either Virtual SCSI (vSCSI) or N Port Id Virtualization (NPIV) to attach disk for data storage and OCR. This may be done for both ASM and GPFS 3.4 and above. Customer must confirm IBM support of the configuration, and install any required AIX and Oracle updates before using.

VIOS 2.2.2 and above are supported with Oracle Database 12c Release 1 RAC with AIX 6.1 and 7.1 respectively

**VIOS2.2:**
- VIOS 2.2.2.3 or later
- Oracle Database 12c Release 1 version 12.1.0.1.0
- AIX 6.1 TL07 SP03 (or later) or AIX 7.1 TL01 SP03 (or later)
The VIOS Support web page is:

These are some PowerVM features still being evaluated for support on Oracle Database 12c Release 1 RAC:

- **Dynamic LPARs** (DLPAR) are a shared or dedicated LPAR to which changes can be made to the amount of processors, memory and virtual or physical adapters without requiring a reboot.
  - For dedicated processor partitions, it is only possible to dynamically add, move or remove whole processors. When a processor is removed from a dedicated processor partition, it is then assigned to the shared processor pool.
  - For a shared processor partition, it is also possible to dynamically change the shared processor capacity, the weight of the uncapped attribute, virtual processors and capped/uncapped mode.

- **Live Partition Mobility (LPM)** allows you to migrate running AIX and Linux LPARs and their hosted applications from one physical server to another without disrupting infrastructure services. The migration transfers the entire partition state, including the processor context, memory, attached virtual devices, and connected users.

- **Workload Partition** (WPAR) is a software-based virtualization feature. WPARs subdivide an AIX instance into multiple environments, each hosting applications and providing isolation from applications executing in other environments. **Live Application Mobility** allows you to relocate running WPARs from one LPAR to another. For more information on WPARs, see the *Introduction to Workload Partition Management in IBM AIX Version 6.1* Redbook, http://www.redbooks.ibm.com/abstracts/sg247431.html?Open

Customers should monitor the latest Oracle Certification information to be aware of the ongoing certification of new features.

Virtualization features are powerful, yet their implementation can get quite complex in Oracle Database 12c Release 1 RAC. If you have any questions about implementing virtualization with Oracle database 12c Release 1 RAC, contact the IBM Oracle International Competency Center at ibmoracl@us.ibm.com. For additional, detailed PowerVM information, see these documents and websites:

- **Active Memory Expansion (AME)**
  AME is a new technology included in IBM POWER7 and later systems with AIX 6.1 and AIX 7.1 for expanding a system’s effective memory capacity. Active Memory Expansion employs memory compression technology to transparently compress in-memory data, allowing more data to be placed into memory and thus expanding the memory capacity of POWER7 systems. Utilizing Active Memory Expansion can improve system utilization and increase a system’s throughput.

- PowerVM webpage,
  http://www-03.ibm.com/systems/power/software/virtualization/index.html
- PowerVM Virtualization on IBM System p: Introduction and Configuration Fourth Edition,
IBM System p PowerVM Best Practices,

Network interconnects

To determine the current certifications for network interconnects on Oracle RAC, browse to the “General Notes for RAC for Unix on IBM AIX based Systems (RAC only)” web page, as described in the beginning of the Current Certifications sub-section (see above) for Oracle Database 12c Release 1 RAC. Then select the link for the RAC Technologies Compatibility Matrix (RTCM). Within RTCM, Network Interconnect certifications are listed. Currently, the following are supported and certified with AIX 6.1 and 7.1.

- 100 Mbps, 1 Gigabit
- 10 Gigabit Ethernet

IP over InfiniBand (IPiB) and Reliable Datagram Sockets (RDS) are still being evaluated for support with Oracle Database 12c Release 1 RAC.

Integrated Virtual Ethernet

The Integrated Virtual Ethernet (IVE) is a collection of POWER6, POWER7 and POWER7+ hardware, software and hypervisor features that provides integrated high-speed Ethernet adapter ports with virtualization capabilities. The IVE appears in AIX system commands as the Host Ethernet Adapter (HEA) or Local HEA (LHEA). The IVE offers:

- IVE Adapter Ethernet port options:
  - Two 1 Gbps ports or
  - Four 1 Gbps ports or
  - Two 10 Gbps ports
- External network connectivity for LPARs using dedicated ports without the need of a VIOS.
- Industry standard hardware acceleration, loaded with flexible configuration possibilities.
- The speed and performance of the GX+ bus, faster than PCI Express x16.

For additional information about IVE/HEA:

- Integrated Virtual Ethernet Adapter, Technical Overview and Introduction (Redbook),

Ensure your IVE/HEA is deployed consistent with the instructions in My Oracle Support note 282036.1, “Minimum Software Versions and Patches Required to Support Oracle Products on IBM pSeries”.

Refer the IBM technical document for “Setting up IBM POWER6 10 Gigabit Ethernet ports and AIX 6.1 Etherchannel for Oracle RAC private interconnectivity”, Document ID: WP101734

http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101734

Some additional consideration as part of the 10 GigE setup as follows,
- LACP timeout: Use the “long timeout” switch setting for the amount of time to wait before sending LACPDUs.
- Flow control: Enable flow control at the switch port and on the server side ports (using HMC) for the 10GE adapter or 10GE HEA configuration.
- UDP tuning: The RAC interconnect uses UDP for interprocess communications. Tune the udp_sendspace and udp_recvspace parameters until the “netstat –s” command indicates there are no “socket buffer overflows”. See the Network Tuning section of the “Oracle Architecture and Tuning on AIX” document:
  
- Jumbo frames: Enable Jumbo frames on the RAC interconnect: Configure Jumbo frames at the switch port. In the certification project we set Jumbo frames to 9252 at the switch.

Configure Jumbo frames on the server side ports (using HMC) for the 10GE adapter or 10GE HEA configuration. Configure Jumbo frames in the Etherchannel (network interface) definition.

Note: When using Gigabit Ethernet, 10 Gigabit Ethernet and IP over InfiniBand customers may configure the network routing using either EtherChannel or AIX VIPA based on their requirements. Customer must confirm IBM support of the configuration, and install any required AIX and Oracle updates before using.

**Important Oracle fixes or issues not specific to AIX release**

No Oracle patch(es) released for AIX platform while writing this paper.

### Tuning tips

Most of the AIX OS tuning tips recommended for Oracle Database 11g Release 2 are applicable to Oracle Database 12c Release 1.

The tuning items chosen for inclusion in this section are those where the defaults are sub-optimal, or settings that require special consideration. Instead of repeating the existing documentation, this section will consolidate references to the existing documentation. The URLs of the documents referenced in this section are listed at the end of the section.

### Automatic Storage Management

Automatic Storage Management (ASM) is a feature in Oracle Database 12c Release 1 that provides the database administrator with a simple storage management interface that is consistent across all server and storage platforms.

Starting with Oracle Database 11g Release 2, Oracle Clusterware OCR and voting disk files can be stored in Oracle ASM disk group.

ASM becomes a complete storage management solution for both Oracle Database and non-database files and has many extended functions for not only storing database files, but also storing binary files, report files, trace files, alert logs and other application data files.
ASM Cluster File Systems (ACFS) extends ASM by providing cluster file system scaled to a large number of nodes and uses extend-based storage allocation for improved performance. ACFS can be exported to remote clients through NFS and CIFS.

ASM Dynamic Volume Manager (DVM), ASM FS Snapshot, ASM Intelligent Data Placement, ASM Storage Management Configuration Assistant (ASMCA), ASM File Access Control and ASMCMD are some of the extended functions of ASM.

In Oracle Database 12c Release 1, Oracle has introduced several new capabilities in ASM. Oracle Flex ASM is one of the major features which protects Oracle 12c Database instances that were relying on a failing ASM instnace by reconnecting to another surviving ASM instance on a different server.

For more information on ASM new features, refer to the Oracle document “Oracle Database New Features Guide 12c Release 1 (12.1)”

http://docs.oracle.com/cd/E16655_.01/server.121/e17906/toc.htm

Managing Raw disks in AIX to use with ASM

To prevent the accidental use of disks which are assigned to ASM disk group in AIX for some other purpose, there are two new AIX commands introduced in AIX 6.1 and AIX 7.1

The two commands “lkdev” and “rendev” are introduced to effectively use the disks for ASM disk groups. The “lkdev” command is used to lock the disk to prevent the device from inadvertently being altered by a system administrator at a later time. It locks the device so that any attempt to modify the device attributes (chdev, chpath) or remove the device or one of its paths (rmdev, rmpath) will be denied.

The “rendev” can be used to assign a meaningful name to the disks used by Oracle Database, ASM, Cluster Ready Services and Voting files. This is useful in identifying disk usage because there is no indication in output from AIX disk commands indicating that a disk is being used by Oracle

For more details of using these commands, refer the “My Oracle Support” note 1445870.1.

For information about ASM, see Oracle’s ASM web page:

http://docs.oracle.com/cd/E16655_.01/server.121/e17612/toc.htm

**Asynchronous I/O**

Asynchronous I/O (AIO) allows a program to initiate an I/O operation then continue with other work in parallel to the I/O operation. Oracle Database 12c often requires multiple server and user processes running at the same time. Therefore Oracle Database 12c takes full advantage of AIO services provided by AIX. AIO is implemented with AIO server processes. The configuration values of: minservers, maxservers and maxreqs control the AIO server configuration of AIX. The Tuning IBM AIX 5L for an Oracle Database whitepaper [1] has an “Asynchronous I/O” section that describes recommendations for the configuration values. GPFS configuration recommendations are also supplied. There is also a “Using Asynchronous I/O” section in the Oracle Architecture and Tuning on AIX whitepaper [2].
In AIX 5.3 AIO is disabled by default. However, in AIX 6.1 AIO is enabled by default. When upgrading to AIX 6.1, the AIO setting will not be changed.

Note, if you use the AIX filemon command, the AIO API calls of aio_read, aio_write and lio_listio are not included in the filemon report.

**Concurrent I/O and direct I/O**

There is file system I/O tuning information in the *Tuning IBM AIX 5L for an Oracle Database* whitepaper [1], the *Oracle Architecture and Tuning on AIX* whitepaper [2] and the *Direct I/O or Concurrent I/O on AIX 5L* My Oracle Support note [6]. For Oracle Database 12c, the database defaults to asynchronous I/O (AIO) enabled and concurrent I/O (CIO) disabled. In general, a good starting point is to set the filesystem_options=setall, in your init*.ora configuration file. This setting will enable AIO (which is the default) and CIO operation. CIO operation is built upon direct I/O (DIO) with the additional function of inode locking. Note, there may be workloads (eg. sequential reads) where cached I/O performs better than CIO.

When using CIO/DIO, the Oracle setting of DB_FILE_MULTIBLOCK_READ_COUNT (the maximum number of blocks read in one I/O operation during a sequential scan) needs to be considered. Also, the alignment of the database blocksize and the file system block size (agblksize) has to be considered.

When not using CIO/DIO, look at the suggested settings in the “AIX sequential read ahead” section of the *Oracle Architecture and Tuning on AIX* whitepaper [3].

From Oracle Database 11g Release 2 version 11.2.0.2 and later, Oracle opens the files using "O_CIOR" which is similar to "O_CIO", but allows subsequent open calls without CIO, so that you no longer need to mount the JFS2 filesystems with mount option ":-o cio" and other OS tools and third part tools can access the database files without any issues.

**File system cache size**

In AIX 6.1 the Virtual Memory Manager (VMM) defaults have been changed to be much more suitable for a database workload. When upgrading from AIX 5.3 to AIX 6.1, the VMM settings will not be changed. So, VMM settings need to be changed in the upgraded AIX 6.1 as needed for Oracle database. Refer the following section “Tuning resources” and the document “Tuning IBM AIX 5.3 and AIX 6.1 for Oracle Database (whitepaper) link.

For an Oracle Database workload, we need to ensure the computational pages used for Oracle code, SGA and PGA remain resident in memory. The Oracle Database buffer cache already provides caching of database files. Therefore, the file system cache size should be tuned (using the VMM settings) to favor computational pages over file pages. Check the “Memory and Paging” chapter in the *Oracle Architecture and Tuning on AIX* whitepaper [3] for recommended VMM settings. Note, these settings are a suggested starting point. If you have already tuned your system, do not revert to these VMM settings.

**RAC IPC**

Oracle RAC 12c uses the User Datagram Protocol (UDP) for inter-process communication (IPC) between nodes. The *Oracle Architecture and Tuning on AIX* whitepaper [3] indicates how to tune the UDP kernel settings in the “Network Tuning” section.
General Parallel File System


Oracle process memory footprint

The AIXTHREAD_SCOPE environment variable can be used for control if an AIX process runs with process-wide contention scope (the default) or with system-wide contention scope. System-wide contention scope significantly reduces the memory required for each database process. AIX operates most effectively with Oracle Database 12c and Oracle RAC when using system-wide contention scope (AIXTHREAD_SCOPE=S). See the “Tuning Memory” chapter of the Tuning IBM AIX 5L for an Oracle Database whitepaper [1] for a detailed description of the AIXTHREAD_SCOPE parameter.

Tuning resources

These are the documents referenced throughout this section. The same tuning of AIX for Oracle Database 11gR2 applies to Oracle Database 12cR1.

2. Oracle RAC on IBM AIX best practices in memory tuning and configuring for system stability
5. Configuration considerations for Oracle 11.2.0.2 use on AIX (with HAIP) http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102001
6. Using VIPA and Dead Gateway Detection on AIX for High Availability Networks, including Oracle RAC http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102177
7. Oracle’s USLAHEAP patches available on AIX http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102066
8. Disabling unshared segment aliasing on AIX for Oracle Database 11.2.0.3 http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102172
9. IBM POWER7 AIX and Oracle Database performance considerations http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP1022171

http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102158
13. Direct I/O or Concurrent I/O on AIX 5L (My Oracle Support note 272520.1),
14. Oracle 9i & 10g on IBM AIX5L: Tips and Considerations (whitepaper),
   http://www-03.ibm.com/support/techdocs/atmastr.nsf/WeblIndex/WP100556

These are supplemental tuning resources.

- AIX 6 Performance Management (AIX documentation),
  nce.htm
- Performance Management for System p,
  http://www-03.ibm.com/systems/p/support/pm/index.html
- Improving Database Performance with AIX Concurrent I/O (whitepaper),
  http://www-03.ibm.com/systems/resources/systems_p_os_aix_whitepapers_db_perf_aix.pdf
- Diagnosing Oracle Database Performance on AIX Using IBM NMON and Oracle Statspack Reports
  (whitepaper),
  http://www-03.ibm.com/support/techdocs/atmastr.nsf/WeblIndex/WP101720
- RAC Starter Kit and Best Practices, “My Oracle Support” note 811293.1
Summary

This document gathers together the key technical topics that need to be considered in planning or implementing Oracle Database 12c R1 or Oracle Database 12c R1 RAC with AIX. In almost all cases, there are reinforcing references included in each section. The resources appendix below contains pointers to general documentation and additional supporting documents.
Resources

These Web sites and documents provide useful references to supplement the information contained in this document:

- Oracle Database 12c Documentation Library,
  [http://docs.oracle.com/cd/E16655_01/nav/portal_11.htm](http://docs.oracle.com/cd/E16655_01/nav/portal_11.htm)

- Oracle RAC SIG,
  [http://www.oracleracsig.org](http://www.oracleracsig.org)

- IBM and Oracle Support Process,

- Oracle My Oracle Support note 341507.1: Oracle Products on Linux on IBM POWER,
  [https://support.oracle.com/CSP/ui/flash.html](https://support.oracle.com/CSP/ui/flash.html)

- Oracle and IBM System Storage
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