

IBM Virtualization Engine TS7700 Series



Introduction and Planning Guide

*IBM Virtualization Engine TS7700, TS7700 Cache Controller, and TS7700 Cache Drawer
Printed in U.S.A.*

Note!

Before using this information and the product it supports, read the information in the **Safety and environmental notices** and **Notices** sections.

This product is not intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications Networks, neither to be used in Public Services Networks.

Edition and version

This edition applies to Version 1, release 11 of the IBM Virtualization Engine TS7700 Series (TS7700 Virtualization Engine) and all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces GA32-0567-10.

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- Exact publication title
- Form number (for example, GA32-0689-00), part number, or EC level (located on the back cover)
- Page numbers to which you are referring

Note: For suggestions on operating enhancements or improvements, please contact your IBM Sales team.

Safety and Environmental notices

This section contains information about safety notices that are used in this guide and environmental notices for this product.

Safety notices

Observe the safety notices when using this product. These safety notices contain danger and caution notices. These notices are sometimes accompanied by symbols that represent the severity of the safety condition.

Most danger or caution notices contain a reference number (Dxxx or Cxxx). Use the reference number to check the translation in the *IBM Systems Safety Notices*, G229-9054 manual.

The sections that follow define each type of safety notice and give examples.

Danger notice

A danger notice calls attention to a situation that is potentially lethal or extremely hazardous to people. A lightning bolt symbol always accompanies a danger notice to represent a dangerous electrical condition. A sample danger notice follows:




DANGER: An electrical outlet that is not correctly wired could place hazardous voltage on metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (D004)

Caution notice

A caution notice calls attention to a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice. A caution notice can be accompanied by one of several symbols:

If the symbol is...	It means...
	A generally hazardous condition not represented by other safety symbols.
	This product contains a Class II laser. Do not stare into the beam. (C029) Laser symbols are always accompanied by the classification of the laser as defined by the U. S. Department of Health and Human Services (for example, Class I, Class II, and so forth).
	A hazardous condition due to mechanical movement in or around the product.

If the symbol is...	It means...
	<p>This part or unit is heavy but has a weight smaller than 18 kg (39.7 lb). Use care when lifting, removing, or installing this part or unit. (C008)</p>

Sample caution notices follow:

Caution

The battery is a lithium ion battery. To avoid possible explosion, do not burn. Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM® has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call. (C007)

Caution

The system contains circuit cards, assemblies, or both that contain lead solder. To avoid the release of lead (Pb) into the environment, do not burn. Discard the circuit card as instructed by local regulations. (C014)

Caution

When removing the Modular Refrigeration Unit (MRU), immediately remove any oil residue from the MRU support shelf, floor, and any other area to prevent injuries because of slips or falls. Do not use refrigerant lines or connectors to lift, move, or remove the MRU. Use handholds as instructed by service procedures. (C016)

Caution

Do not connect an IBM control unit directly to a public optical network. The customer must use an additional connectivity device between an IBM control unit optical adapter (that is, fibre, ESCON®, FICON®) and an external public network . Use a device such as a patch panel, a router, or a switch. You do not need an additional connectivity device for optical fibre connectivity that does not pass through a public network.

Environmental notices

The environmental notices that apply to this product are provided in the *Environmental Notices and User Guide, Z125-5823-xx* manual. A copy of this manual is located on the publications CD.

About this publication

This publication provides installation and planning information for the IBM Virtualization Engine TS7700 Series (TS7700 Virtualization Engine).

Organization of This Book

The information in this publication is organized as follows:

- Chapter 1, "Overview," provides:
 - A discussion of the data storage values used
 - A discussion of the concepts of storage virtualization
 - An introduction to the TS7700 Virtualization Engine
 - A comparison of the TS7720 Virtualization Engine and the TS7740 Virtualization Engine system configurations
 - An overview of the TS7700 Virtualization Engine components
- Chapter 2, "Planning," describes for the TS7700 Virtualization Engine:
 - A discussion of the component details
 - An overview of the system requirements
 - A discussion of host compatibility
 - A discussion of infrastructure requirements
 - A discussion about planning for logical and physical volumes
 - A discussion of the upgrade options
 - A description of the feature codes
 - Checklists for installation and post-installation
- Chapter 3, "Configuring," describes for the TS7700 Virtualization Engine:
 - A discussion of possible configurations
 - A discussion of the data access and availability characteristics
 - A discussion of how to configure for disaster recovery
 - A discussion of how to configure for high availability
 - A discussion of how to configure for disaster recovery and high availability
 - Introduction of selective write protect for disaster recovery
- Chapter 4, "Security," describes TS7700 Virtualization Engine:
 - Security protocols used
 - Audit logging procedures
- Chapter 5, "Managing," describes for the TS7700 Virtualization Engine:
 - A discussion about how to connect to the management interface
 - A discussion about how to shut down the TS7700 Virtualization Engine
 - A discussion of the many aspects of the management interface
- Chapter 6, "Recovering," describes for the TS7700 Virtualization Engine:
 - A discussion about how to recover lost data
 - A discussion about how to test for grid failover
- The "Glossary" on page 223 provides definitions for terms, abbreviations, and acronyms used in this book.

- The “Notices,” on page 237 provide information about the electronic emission regulations that pertain to the TS7700 Virtualization Engine in the United States and other countries and regions.
- The “Index” on page 245 includes keywords and terms to help retrieve information in this publication.

Who Should Read This Book

This book is intended for system planners, programmers, and administrators.

What's New in This Edition

Significant changes include:

- Introduction of the 3957-V07 and 3957-VEB server platforms, including
 - Default configuration of 8 cores with 16 GB of memory
 - 1 Gb grid link Ethernet adapter
 - Optional 10 Gb grid link Ethernet adapter
 - 8 Gb Fibre Channel adapter
 - MES option to replace 3957-V06 or 3957-VEA model
- Four, 1 Gb grid Ethernet links
- Ethernet switches (previously routers)
- 8 Gb Fibre Channel switch, with MES option to upgrade from 4 Gb
- Support for 5- and 6-way grid configurations by RPQ
- Support for 2 million logical volumes
- Selective device access control
- z/OS scratch allocation assistance
- Historical statistics performance monitoring through the TS7700 Virtualization Engine Management Interface

Related Publications

The following publications provide information related to the IBM TS7700 Virtualization Engine, cache controller, cache storage, and components:

- *IBM System Storage® TS1120 and TS1130 Tape Drives and TS1120 Controller Introduction and Planning Guide, GA32-0555*
- *IBM 3953 Tape System Introduction and Planning Guide, GA32-0557*
- *IBM TotalStorage 3953 Tape Frame F05 Maintenance Information, P/N 23R2477*
- *IBM System Storage TS3500 Tape Library with ALMS Introduction and Planning Guide, GA32-0593*
- *IBM System Storage 3953 Tape System Introduction and Planning Guide, GA32-0557*
- *IBM Virtualization Engine TS7700 Customer InfoCenter, P/N 45E8770*
- *IBM Encryption Key Manager component for the Java platform Introduction, Planning, and User's Guide, GA76-0418*
- *IBM Virtualization Engine TS7700 Series Copy Export User's Guide, white paper*

Online References

The following online references are included in this publication:

- IBM Virtualization Engine TS7700 Series Information Center
 - <http://publib.boulder.ibm.com/infocenter/ts7700/cust/index.jsp>
- Information concerning IBM product recycling offerings
 - <http://www.ibm.com/ibm/environment/products/prp.shtml/>
- Information concerning battery return programs
 - <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml/>
- Information concerning Web-Based Enterprise Management
 - <http://www.dmtf.org/standards/wbem/>
- Information concerning Common Information Model, the Web-Based Enterprise Management data model
 - <http://www.dmtf.org/standards/cim/>
- Information concerning the most recent list of supported FICON directors
 - <http://www.ibm.com/support/techdocs/atmastr.nsf/WebIndex/FQ116133>

Chapter 1. Overview

The topics in this section provide overview information related to your IBM Virtualization Engine TS7700 Series (TS7700 Virtualization Engine).

Data storage values

TS7700 Virtualization Engine documentation displays data storage values using both decimal (base-10) prefixes and binary (base-2) units of measurement.

Decimal units such as K, MB, GB, and TB have commonly been used to express data storage values, though these values are more accurately expressed using binary units such as KiB, MiB, GiB, and TiB. At the kilobyte level, the difference between decimal and binary units of measurement is relatively small (2.4%). This difference grows as data storage values increase, and when values reach terabyte levels the difference between decimal and binary units approaches 10%.

To reduce the possibility of confusion, the IBM Virtualization Engine TS7700 Information Center represents data storage using both decimal and binary units. Data storage values are displayed using the following format:

decimal unit (binary unit)

By this example, the value 512 terabytes is displayed as:

512 TB (465.6 TiB)

Table 1 compares the names, symbols, and values of the binary and decimal units. Table 2 shows the increasing percentage of difference between binary and decimal units.

Table 1. Comparison of binary and decimal units and values

Decimal			Binary		
Name	Symbol	Value (base-10)	Name	Symbol	Value (base-2)
kilo	K	10 ³	kibi	Ki	2 ¹⁰
mega	M	10 ⁶	mebi	Mi	2 ²⁰
giga	G	10 ⁹	gibi	Gi	2 ³⁰
tera	T	10 ¹²	tebi	Ti	2 ⁴⁰
peta	P	10 ¹⁵	pebi	Pi	2 ⁵⁰
exa	E	10 ¹⁸	exbi	Ei	2 ⁶⁰

Table 2. Percentage difference between binary and decimal units

Decimal Value	Binary Value	Percentage Difference
100 kilobytes (KB)	97.65 kibibytes (KiB)	2.35%
100 megabytes (MB)	95.36 mebibytes (MiB)	4.64%
100 gigabytes (GB)	93.13 gibibytes (GiB)	6.87%
100 terabytes (TB)	90.94 tebibytes (TiB)	9.06%
100 petabytes (PB)	88.81 pebibytes (PiB)	11.19%

Table 2. Percentage difference between binary and decimal units (continued)

Decimal Value	Binary Value	Percentage Difference
100 exabytes (EB)	86.73 exbibytes (EiB)	13.27%

Concepts of storage virtualization

Virtualization permits the full utilization of modern tape technology's underlying storage capacity and decreases the logical volume access time of data storage and retrieval.

Virtualization reconfigures the relationship between a physical tape drive, storage media, and the application that reads and writes data. The TS7700 Cache uses disk drive modules (DDMs) as storage media and the TS7700 Server emulates the function and operation of IBM 3490 Enhanced Capacity (3490E) tape drives. These emulated tape drives are called *virtual tape drives*, and to an attached host they appear identical to physical tape drives.

Data written or read through a virtual tape drive resides in a *virtual volume* on the DDMs in the TS7700 Cache. To a host application, a virtual volume shows the same characteristics as a physical tape volume. The size of virtual volumes is dependent upon the size of data received from the host; virtual volumes will only be as large as necessary to hold the host data. This characteristic of virtual volumes increases the efficiency of layered storage and permits physical tape volumes to maximize available storage.

When the TS7700 Virtualization Engine is attached to a tape library, the TS7700 Server manages the physical tape drives, or *physical volumes*, in the tape library and controls the movement of data between physical and virtual volumes. The TS7700 Cache temporarily holds data before writing it to tape, caches the data after a read or write operation to provide fast subsequent access, and provides source data when replicating to another cluster in a Grid. When a virtual volume is read from the TS7700 Cache DDMs and written to a physical volume, *premigration* is said to have occurred and the virtual volume becomes a *logical volume*. Conversely, when a logical volume is moved from a physical volume to the TS7700 Cache, a *recall* is said to have occurred and the logical volume again becomes a virtual volume. A physical volume can contain one or more logical volumes; a physical volume that contains more than one logical volume is referred to as a *stacked volume*.

When the TS7700 Virtualization Engine is not attached to a tape library, all data is held in logical volumes in the TS7700 Cache. In both configurations (with or without an attached physical library), caching algorithms ensure the cache is full of the most recently created and/or accessed data. The caching algorithms may also be influenced by cache management policies as part of the advanced policy management functions. In both configurations, the replication of a logical volume from one site to another across the connecting infrastructure (grid network) is referred to as a *copy*.

TS7700 Virtualization Engine product introduction

The TS7700 Virtualization Engine is a member of the TS line of products and builds upon previous implementations of tape storage virtualization.

The TS7700 Virtualization Engine offers a modular and scalable architecture to the tape virtualization market, allowing you to better customize the system to meet

your particular requirements. Digital information generated by a smarter planet requires increasing storage and management. Online application storage and offline, permanent archive media continue to increase and require high-performance and high-capacity data storage solutions. The TS7700 Virtualization Engine is a fully integrated, tiered storage hierarchy of disk and tape. It leverages the benefits of both technologies by storing recent, frequently accessed data on disk to maximize performance in backup-and-restore operations, while moving older, less accessed data to tape, minimizing storage costs and securing long term retention. The TS7700 Virtualization Engine can also fulfill storage requirements for applications and deployments designed to store data on tape, but that also require disk performance and capabilities. The TS7700 Virtualization Engine can help reduce batch processing time, total cost of ownership, and management overhead. The TS7700 Virtualization Engine delivers significant processing power increase over previous models, resulting in:

- Greater efficiency
- Improved connectivity for grid configurations and tape and cache support
- Improved resiliency using 4-way and larger grid configuration support
- Improved data management in mainframe environments

The TS7700 Virtualization Engine is part of a family of IBM System Storage Enterprise tape products, and can be the answer to growing storage requirements, shrinking backup windows, and the need for access to data. Features and functionality include:

The TS7720 Virtualization Engine

A disk-only virtual tape system that does not connect to a physical library.

The TS7720 Virtualization Engine supports use of the TS7720 Server model 3957-VEB with code levels 8.20.0.xx or higher. This model can be used as a replacement in any of the current 3957-VEA configurations.

The TS7720 Cache supports existing 1 TB (0.91 TiB) SATA drives, and with code levels of 8.7.0.xx or higher, 2 TB (1.82 TiB) SATA drives. When ordered from manufacturing, the TS7720 Server (3957-VEB) ships with 2 TB (1.82 TiB) SATA drives. The TS7720 Cache can contain up to 164 TB (149.14 TiB) of raw disk cache in the TS7720 Base Frame.

An option is available to expand the disk cache to a maximum of 444 TB (403.77 TiB) of raw capacity by attaching to the TS7720 Storage Expansion Frame. This option enables each additional TS7720 Cache Controller to function as a "head" of its own "string" of TS7720 Cache Drawers, creating a TS7720 Cache that operates with multiple heads of cache strings.

Figure 1 on page 4 displays a TS7720 Virtualization Engine as viewed from the front of the machine.



Figure 1. The TS7720 Virtualization Engine

The TS7740 Virtualization Engine

A virtual tape system that connects to a physical library.

The TS7740 Virtualization Engine supports use of the TS7740 Server model 3957-V07 with code levels 8.20.0.xx or higher. This model can be used as a replacement in any of the current 3957-V06 configurations using 300 GB (279 GiB) or 600 GB (558 GiB) Fibre Channel drives.

The TS7740 Cache supports existing 300 GB (279 GiB) Fibre Channel drives, and with code levels of 8.7.0.xx or later, 600 GB (558 GiB) Fibre Channel drives. When ordered from manufacturing, the TS7740 Server (3957-V07) ships with 600 GB (558 GiB) Fibre Channel drives. The TS7740 Cache can contain up to 28.8 TB (26.21 TiB) of raw disk capacity.

Figure 2 on page 5 displays a TS7740 Virtualization Engine as viewed from the front of the machine.



Figure 2. The TS7740 Virtualization Engine

The TS7700 Server

A new platform for the TS7720 Server and the TS7740 Server that improves performance, reduces power consumption, and will scale to support future performance improvements.

New I/O drawers and adapter types that support the new TS7700 Server platform and provide more flexible adapter placement.

New 8 Gb Fibre Channel switches, with an MES option to replace existing 4 Gb Fibre Channel switches.

Expanded memory

Total physical memory of 16 GB for each TS7700 Server (existing 3957-V06 or 3957-VEA).

Integrated Library Manager support for the TS7700 Virtualization Engine

Integrates logical volume management and some physical volume and device management into the TS7700 Virtualization Engine.

4 Gb FICON host attachments

Note: Each FICON adapter supports a maximum of 256 logical paths. When the maximum number of FICON adapters is installed, the total supported number of logical paths is 1024.

Tape library attachment

- IBM System Storage TS3500 Tape Library (TS3500 Tape Library also referred to as the 3584 Tape Library or machine type 3584)

Note: “FC 9219, Attach to TS3500” on page 126, enables this configuration, which is required for TS7740 Virtualization Engine microcode levels of 8.5.0.xx or later.

- IBM TotalStorage 3494 Tape Library

Note: Attachment to a 3494 Tape Library is not formally supported by code levels of 8.6.0.xx or later. Support for 3494 Tape Library attachment is available only by RPQ.

Tape drive support

Note: TS1130 Tape Drives, TS1120 (E05) Tape Drives, and 3592 J1A Tape Drives are collectively referred to as *3592 Tape Drives*.

IBM System Storage TS1130 Tape Drive

Also referred to as 3592 E06 Tape Drive or 3592 EU6 Tape Drive (if converted from a 3592 E05 Tape Drive).

Note: TS1130 Tape Drives are shipped encryption-capable. To use TS1130 Tape Drives for a TS7740, the minimum required IBM Virtualization Engine TS7740 microcode level is 8.5.0.xx. TS1130 Tape Drives cannot be intermixed with TS1120 or 3592 J1A Tape Drives.

IBM System Storage TS1120 Tape Drive

Also referred to as 3592 E05 Tape Drive.

Note: TS1120 Tape Drives can operate in native E05 mode or in 3592 J1A emulation mode. To use TS1120 Tape Drives in E05 mode, all drives associated with the system must be TS1120 Tape Drives, the drives must be set to E05 native mode, and the minimum required TS7700 Virtualization Engine microcode level must be 8.0.1.xx. Encryption is supported when all drives associated with the TS7700 Virtualization Engine are encryption-capable TS1120 Tape Drives (FC 5592 or FC 9592 is ordered against each TS1120 Tape Drive) and “FC 9900, Encryption configuration” on page 129 is ordered against the TS7740 Server.

IBM TotalStorage 3592 Tape Drive J1A

Note: When 3592 J1A drives (or 3592 E05 Tape Drives in J1A emulation) are replaced with E05 drives, E05 drives append to the filling J1A-formatted drives. As the active data on the J1A gets reclaimed or expired, the tape goes back to the scratch pool and then is reformatted to the E05 data format on its first write operation. Likewise, when 3592 J1A drives (or 3592 E05 Tape Drives in J1A emulation) are replaced with 3592 E06 Tape Drives, the TS7700 marks the J1A formatted tapes with active data FULL. By marking these tapes full, the TS7700 does not append more data since the 3592 E06 Tape Drive cannot append data to a J1A formatted tape. As the active data on the J1A gets reclaimed or expired, the tape goes back to the scratch pool and then is reformatted to the E06 data format on its first write operation.

Support for a hybrid TS7700 Grid

A hybrid TS7700 Grid contains an intermix of one or more TS7700 Clusters that connect to physical tape drives in a physical tape library (TS7740 Clusters), and one or more TS7700 Clusters that do not connect to physical tape drives in a physical tape library (TS7720 Clusters), configured together within the same grid.

Support for 5- and 6-way TS7700 Grid configurations

Support for a grid consisting of 5 or 6 TS7700 Clusters.

Note: Support for 5- and 6-way grid configurations is available by RPQ only and supported by a code level of 8.7.0.xx or higher.

Support for four, 1 Gb grid Ethernet links

Support for use of the second 1 Gb Ethernet port present in both grid Ethernet adapters. This support results in availability of four total 1 Gb ports for TS7700 Grid interconnections. Each 1 Gb link requires a unique IP address. Selective device access control can be used to tune use of links between sites.

This configuration is only supported by microcode levels of 8.20.0.xx and higher. It requires two dual-ported adapters and is activated via FC 1034, Enable dual port grid connection.

Support for a single port optical Ethernet longwave adapter for grid communication

Support for a standard longwave (1,310 nm) optical adapter conforming to the IEEE 802.3ae standards, at distances up to 10 km.

TS7700 Cluster Family grouping

A user-defined grouping of clusters that share a common purpose or role; it facilitates cooperative replication and improved tape volume cache (TVC) selection.

Larger logical volume sizes

Available logical volume sizes include:

- 1.05 GB (1000 MiB)
- 2.1 GB (2000 MiB)
- 4.19 GB (4000 MiB)
- 6.29 GB (6000 MiB)

Logical volume sizes are set by data class using the base-10 unit mebibyte (MiB). For a discussion of the relationship between decimal and base-10 units, refer to the topic *Data storage values*. Refer to the topic *Logical volumes* to determine the number and size of logical volumes required to accommodate the planned workload. Links to both topics are found in the **Related information** section.

On-demand capabilities

- Up to two million logical volumes per TS7700 Virtualization Engine.

Note: The default maximum number of logical volumes supported is one million. Support for additional logical volumes can be added in 200,000 volume increments up to two million total using FC 5270, Increased logical volumes. In a grid environment, the number of logical volumes supported is determined by the cluster having the smallest number of FC 5270, Increased logical volumes, installed.

- 256 virtual tape device addresses.

Incremental capabilities

- High performance disk cache capacity: increments of 1 TB (0.91 TiB) up to 28 TB (25.48 TiB) in the TS7740 Virtualization Engine
- Host data transfer performance (increments of 100 MB/sec up to 1000 MB/sec)

Note: “FC 5268, 100 MB/sec increment” on page 118 enables a 100-MB/sec increment of peak data throughput. On the TS7740

Virtualization Engine, one instance of this feature is shipped standard and a maximum of nine additional instances can be ordered. On the TS7720 Virtualization Engine, one instance of "FC 9268, Plant install 100 MB/s throughput" on page 126 is shipped standard and a maximum of nine instances of "FC 5268, 100 MB/sec increment" on page 118 can be added. When the maximum number of these instances is installed, the system does not restrict peak data throughput. Unrestricted peak data throughput is not constrained by system requirements and use of "unrestricted" does not imply unlimited peak data throughput.

Logical WORM

Emulates physical Write Once, Read Many (WORM) and leverages the host software support of physical WORM media.

Host override for cache residency

A host console request (HCR) function that permits the temporary override of a logical volume preference group assignment while the volume is in cache.

Selective write protect for disaster recovery testing

An option configurable from the TS7700 Virtualization Engine Management Interface that permits exclusion of up to 16 categories from a cluster's write protect enablement.

This function permits the emulation of disaster recovery events by performing test operations at a disaster recovery site within a TS7700 Grid configuration.

Device allocation assistance (DAA)

For a specific mount, returns to the host a list of prioritized clusters to determine which cluster is best configured to direct a device allocation.

Scratch allocation assistance (SAA)

For a scratch mount, returns to the host a list of candidate clusters for the allocation request. The list of candidate clusters is a subset of all clusters in the grid having a specific Management Class construct value. When the Scratch Mount Candidate option is selected for a Management Class, SAA returns the list of clusters specified by that Management Class. A scratch allocation request is then directed to that specific set of clusters.

Selective device access control

Creation of library port access groups that permit segmentation of resources and authorization by controlling access to library data ports.

Note: "FC 5271, Selective device access control" on page 118, enables this function. Each feature code key will enable definition of up to eight selective device access groups, excluding the default group in the count. A feature key will need to be installed on all clusters in the grid per eight groups before the function becomes enabled. This feature is only available with microcode levels of 8.20.0.xx and later.

Advanced policy management functions

Such as:

- Physical volume pooling
- Logical volume copies on separate physical volumes
- Extension of logical volume size
- Multiple reclamation policies
- Grid replication policies

- Cache retention policies
- Enhanced cache removal policies for the TS7720 Virtualization Engine to permit greater control over content removal as active data approaches full capacity

Security enhancements

- System Storage Productivity Center (SSPC) integration
- Audit logging
- Security audit SNMP trap definition filters

Enhancements for Reliability, Availability, and Serviceability (RAS)

- Machine-reported product data - vital product data (MRPD-VPD) enhancements
- Tivoli® Assist on Site (AOS) enhancements

Important: Use “FC 0521, Functional enhancement field” on page 110 to receive the most current level of TS7700 Virtualization Engine code.

Microcode level 8.20.0.xx can be installed on any existing TS7720 Server model 3957-VEA or TS7740 Server model 3957-V07 with the following restrictions:

- The existing cluster must operate using a TS7700 Virtualization Engine microcode of 8.6.x.xx or later.
- The existing server must have at least 16 GB of Random Access Memory (RAM) installed.
- For a TS7740 Virtualization Engine, any attached library is a TS3500 Tape Library.

Related information

“About cluster families” on page 179

“Allocation assistance” on page 199

“Concepts of storage virtualization” on page 2

“Data storage values” on page 1

“Logical volumes” on page 69

“TS7700 Virtualization Engine system component details” on page 21

“TS7720 Storage Expansion Frame” on page 27

TS7700 Virtualization Engine system configurations

A TS7700 Virtualization Engine is configured either as a TS7720 Virtualization Engine or a TS7740 Virtualization Engine. The TS7720 Virtualization Engine stores all data in disk cache and does not attach to a physical library. The TS7740 Virtualization Engine stores data in disk cache and on physical tape in an attached physical library.

Table 3 on page 10 displays the available system configurations of the TS7700 Virtualization Engine.

Table 3. TS7700 Virtualization Engine system configurations

TS7700 Virtualization Engine	
TS7720 Virtualization Engine TS7720 Server (3957-VEA or 3957-VEB) TS7720 Cache Controller (3956-CS7 or 3956-CS8+) TS7720 Cache Drawer (3956-XS7‡) 3952 Tape Frame Optional attachment to a TS7720 Storage Expansion Frame	TS7740 Virtualization Engine TS7740 Server (3957-V06 or 3957-V07) TS7740 Cache Controller (3956-CC7 or 3956-CC8+) TS7740 Cache Drawer (3956-CX7‡) 3952 Tape Frame
The TS7720 Virtualization Engine does not attach to a physical library.	Library Attachments TS3500 Tape Library Tape Drives 3592 Tape Drive <ul style="list-style-type: none"> • TS1130 Tape Drive • 3592 J1A Tape Drive • TS1120 Tape Drive (in native mode and emulating a 3592 J1A Tape Drive) Tape Cartridges 3592 Tape Cartridge
†Use of 3956-CS8 or 3956-CC8 is supported only with code levels of 8.7.0.xx or later. ‡Use of higher capacity TS7700 Cache Drawers [2 TB (1.82 TiB) 3956-XS7 and 600 GB (558.78 GiB) 3956-CX7] is supported only with code levels of 8.7.0.xx or later.	

Note: The IBM TS7700 Virtualization Engine 3957 (3957 VE, also 3957-Vxx) is the regulatory model and can represent either the 3957-V06 or 3957-VEA.

TS7700 Virtualization Engine system components

The TS7700 Virtualization Engine consists of several primary components that can be described in terms of their system role or according to their technical functions.

Nodes, Clusters, and Grid

The TS7700 Virtualization Engine is built on a distributed node architecture. The nodes perform either virtualization (vNode) or hierarchical data storage management (hNode). The vNode presents the virtual image of a library(ies) and the drives to a host system. When the TS7700 Virtualization Engine is attached to a physical library, the vNode also receives tape drive and library requests from the host and processes them as real devices do. It then translates the tape requests through a virtual drive and uses a file in a file system to represent the virtual tape image. Once created or altered by the host system through a vNode, a logical volume resides in disk cache or on physical tape, where it is managed by the hNode. When the TS7700 Virtualization Engine is attached to a physical library, the hNode is the only node that is aware of physical tape resources and the relationships between the logical and physical volumes. The hNode is also responsible for any replication of the logical volumes and their attributes across site boundaries.

Based on the node architecture, a vNode or hNode can run on separate virtualization hardware or be combined to run on the same hardware. When a vNode and hNode are combined to run on the same virtualization hardware, they are referred to collectively as a General Node, or gNode. The TS7700 Virtualization

Engine runs a gNode. See Figure 3 for an illustration of the relationship between nodes.

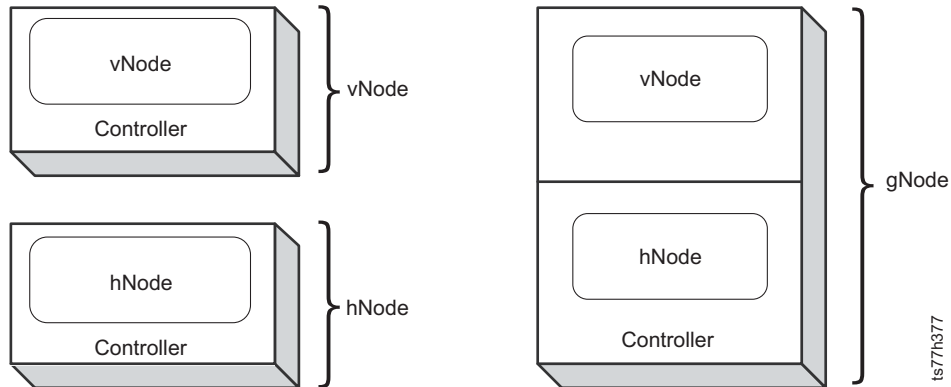


Figure 3. vNode, hNode, and gNode construction

The TS7700 Virtualization Engine *Cluster* combines the TS7700 Server with a disk subsystem, the TS7700 Cache Controller. This architecture permits additional disks or nodes to be added in future offerings to expand the capabilities of the system. Figure 4 displays a TS7700 Virtualization Engine configured as a cluster.

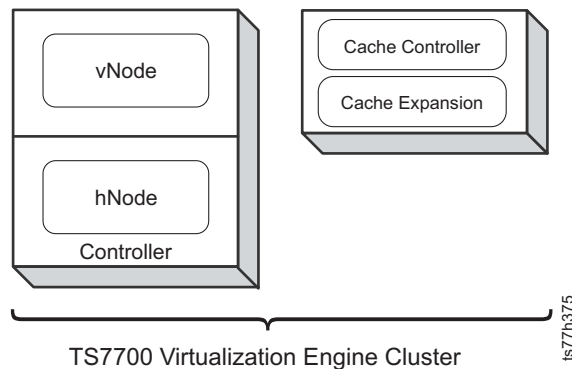


Figure 4. TS7700 Virtualization Engine Cluster configuration

The TS7700 Virtualization Engine *Grid*, or grid configuration, is a series of two or more clusters connected to one another to form a high availability or disaster recovery solution. Logical volume attributes and data are replicated across the clusters in a grid to ensure the continuation of production work, should a single cluster become unavailable.

A logical volume can be accessed from any virtual device in the system, even if the logical volume has only a single replica. Should a failure occur at the source cluster, replicated logical volumes are still available since any data replicated between the clusters is accessible through any other cluster in a grid configuration. Each copy is a valid source of the logical volume. A grid configuration looks like a single storage subsystem to the hosts attached to the clusters; it can be described as a composite library with underlying distributed libraries similar to the prior generation's peer-to-peer (PTP) VTS. For additional information about data accessibility in the event of a source cluster failure, please refer to "The Autonomic Ownership Takeover Manager" on page 195.

A TS7700 Grid can be created using TS7720 Clusters, TS7740 Clusters, or a combination of both.

Multiple TS7700 Virtualization Engine Grids can be attached to the same host system yet operate independent of one another.

Figure 5 shows a typical six-cluster grid.

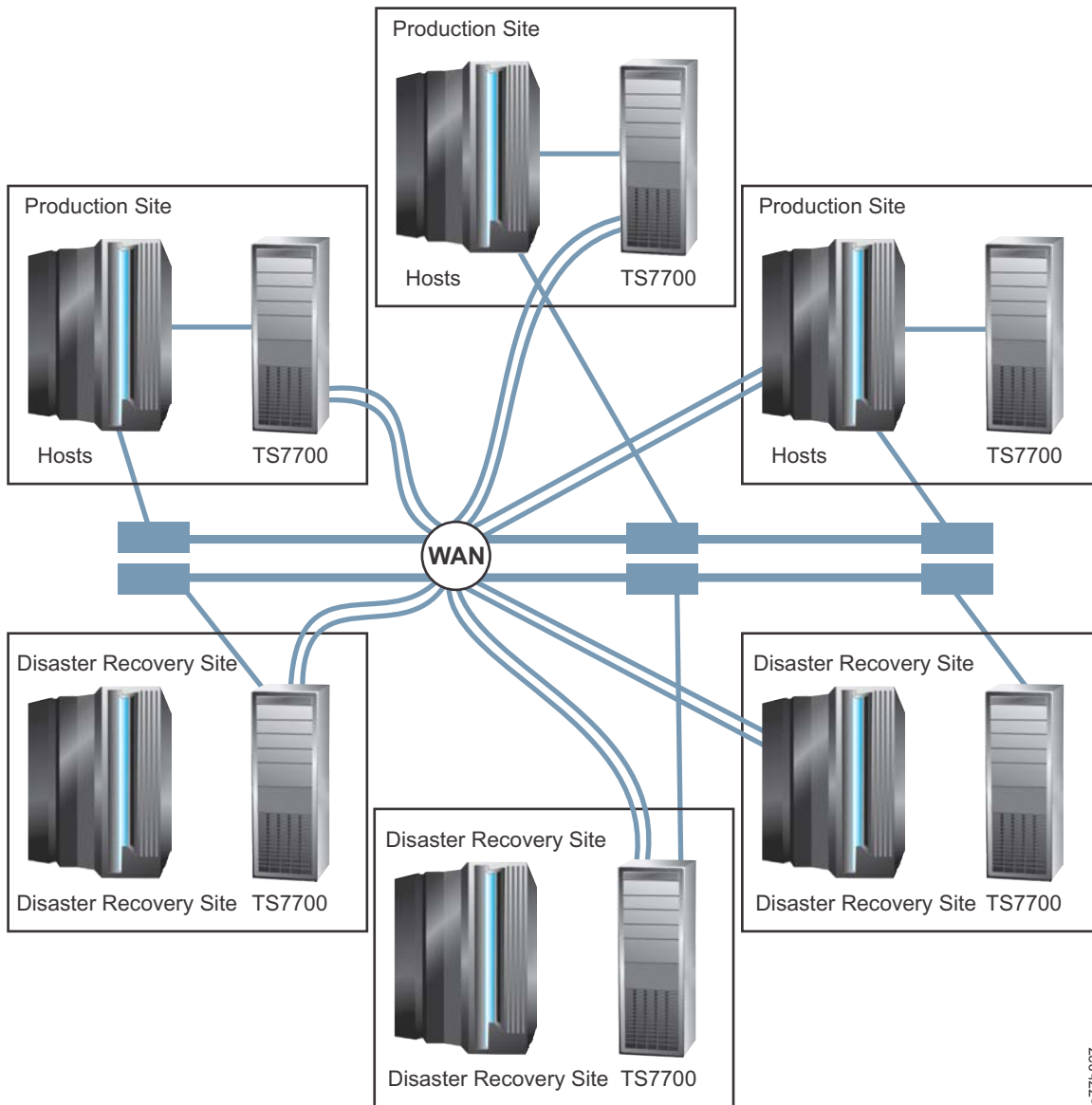


Figure 5. TS7700 Virtualization Engine six-cluster grid configuration

†FICON channel extenders are optional.

Operational components

A TS7700 Virtualization Engine configured as a gNode is comprised of these major operational components:

- A TS7700 Server (includes System Unit and Expansion Unit with I/O drawers)
- A TS7700 Cache Controller

- TS7700 Cache Drawers (optional depending on configuration)
- A 3952 Tape Frame

Note: A TS7720 Virtualization Engine may also be configured to include a TS7720 Storage Expansion Frame, which houses additional TS7720 Cache Controllers and TS7720 Cache Drawers

The configuration of these components differs depending on whether a TS7700 Virtualization Engine is configured as a TS7720 Virtualization Engine or a TS7740 Virtualization Engine. Table 4 compares the major operational components of the TS7700 Virtualization Engine in each of these configurations, contained by a 3952 Tape Frame.

Table 4. TS7720 Virtualization Engine and TS7740 Virtualization Engine components

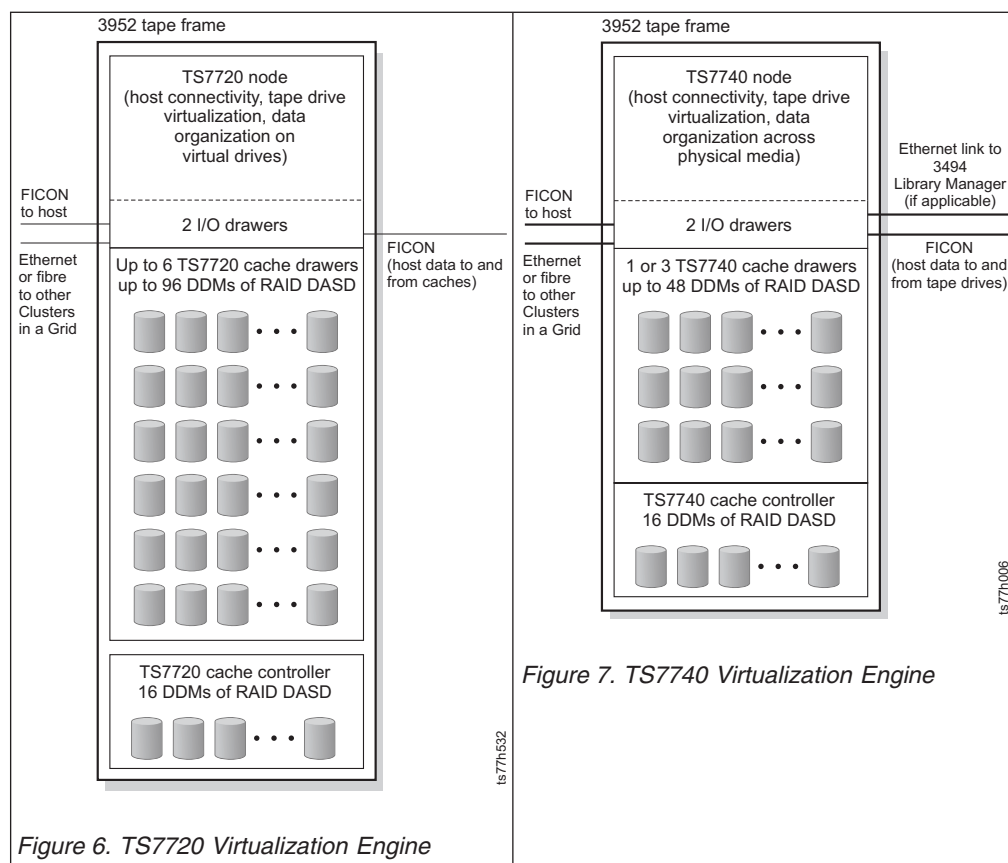


Figure 6. TS7720 Virtualization Engine

Figure 7. TS7740 Virtualization Engine

Related information

- “Concepts of storage virtualization” on page 2
- “TS7700 Virtualization Engine system configurations” on page 9
- “TS7700 Virtualization Engine system component details” on page 21
- “TS7700 Grid” on page 174
- “TS7720 Storage Expansion Frame” on page 27

Tape frame

A TS7700 Virtualization Engine is enclosed by a 3952 Tape Frame.

A 3952 Tape Frame contains the TS7700 Server and TS7700 Cache, as well as additional components such as switches and power distribution units for

connection to independent power sources. The 3952 Tape Frame can house either a TS7720 Virtualization Engine or a TS7740 Virtualization Engine.

Additionally, a 3952 Tape Frame used with a TS7720 Virtualization Engine can be designated as a TS7720 Storage Expansion Frame. When attached to a TS7720 Virtualization Engine, the TS7720 Storage Expansion Frame expands the TS7720 Cache by adding two additional TS7720 Cache Controllers, each with the capacity to support up to five additional TS7720 Cache Drawers.

Note: A TS7720 Virtualization Engine must be fully configured (contain a complete seven-drawer TS7720 Cache) before it can attach to a TS7720 Storage Expansion Frame.

Related information

“Concepts of storage virtualization” on page 2

“TS7700 Virtualization Engine system configurations” on page 9

“TS7700 Virtualization Engine system component details” on page 21

“TS7700 Grid” on page 174

TS7700 Server

The TS7700 Server facilitates data transfer between the host and data storage, as well as to and from physical tape drives when the TS7700 Virtualization Engine connects to a physical tape library.

The TS7700 Server performs the following major functions:

- Host connectivity
- Virtualization of tape drives and media, when connected to a physical tape library
- Storage, replication, and organization of data, including organization across tape libraries and physical media when connected to a physical tape library

3957-V07 and 3957-VEB configuration

A TS7700 Server (3957-V07 or 3957-VEB) configuration includes:

- 8 cores, on a 3.0 GHz processor card
- 16 GB of 1066 MHz ECC memory in a single processor card
- The following integrated features:
 - Service processor
 - Quad-port 10/100/1000 Mb Ethernet
 - EnergyScale™ technology
 - 3 USB ports
 - 2 system (serial) ports
 - 2 HMC ports
 - 2 SPCN ports
- The following expansion slots:
 - 2 PCIe x8 slots (short length adapter)
 - 1 PCIe slot (full adapter length)
 - 2 PCI-X DDR slots (full adapter length)
- The following storage features:
 - An internally connected 4-drive SAS bay

- A second 4-drive SAS bay connected by SAS adapter in the PCIe short slot
- A slim media bay for DVD-RAM

The TS7700 Server System Unit (3957-V07 or 3957-VEB) includes gigabit copper and optical fibre Ethernet adapters for grid configuration connection. Table 5 displays the slot numbers and adapters associated with ports on the system unit.

Table 5. TS7700 Server System Unit (3957-V07 or 3957-VEB) adapters

Slot Number	Adapter
1	PCIe dual-x4 adapter for SAS
2	PCIe adapter for connection to Expansion Unit I/O drawer
3	
4	10/100Mb dual port Ethernet to grid:
5	<ul style="list-style-type: none"> • Copper <ul style="list-style-type: none"> – “FC 1032, 1Gb grid dual port copper connection” on page 111 – “FC 1036, 1Gb grid dual port copper connection” on page 112* installed on the I/O drawer or • Optical fibre <ul style="list-style-type: none"> – “FC 1033, 1Gb grid dual port optical SW connection” on page 111 – “FC 1035, Grid optical LW connection” on page 111* installed on the I/O drawer – “FC 1037, 1Gb dual port optical SW connection” on page 112* installed on the I/O drawer
6	Not used
*Minimum required TS7700 Virtualization Engine microcode level is 8.20.0.xx.	

The TS7700 Server Expansion Unit for the 3957-V07 or 3957-VEB includes two input/output (I/O) drawers, which are identically configured and simultaneously active. The I/O drawers contain ports for connection to the host, to other internal component interfaces, and to tape drives when the TS7700 Server is connected to a tape library. Table 6 displays the slot numbers and adapters associated with ports on the expansion unit I/O drawers.

Table 6. TS7700 Server Expansion Unit I/O drawer adapters for 3957-V07 or 3957-VEB

Slot Number	Adapter
1	PCIe Ethernet adapter: <ul style="list-style-type: none"> • Dual port 1Gb, or • Single port 10Gb
2	Not used
3	PCIx 4 Gb FICON attachment to host†
4	PCIe 8 Gb dual port Fibre Channel: <ul style="list-style-type: none"> • Used for tape drive attachment by 3957-V07 • Present in 3957-VEB only if the optional cache expansion frame is installed
5	PCIe 8 Gb dual port Fibre Channel used for primary cache controller connectivity
6	PCIx 4 Gb FICON adapter

Table 6. TS7700 Server Expansion Unit I/O drawer adapters for 3957-V07 or 3957-VEB (continued)

Slot Number	Adapter
‡When four FICON adapters connect to hosts Note: FICON adapters may be upgraded in number (two to four) and kind (shortwave or longwave) using “FC 3441, FICON short-wavelength attachment” on page 114, “FC 3442, FICON long-wavelength attachment” on page 114, and “FC 3443, FICON 10-km long-wavelength attachment” on page 115.	

The minimum required TS7700 Virtualization Engine microcode level is 8.20.0.xx for use with the 3957-V07 and 3957-VEB. Use “FC 0521, Functional enhancement field” on page 110 to receive the most current levels of TS7700 Virtualization Engine code.

3957-V06 and 3957-VEA configuration

The TS7700 Server System Unit (3957-V06 and 3957-VEA) configuration includes gigabit copper and optical fibre Ethernet adapters for grid configuration connection. Table 7 displays the slot numbers and adapters associated with ports on the system unit.

Note: The TS7700 Server models 3957-V06 and 3957-VEA are scheduled for withdrawal on August 15, 2011.

Table 7. TS7700 Server System Unit (3957-V06 and 3957-VEA) adapters

Slot Number	Adapter
1	SCSI adapter for mirrored TS7740 Server hard drives
2	Not used
3	
4	Ethernet to grid: <ul style="list-style-type: none"> • Copper <ul style="list-style-type: none"> – “FC 1032, 1Gb grid dual port copper connection” on page 111‡ or • Optical fibre <ul style="list-style-type: none"> – “FC 1033, 1Gb grid dual port optical SW connection” on page 111‡
5	
6	Not used
‡Minimum required TS7700 Virtualization Engine microcode level is 8.5.0.xx.	

The TS7700 Server Expansion Unit for the 3957-V06 and 3957-VEA includes two input/output (I/O) drawers, which are identically configured and simultaneously active. The I/O drawers contain ports for connection to the host, to other internal component interfaces, and to tape drives when the TS7700 Server is connected to a tape library. Table 8 displays the slot numbers and adapters associated with ports on the expansion unit I/O drawers.

Table 8. TS7700 Server Expansion Unit I/O drawer adapters for 3957-V06 or 3957-VEA

Slot Number	Adapter
1	
2	

Table 8. TS7700 Server Expansion Unit I/O drawer adapters for 3957-V06 or 3957-VEA (continued)

Slot Number	Adapter
3	FICON attachment to host‡ Not used†
4	Fibre channel to TS7700 Cache Controller
5	Fibre channel to tape drives (used only with TS7740 Virtualization Engine)
6	FICON to host
†When two FICON adapters connect to hosts ‡When four FICON adapters connect to hosts Note: FICON adapters may be upgraded in number (two to four) and kind (shortwave or longwave) using “FC 3441, FICON short-wavelength attachment” on page 114, “FC 3442, FICON long-wavelength attachment” on page 114, and “FC 3443, FICON 10-km long-wavelength attachment” on page 115.	

The minimum required TS7700 Virtualization Engine microcode level is 8.4.0.39.

Related information

“Concepts of storage virtualization” on page 2

“TS7700 Virtualization Engine system configurations” on page 9

“TS7700 Virtualization Engine system component details” on page 21

“TS7700 Grid” on page 174

TS7700 Cache Controller

The TS7700 Cache Controller consists of a redundant array of independent disks (RAID) controller and associated disk storage media, which act as cache storage for data.

The TS7700 Cache Controller contains 16 disk drive modules (DDMs). The capacity of each depends on your configuration.

Note: Total cache capacity shown reflects raw capacity and does not directly correlate to usable capacity.

TS7720 Cache Controller

The TS7720 Cache Controller contains 16 DDMs, which each have a capacity of 2 TB (1.82 TiB). Total usable capacity per controller is 19.84 TB (18.05 TiB) when used with RAID-6 formatting.

For extended cache capacity you can order “FC 7323, TS7720 Storage expansion frame” on page 124 against a new 3952 Tape Frame and “FC 9323 Expansion frame attachment” on page 126 against the TS7720 Base Frame to attach a fully configured TS7720 Virtualization Engine to the TS7720 Storage Expansion Frame. This cache expansion frame contains two additional TS7720 Cache Controllers, each with the capacity to support up to six TS7720 Cache Drawers.

TS7740 Cache Controller

The TS7740 Cache Controller contains 16 DDMs, which each have a potential capacity up to 600 GB (558.78 GiB). Total usable capacity per controller is 7.04 TB (6.41 TiB) when used with RAID-5 formatting.

Related information

- “Concepts of storage virtualization” on page 2
- “Data storage values” on page 1
- “TS7700 Virtualization Engine feature codes” on page 102
- “TS7700 Virtualization Engine system configurations” on page 9
- “TS7700 Virtualization Engine system component details” on page 21
- “TS7700 Virtualization Engine upgrade options” on page 77
- “TS7700 Grid” on page 174
- “TS7720 Cache Drawer” on page 30
- “TS7720 Storage Expansion Frame” on page 27

TS7700 Cache Drawer

The TS7700 Cache Drawer acts as an expansion unit for the TS7700 Cache Controller, and collectively both are referred to as the *TS7700 Cache*.

The amount of cache available per TS7700 Cache Drawer depends on your configuration.

TS7720 Cache Drawer

Each TS7720 Cache Drawer contains 16 DDMs, which in turn each have a capacity of 2 TB. Total usable capacity per drawer is 23.84 TB (21.68 TiB) when used with RAID-6 formatting.

The base TS7720 Cache (contained by the TS7720 Base Frame) can be configured to contain up to six TS7720 Cache Drawers attached to one TS7720 Cache Controller. Fully configured, the base TS7720 Cache has a total usable capacity of 162.87 TB (148.13 TiB). Table 9 displays the storage capacities of a base TS7720 Cache with a range of TS7720 Cache Drawer configurations.

Table 9. Base TS7720 Cache configurations and capacities

Number of TS7720 Cache Controllers (3956-CS8)	Number of TS7720 Cache Drawers (3956-XS7)	Available capacity
1	1	43.68 TB (39.73 TiB)
	2	67.52 TB (61.41 TiB)
	3	91.35 TB (83.09 TiB)
	4	115.19 TB (104.77 TiB)
	5	139.03 TB (126.45 TiB)
	6	162.87 TB (148.13 TiB)

A fully-configured base TS7720 Cache can be expanded by attaching to a TS7720 Storage Expansion Frame using “FC 7323, TS7720 Storage expansion frame” on page 124. The TS7720 Storage Expansion Frame adds two TS7720 Cache Controllers (3956-CS8), each of which can attach to a maximum of five TS7720 Cache Drawers (2 TB 3956-XS7).

In the TS7720 Storage Expansion Frame each TS7720 Cache Controller and its attached TS7720 Cache Drawers are referred to as "strings", with each TS7720 Cache Controller acting as the "head of [the] string". For configurations and capacities of a TS7720 Cache including a TS7720 Storage Expansion Frame, refer to Table 12 on page 28 in the *TS7720 Storage Expansion Frame* topic link, available in the **Related information** section.

Refer to “FC 5647, Field install 3956-XS7” on page 121 and “FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05” on page 128 for additional information concerning field installation.

TS7740 Cache Drawer

Each TS7740 Cache Drawer contains 16 DDMs, which each have a potential capacity up to 600 GB (558.78 GiB). Total usable capacity per drawer is 6.86 TB (6.24 TiB) when used with RAID-5 formatting. Available configurations include:

Single-drawer

A single-drawer configuration consists of one TS7740 Cache Controller without an attached TS7740 Cache Drawer.

Two-drawer

A two-drawer configuration consists of one TS7740 Cache Controller attached to one TS7740 Cache Drawer.

Four-drawer

A four-drawer configuration consists of one TS7740 Cache Controller attached to three TS7740 Cache Drawers.

Table 10 displays the storage capacities of a base TS7740 Cache with a range of TS7740 Cache Drawer configurations.

Table 10. TS7740 Cache configurations and capacities

Number of TS7740 Cache Controllers		Number of TS7740 Cache Drawers	Usable capacity
3956-CC7	3956-CC8	3956-CX7	
1	0	0	3.44 TB (3.13 TiB)
1	0	1	10.48 TB (9.53 TiB)
1	0	3	24.57 TB (22.34 TiB)
0	1	0	7.04 TB (6.41 TiB)
0	1	1	14.09 TB (12.81 TiB)
0	1	3	28.17 TB (25.63 TiB)

Note: The following cache upgrade restrictions apply:

- An existing one-drawer TS7740 Cache subsystem can be upgraded to a two-drawer TS7740 Cache subsystem.
- An existing two-drawer TS7740 Cache subsystem can be upgraded to a four-drawer TS7740 Cache subsystem.
- No MES is available to upgrade an existing one-drawer TS7740 Cache subsystem directly to a four-drawer TS7740 Cache subsystem. A one-drawer cache subsystem must be upgraded to a two-drawer cache subsystem before an upgrade to a four-drawer cache subsystem can occur.

Refer to “FC 5642, Field install 3956-CX7” on page 121 and “FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05” on page 128 for additional information concerning field installation.

Related information

“Concepts of storage virtualization” on page 2

“Data storage values” on page 1

“TS7700 Virtualization Engine system configurations” on page 9

“TS7700 Virtualization Engine system component details” on page 21
“TS7700 Virtualization Engine upgrade options” on page 77
“TS7700 Grid” on page 174
“TS7720 Storage Expansion Frame” on page 27

Chapter 2. Planning

The topics in this section provide planning information related to your TS7700 Virtualization Engine.

TS7700 Virtualization Engine system component details

Major components of the TS7700 Virtualization Engine include the 3952 Tape Frame, TS7700 Server, TS7700 Cache Controller, and TS7700 Cache Drawer.

3952 Tape Frame details

This topic describes the key characteristics of the 3952 Tape Frame.

Note: Any lock on the 3952 F05 Frame prevents access to the TS7700 Virtualization Engine Emergency Power Off (EPO) switch. If a lock (FRU 12R9307) is installed on the 3952 F05 Frame, an external EPO switch or circuit breaker must be installed near the TS7700 Virtualization Engine to permit emergency shut down. Additionally, the emergency contact label included with the *Installation Instruction RPQ 8B3585 (Front/Rear and Side Panel Locking Procedure)*, PN 46X6208, must be completed and affixed to the 3952 F05 Frame door in an immediately visible location. This label must clearly indicate the location of the external EPO switch or circuit breaker.

If a lock is installed on the 3952 F05 Frame and the original key is not available, any 3952 F05 Frame key can be used to open the lock. If no frame key is available and immediate access is required to get inside the frame, you must contact a locksmith to open the lock. If the key is still unavailable after the lock has been opened, you can contact your IBM service representative to order a new lock and key set (FRU 12R9307).

The 3952 F05 Base Frame houses TS7700 Virtualization Engine controllers and their components. The 3952 F05 Base Frame used with the TS7700 Virtualization Engine contains the following components:

- Ethernet switches

Note: Ethernet routers are supported if FC 9110, Ship with R1.7 machine code, is installed.

- Optional components
 - TSSC Server
 - Keyboard and monitor
 - Ethernet switch
- TS7700 Server
 - TS7720 Server (3957-VEB)
 - TS7740 Server (3957-V07)
- I/O drawers
- Cache controller
 - TS7720 Cache Controller (3956-CS7/CS8)
 - TS7740 Cache Controller (3956-CC7/CC8)
- Optional cache expansion drawers

- TS7720 Cache Drawer (3956-XS7)
- TS7740 Cache Drawer (3956-CX6, 3956-CX7)

Table 11 lists the physical characteristics of a maximally configured 3952 Tape Frame. For physical specifications of a 3952 Tape Frame and its individual components, refer to the topic *3952 Tape Frame specifications* in the **Related information** section.

Table 11. Physical characteristics of a maximally configured 3952 Tape Frame

Characteristic	Value
Height	1804 mm (71.0 in.)
Width	644 mm (25.4 in.)
Depth	1098 mm (43.23 in.)
Weight	270 kg (595.25 lbs.) empty 565.6 kg (1570 lbs.) maximally configured †
Power	240 Vac, 15 amp (single phase)
Unit height	36 U
†Refer to the topics “TS7720 Virtualization Engine specifications and requirements” on page 48 and “TS7740 Virtualization Engine specifications and requirements” on page 51 for maximum configurations for the TS7720 Virtualization Engine and the TS7740 Virtualization Engine.	

The 3952 Tape Frame can be designated as a TS7720 Storage Expansion Frame when ordered with FC 7323, TS7720 Storage expansion frame. Refer to the topic *TS7720 Storage Expansion Frame* in the **Related information** section for TS7720 Storage Expansion Frame features and storage capacities.

Related information

- “3952 Tape Frame specifications” on page 46
- “System requirements” on page 46
- “TS7720 Storage Expansion Frame” on page 27
- “TS7720 Virtualization Engine specifications and requirements” on page 48
- “TS7740 Virtualization Engine specifications and requirements” on page 51

TS7700 Server details

The TS7700 Server is comprised of a server and two drawers for I/O adapters.

The TS7700 Server controls virtualization processes such as host connectivity and device virtualization, and hierarchical storage management (HSM) functions such as storage, replication, and organization of data across physical media and libraries.

The TS7700 Server offers the following features:

- Eight-core design with one 3.0 GHz processor
- Processor card and memory configuration (using only 8 GB DDR3 DIMMs):
 - 16 GB total memory with 1 processor card and 8 cores
- An additional SAS controller with support for RAID 0,1,5,6 and 10
- 8 SFF 146 GB SAS internal drives using RAID 1
- Quad-port 10/100/1000 Mb Ethernet
- Three USB ports

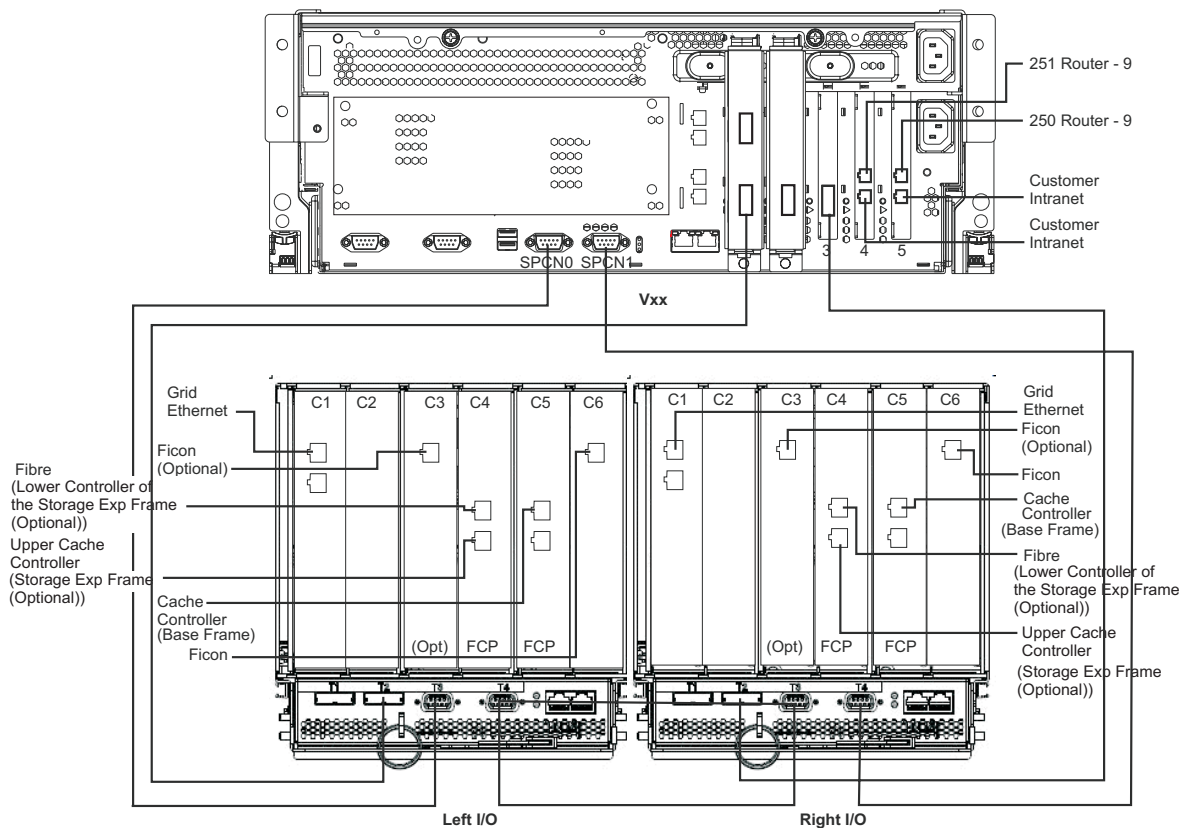
- Two system (serial) ports
- Two HMC ports
- Two SPCN ports
- Extended Error Handling (EEH) and hot plug support on PCI expansion slots
- Two four-drive SAS bays
- One slim line DVD RAM drive

Each Expansion Unit I/O adapter drawer offers the following features:

- Six additional hot-pluggable PCIe cartridge style slots (used to house FICON adapters for host attachment, fibre channel adapters for cache drawer attachment, fibre channel adapters for tape communication, and Ethernet adapters for grid communication).
 - PCIe standard achievable using Kleber riser adapters
 - PCI-X standard achievable using Oroville riser adapters
- Always redundant AC power
- Always redundant cooling
- Concurrent maintenance of:
 - PCIe or PCI-X adapters
 - Two power supplies
 - Two fans
- PCIe Gen2, four-lane cable connection to the TS7700 Server (PCIe connector at both ends)

Figure 8 on page 24 depicts the TS7700 Server connected to two I/O expansion drawers.

Note: Base frame and expansion frame notations in the illustration refer to a TS7700 Server configured for use with a TS7720 Virtualization Engine. These connections are not used when the TS7700 Server is configured for use with a TS7740 Virtualization Engine.



Vxx	
From	To
Router Ethernet Alt port 0 (disconnect)	Vxx slot 5 lower port (reconnect)
Router Ethernet Pry port 0 (disconnect)	Vxx slot 4 lower port (reconnect)
Router Ethernet Alt port 9 (leave connected)	Vxx slot 5 upper port (reconnect)
Router Ethernet Pry port 9 (leave connected)	Vxx slot 4 upper port (reconnect)
SPCN0	Left I/O T3
SPCN1	Right I/O T4
Processor Slot 2	Left I/O T2
Processor Slot 3	Right I/O T2

Left I/O Drawer	
From	To
T2	Processor Vxx slot 2
T3	Processor Vxx SPCN0
T4	Right I/O T3

Right I/O Drawer	
From	To
T2	Processor Vxx slot 3
T3	Left I/O T4
T4	Processor Vxx SPCN1

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Figure 8. TS7700 Server and I/O expansion drawers

Related information

“System requirements” on page 46

IBM Virtualization Engine TS7720 details

This section provides topics for the IBM Virtualization Engine TS7720 components.

Figure 9 on page 25 displays the frame layout for a manufacturing installed TS7720 Virtualization Engine.

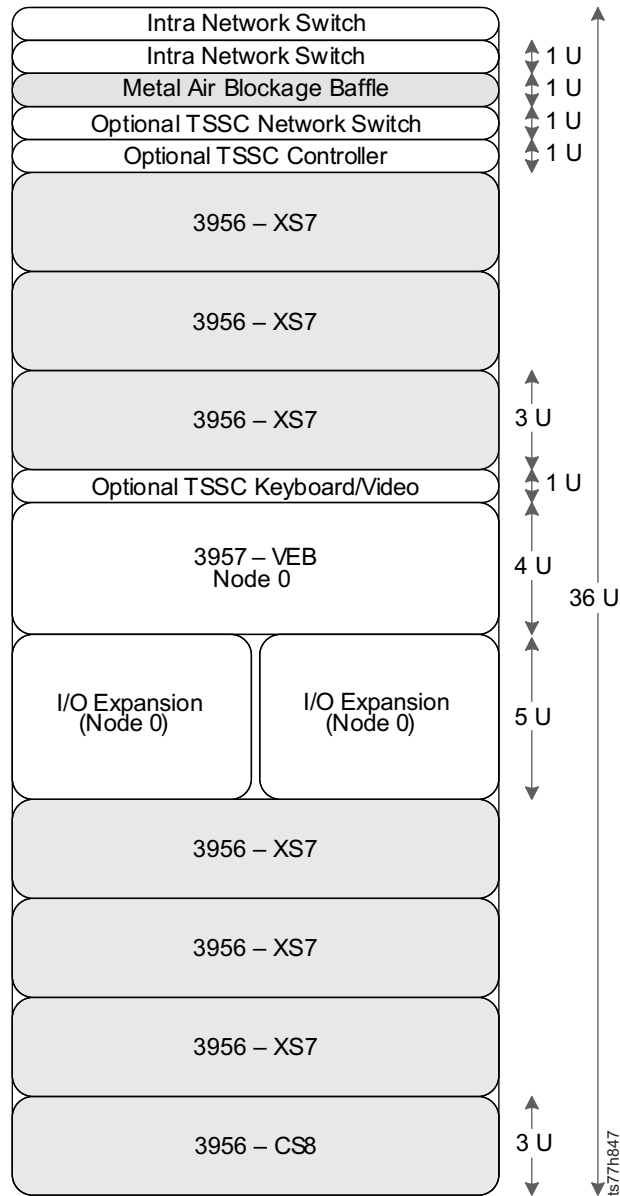


Figure 9. Single frame layout of a TS7720 Virtualization Engine with manufacturing installed 3957-VEB, 3956-CS8, and 3956-XS7

Figure 10 on page 26 displays the frame layout for a TS7720 Virtualization Engine in the field configured using 3956-CS7/CS8 and 3956-XS7 and upgraded with a 3957-VEB.

Note: Use of a 3956-CS7 in this configuration is only supported when a field-installed 3957-VEB replaces an existing 3957-VEA attached to a 3956-CS7.

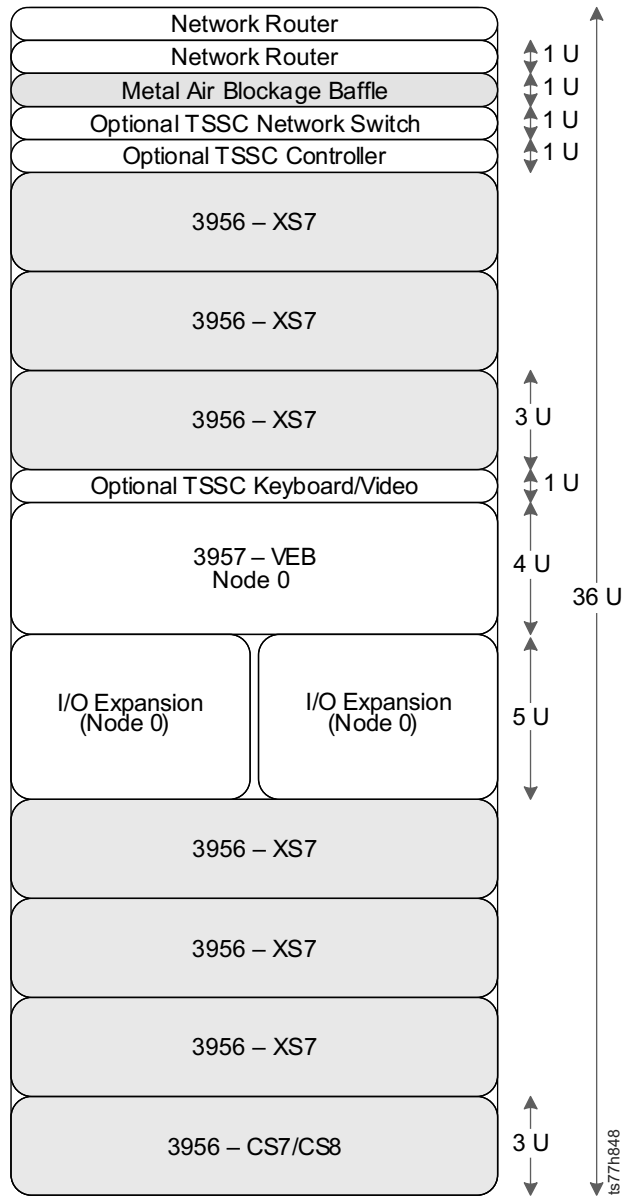


Figure 10. Single frame layout of a TS7720 Virtualization Engine with 3956-CS7/CS8 and 3956-XS7 and field upgraded with a 3957-VEB

Figure 11 on page 27 displays the frame layout for a TS7720 Storage Expansion Frame.

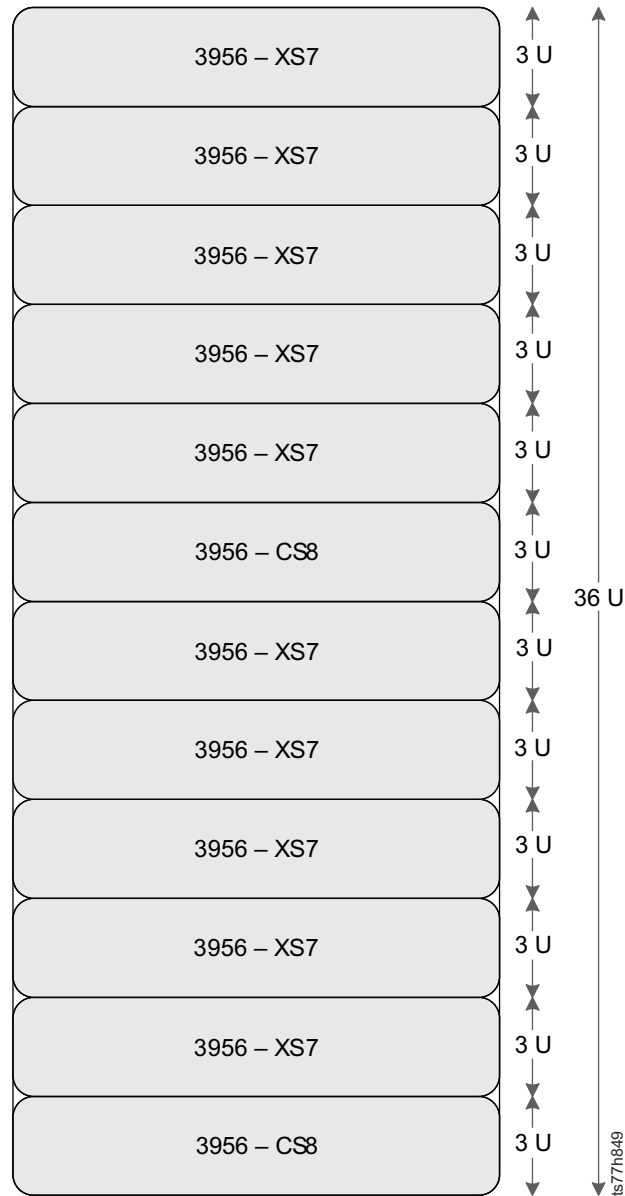


Figure 11. Layout of a TS7720 Storage Expansion Frame with 3956-CS8 and 3956-XS7

Related information

“System requirements” on page 46

TS7720 Storage Expansion Frame

The TS7720 Storage Expansion Frame is a 3952 Tape Frame designated as a cache expansion frame for use with a fully-configured TS7720 Virtualization Engine Base Frame.

The TS7720 Storage Expansion Frame enables expansion of the TS7720 Cache by attaching an additional storage frame containing two additional TS7720 Cache Controllers. Each additional controller can attach to a maximum of five additional TS7720 Cache Drawers, resulting in a maximum addition of 12 TS7720 Cache units (2 controllers and 10 drawers) within the TS7720 Storage Expansion Frame. Each TS7720 Cache Controller and its attached TS7720 Cache Drawers are referred to as "strings", with each TS7720 Cache Controller acting as the "head of [the] string".

The distance between a TS7720 Storage Expansion Frame and the TS7720 Base Frame cannot exceed 10 meters, as per the prerequisites for “FC 7323, TS7720 Storage expansion frame” on page 124. This distance permits connection of the two frames using a 30 meter cable.

Note: A TS7720 Virtualization Engine configured to use the TS7720 Storage Expansion Frame must operate a microcode level of 8.7.0.xx or higher.

The TS7720 Storage Expansion Frame offers the following features:

- Two TS7720 Cache Controllers (3956-CS8), each containing 16 DDMs, each of which have a storage capacity of 2 TB
- Optional attachment to up to 10 TS7720 Cache Drawers (3956-XS7)
- Two 4 Gb, dual-ported fibre host bus adapter cards

Table 12. TS7720 Storage Expansion Frame configurations with a new TS7720 Virtualization Engine

Cache configuration in a new TS7720 Virtualization Engine	Additional TS7720 Storage Expansion Frame cache controllers (3956-CS8)†	Additional TS7720 Storage Expansion Frame cache drawers (3956-XS7)†	Total TS7720 Cache units‡ (including TS7720 Base Frame)	Available capacity (when TS7720 Base Frame contains only 2 TB drives)
1 TS7720 Cache Controller (3956-CS7 or 3956-CS8)	2	0	9	202.86 TB (184.50 TiB)
		1	10	226.85 TB (206.32 TiB)
2		11	250.85 TB (228.14 TiB)	
3		12	274.84 TB (249.97 TiB)	
4		13	298.84 TB (271.79 TiB)	
5		14	322.84 TB (293.62 TiB)	
6		15	346.83 TB (315.44 TiB)	
7		16	370.83 TB (337.27 TiB)	
8		17	394.82 TB (359.09 TiB)	
9		18	418.82 TB (380.91 TiB)	
6 TS7720 Cache Drawers (3956-XS7)		10	19	442.82 TB (402.74 TiB)
†The lower controller must control at most one more drawer than the upper controller.				
‡The term "Total cache units" refers to the combination of cache controllers and cache drawers.				

A new TS7720 Storage Expansion Frame can be added to a fully-configured TS7720 Virtualization Engine using “FC 7323, TS7720 Storage expansion frame” on page 124

124 as a miscellaneous equipment specification (MES). Refer to the topic *Upgrades specific to the TS7720 Virtualization Engine* in the **Related information** section for MES details and requirements.

Related information

“Feature details” on page 108

“System requirements” on page 46

“Upgrades specific to the TS7720 Virtualization Engine” on page 83

TS7720 Cache Controller

The TS7720 Cache Controller is a self-contained 3U enclosure that mounts in the 3952 Tape Frame.

The TS7720 Cache Controller provides RAID-protected virtual volume disk storage for fast retrieval of data from cache. The TS7720 Cache Controller offers the following features:

- Two fibre channel processor cards
- Intel[®] xScale 667MHz or custom ASIC microprocessor
- Two battery backup units (one for each processor card)
- Two AC or DC power supplies with imbedded enclosure cooling units
- 16 DDMs, each with a storage capacity of 2 TB (1.82 TiB)
- Optional attachment to a maximum of six TS7720 Cache Drawers in a TS7720 Base Frame
- Optional expansion of cache capabilities (up to 16 total TS7720 Cache Drawers) when a fully populated TS7720 Base Frame attaches to a fully populated TS7720 Storage Expansion Frame



Figure 12. TS7720 Cache Controller 3956-CS8 (rear view)

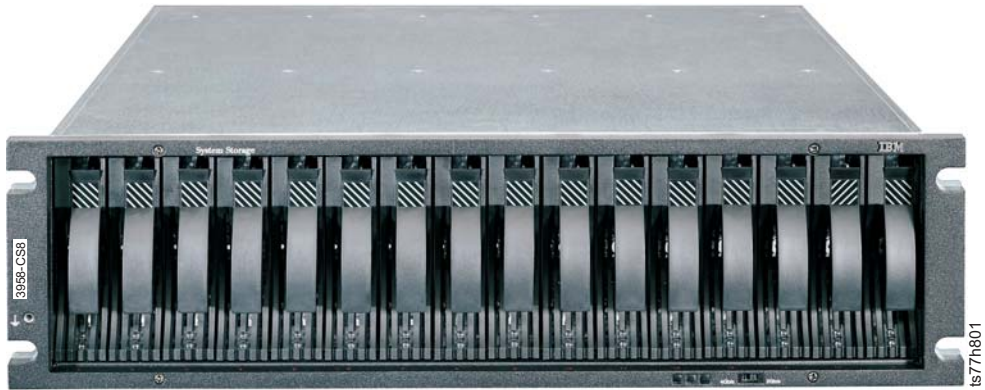


Figure 13. TS7720 Cache Controller 3956-CS8 (front view)

†Refer to the topic *Trademarks* in the **Related information** section for complete attribution.

Related information

“System requirements” on page 46

“TS7720 Storage Expansion Frame” on page 27

TS7720 Cache Drawer

The TS7720 Cache Drawer is a self-contained 3U enclosure that mounts in the 3952 Tape Frame.

The TS7720 Cache Drawer expands the capacity of the TS7720 Cache Controller by providing additional RAID-protected disk storage. Each TS7720 Cache Drawer offers the following features:

- Two fibre channel processor cards
- Two AC or DC power supplies with imbedded enclosure cooling units
- 16 DDMs, each with a storage capacity of 2 TB (1.82 TiB)
- Attachment to the TS7720 Cache Controller



Figure 14. TS7720 Cache Drawer 3956-XS7 (rear view)



Figure 15. TS7720 Cache Drawer 3956-XS7 (front view)

Related information

“System requirements” on page 46

IBM Virtualization Engine TS7740 details

This section provides topics for the IBM Virtualization Engine TS7740 components.

Figure 16 on page 32 displays the frame layout for a manufacturing installed TS7740 Virtualization Engine.

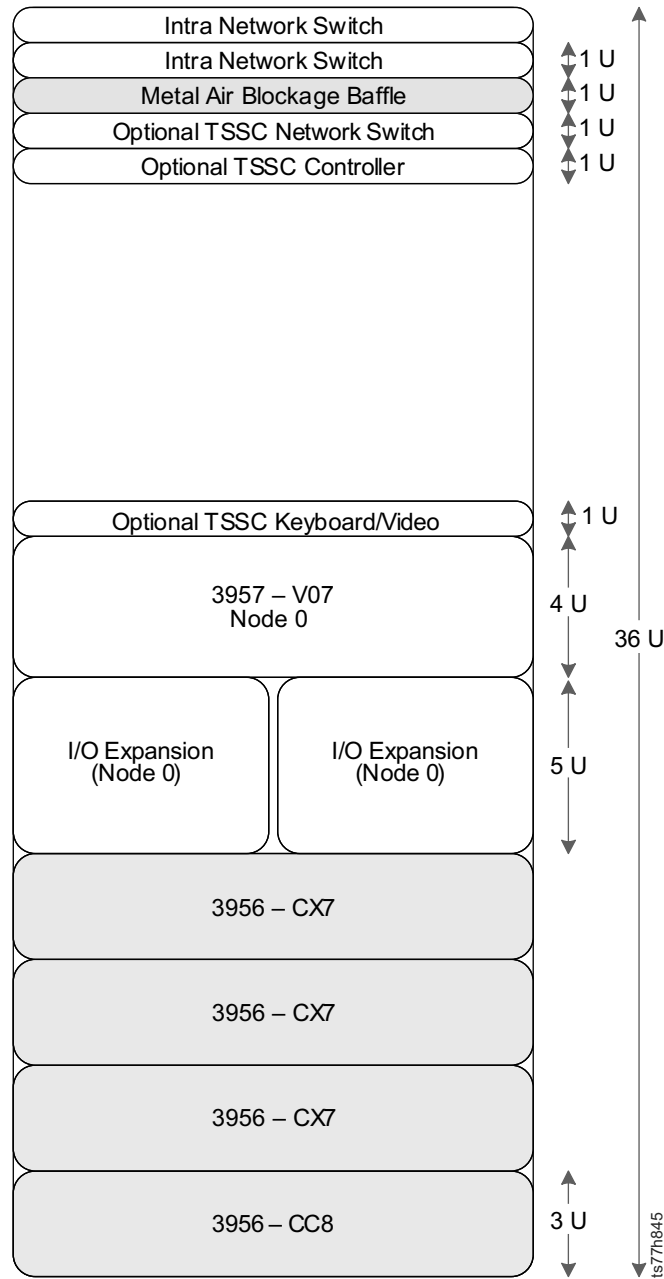


Figure 16. Single frame layout of a TS7740 Virtualization Engine with a manufacturing installed 3957-V07, 3956-CC8, and 3956-CX7

Figure 17 on page 33 displays the frame layout for a TS7740 Virtualization Engine in the field configured using 3956-CC7/CC8 and 3956-CX7 and upgraded with a 3957-V07.

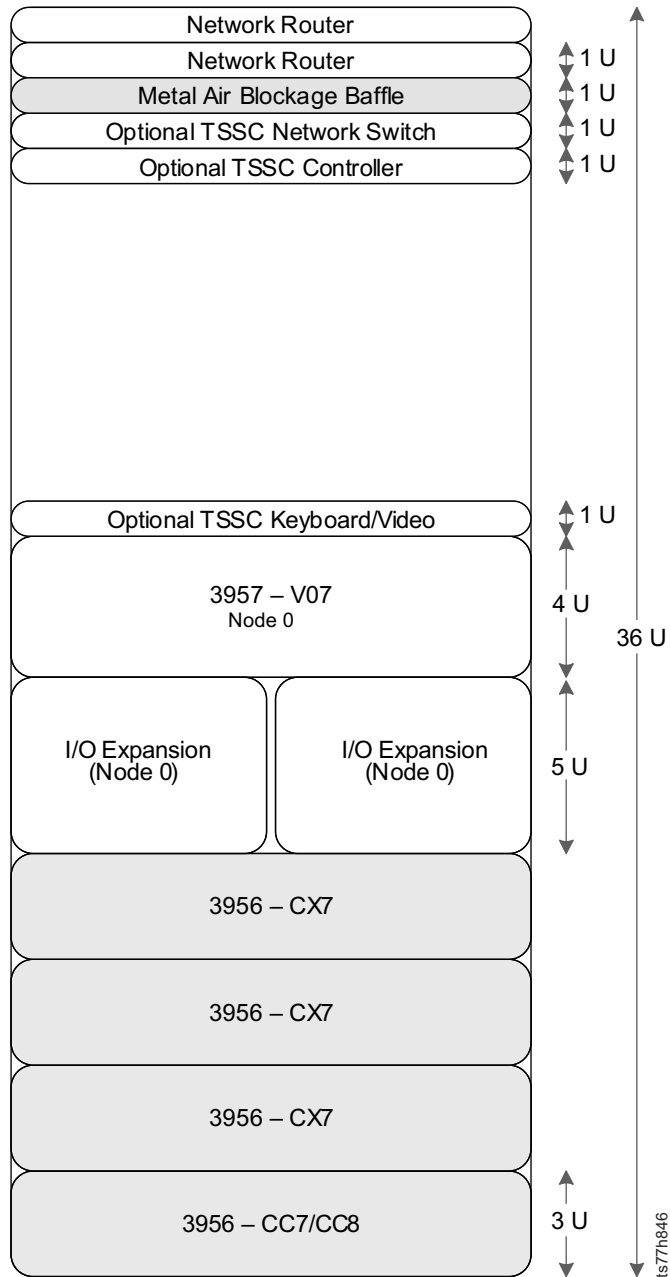


Figure 17. Single frame layout of a TS7740 Virtualization Engine with 3956-CC7/CC8 and 3956-CX7 and field upgraded with a 3957-V07

Related information

“System requirements” on page 46

TS7740 Cache Controller

The TS7740 Cache Controller is a self-contained 3U enclosure that mounts in a 3952 Tape Frame.

The TS7740 Cache Controller provides RAID-protected virtual volume disk storage to temporarily hold data from the host before writing to physical tape, then caches the data to allow fast retrieval from the disk. The TS7740 Cache Controller offers the following features:

- Two fibre channel processor cards

- PowerPC® 750GX 1 GHz processor
- Two battery backup units (one for each processor card)
- Two AC or DC power supplies with imbedded enclosure cooling units
- 16 DDMs:
 - 3956-CC7 DDMs each possess 300 GB (279.39 GiB) storage capacity
 - 3956-CC8 DDMs each possess 600 GB (558.78 GiB) storage capacity
- Optional attachment to one or three TS7740 Cache Drawers.



Figure 18. TS7740 Cache Controller 3956-CC7 (rear view)

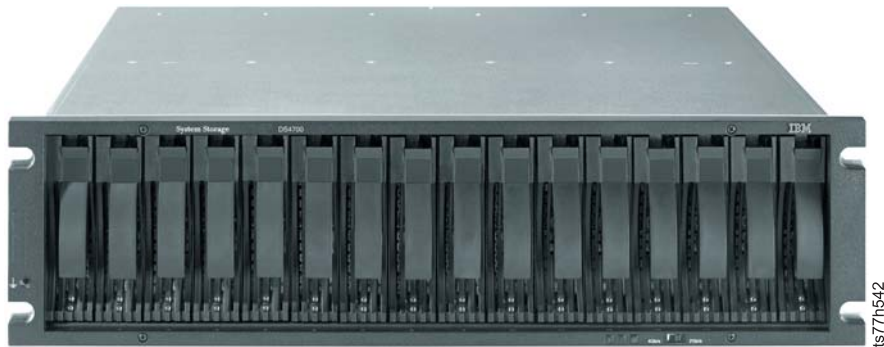


Figure 19. TS7740 Cache Controller 3956-CC7 (front view)



Figure 20. TS7740 Cache Controller 3956-CC8 (rear view)

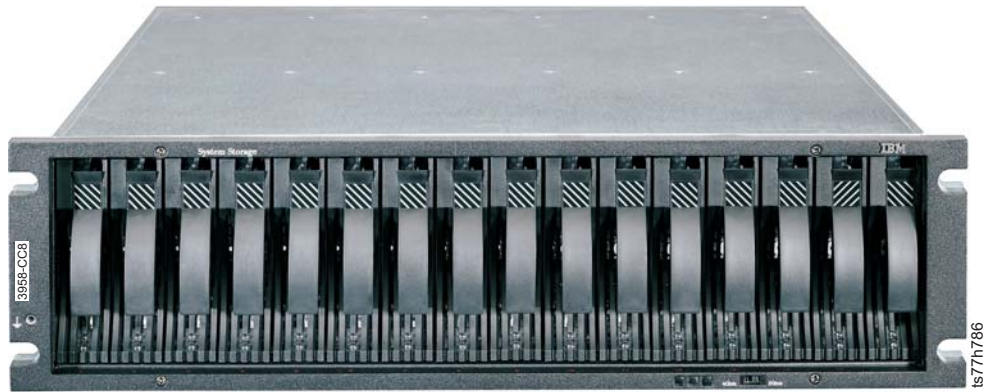


Figure 21. TS7740 Cache Controller 3956-CC8 (front view)

Related information

“System requirements” on page 46

TS7740 Cache Drawer

The TS7740 Cache Drawer is a self-contained 3U enclosure that mounts in the 3952 Tape Frame.

The TS7740 Cache Drawer expands the capacity of the TS7740 Cache Controller by providing additional RAID-protected disk storage. Each TS7740 Cache Drawer offers the following features:

- Two fibre channel processor cards
- Two AC or DC power supplies with imbedded enclosure cooling units
- 16 DDMs:
 - 3956-CX7 DDMs each possess 600 GB (558.78 GiB) storage capacity
- Attachment to the TS7740 Cache Controller



Figure 22. TS7740 Cache Drawer 3956-CX7 (rear view)

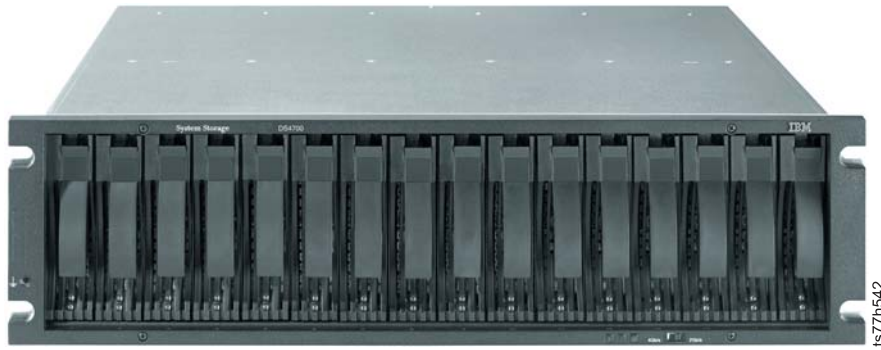


Figure 23. TS7740 Cache Drawer 3956-CX7 (front view)

Related information

“System requirements” on page 46

Tape library attachments, drives, and media

In the IBM Virtualization Engine TS7740 configuration, a TS7700 Virtualization Engine is used in conjunction with a tape library attached to a host system.

The TS7740 Virtualization Engine provides storage virtualization for host systems attached to the following tape libraries:

- IBM System Storage TS3500 Tape Library (TS3500 Tape Library)
- 3494 Tape Library

Note: Attachment to a 3494 Tape Library is not formally supported by code levels of 8.6.0.xx or later. Support for 3494 Tape Library attachment is available only by RPQ.

Attachment to a 3494 Tape Library is not supported by microcode levels of 8.20.0.xx or later. Any TS7740 Virtualization Engine that attaches to a 3494 Tape Library, either officially or by RPQ, must convert the back end library to a TS3500 Tape Library and remove FC 9218, Attach to 3494 LM (if present) before upgrading to a microcode level of 8.20.0.xx or later. A TS7740 Virtualization Engine operating a microcode level of 8.20.0.xx or later does not come online if an attached 3494 Tape Library is detected.

Related information

“TS7700 Grid” on page 174

“3494 Tape Library attachment”

“TS3500 Tape Library attachment” on page 37

3494 Tape Library attachment:

Attachment of the TS7700 Virtualization Engine to the 3494 Tape Library involves power control, interface to tape drives in the tape library, and communication with the Library Manager in the tape library.

Note: Attachment to a 3494 Tape Library is not formally supported by code levels of 8.6.0.xx or later. Support for 3494 Tape Library attachment is available only by RPQ.

The attachment of the TS7700 Virtualization Engine to the 3494 Tape Library involves the following connections:

Power control

The 3494 Tape Library contains power sequencing and control equipment that remotely turns on and off the power to the TS7700 Virtualization Engine. This is the normal mode of power control for the TS7700 Virtualization Engine.

Note: This power control is not a physical connection. For power sequencing and shutdown information, refer to *IBM TotalStorage 3494 Tape Library Operator Guide*, GA32-0449, available at the *IBM Support & Downloads* web page linked in the **Related information** section.

Library Manager and tape drives

The 3494 Tape Library contains a minimum of one internal Library Manager; there is no need for an external Library Manager as there is for the TS3500 Tape Library. Communication and control signals travel among the Library Manager, the TS7700 Virtualization Engine, and the tape drives within the 3494 Tape Library through a local area network (LAN). Data between the host and the TS7700 Virtualization Engine travels along FICON connections. Data travels between the TS7700 Virtualization Engine and the tape drives within the 3494 Tape Library along fibre channel connections. A fibre channel switch routes the data to and from the correct tape drive.

Note:

1. The TS7700 Virtualization Engine can only attach to 3592 Tape Drives. Up to 12 3592 Tape Drives in a single model D22 frame in the 3494 Tape Library can be attached to the TS7700 Virtualization Engine.
2. The term *3592 Tape Drives* refers collectively to 3592 J1A Tape Drives, TS1120 Tape Drives, and TS1130 Tape Drives.

The following 3494 Tape Library feature codes are required to support attachment to the TS7700 Virtualization Engine:

- FC 5214, Second Disk Drive for Library Manager, installed on all Library Managers in the 3494 Tape Library
- FC 5246, Dual Path Concentrator, installed on all frames in the 3494 Tape Library that contain a Library Manager

For additional information concerning 3494 Tape Library features, refer to *IBM TotalStorage 3494 Tape Library Introduction and Planning Guide*, GA32-0448, available at the *IBM Support & Downloads* web page linked in the **Related information** section.

Related information

FC 9218, Attach to 3494 LM

 <http://www.ibm.com/support/us/en/>

TS3500 Tape Library attachment:

A TS7740 Virtualization Engine attached to a TS3500 Tape Library (3584 Tape Library) interfaces directly with tape drives in the library.

When attached to a TS3500 Tape Library, the TS7700 Virtualization Engine can only attach to 3592 Tape Drives. Up to 16 3592 Tape Drives can be attached; the tape drives must reside in either Model L22, L23, D22, or D23 frames in the tape library. Each frame can contain up to 12 3592 Tape Drives.

Communication, control, and data signals travel along Fibre Channel connections between the TS7700 Virtualization Engine and tape drives contained in the TS3500 Tape Library. A pair of Fibre Channel switches routes the data to and from the correct tape drive.

Notes:

1. FC 0203, 50-micron LC/LC 31-meter provides a 50 micron, 31 m fibre cable for connection between the fibre switch and the host.
2. FC 1950, Power Distribution Unit, ordered against the TS3500 Tape Library, provides higher capacity connection between a TS3500 Tape Library and a TS7700 Virtualization Engine.

The distance between a TS3500 Tape Library attached to a TS7700 Virtualization Engine should not exceed 30 m (98.43 ft.). Although the length of Fibre Channel cables provided by “FC 0203, 50-micron LC/LC 31-meter” on page 109 is 31 m (101.71 ft.), the remaining 1 m (3.28 ft.) length is required to complete attachments within the frames.

To ensure correct operation of 3592 Tape Drives in a TS3500 Tape Library attached to the TS7700 Virtualization Engine, you must:

- Install and enable the Advanced Library Management System (ALMS) on the TS3500 Tape Library.
- Designate four 3592 Tape Drives as control paths using the operator panel on the TS3500 Tape Library or the Tape Library Specialist Web interface.
- Install either a Model L22 and a Model D22 frame, or a Model L23 and a Model D23 frame, or a combination of L- and D- Model frames if you want automatic log capturing.

Related information

FC 0203, 50-micron LC/LC 31-meter
FC 9217, Attach to 3953 LM

Tape drives:

The TS7740 Virtualization Engine supports only TS1130 Tape Drives, TS1120 Tape Drives (in native mode and emulating 3592 J1A Tape Drives), and 3592 J1A Tape Drives. These are collectively referred to as *3592 Tape Drives*. Unique drive characteristics are referenced with the specific drive model when appropriate.

In order to use encryption, all drives associated with the TS7740 Virtualization Engine must be encryption-capable and -enabled TS1130 Tape Drives or TS1120 Tape Drives. Encryption is not supported on 3592 J1A tape drives. If you intend to use TS1120 Tape Drives in encryption mode, you must enable encryption on **all** TS1120 Tape Drives attached to the TS7740 Virtualization Engine.

Use “FC 0521, Functional enhancement field” on page 110 to receive the most current levels of TS7740 Virtualization Engine microcode.

Note: Intermix of TS1130 E06 Tape Drives and prior 3592 drive types is not supported.

Related information

“3592 Tape Drives” on page 39
“Secure Data Erasure” on page 41
“Tape encryption overview” on page 87

FC 9900, Encryption configuration

3592 Tape Drives:

This section describes the 3592 Tape Drives associated with the TS7740 Virtualization Engine.

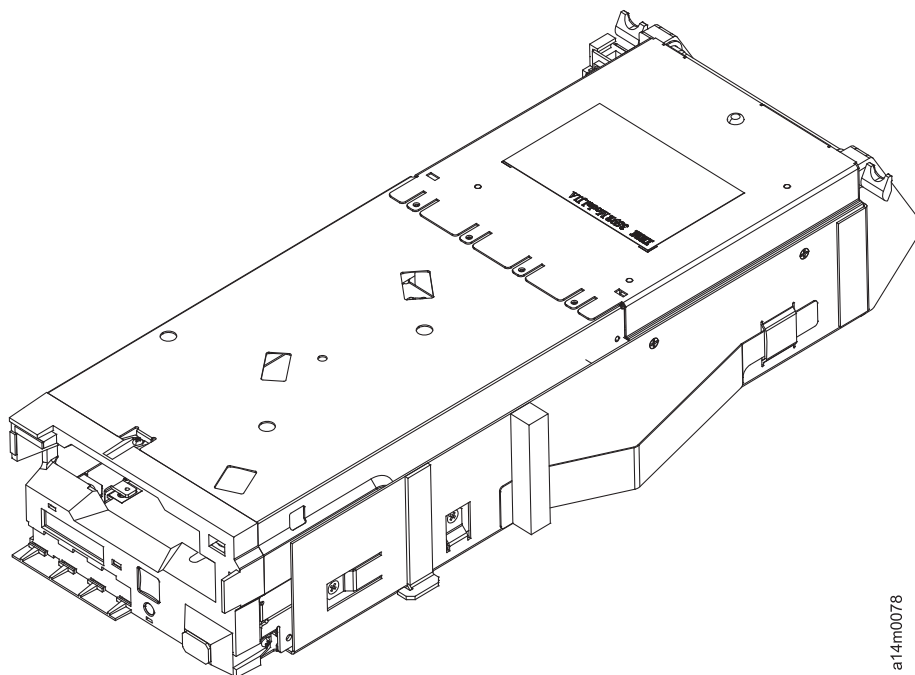
3592 Tape Drives refer collectively to 3592 J1A Tape Drives, TS1120 Tape Drives, or TS1130 Tape Drives. Tape drive types used with the TS7740 Virtualization Engine cannot be intermixed, except for 3592 J1A Tape Drives and TS1120 Tape Drives operating in 3592 J1A emulation mode. Both TS1120 and TS1130 Tape Drives can be enabled for encryption.

When compared to the 3590 Tape Drive models, 3592 Tape Drives are smaller in size and offer higher performance, reliability, and cartridge capacity. The 3592 Tape Drives achieve greater overall storage capacity than the 3590 Tape Drive models, while simultaneously reducing the required number of tape drives and cartridges as well as the required amount of floor space. For comparison of standard features of the 3592 Tape Drives, refer to *IBM System Storage TS1120 and TS1130 Tape Drives and TS1120 Controller Introduction and Planning Guide (3592 Models J1A, E05, E06, EU6, J70 and C06)*, GA32-0555, available at the *IBM Support & Downloads* web page linked below.

Other features include:

- Dual-ported 8 Gbps Fibre Channel switch attachments
- High reliability and availability
- Small form factor
- Redundant power supplies
- Dynamic digital speed matching
- Individual read/write data channel calibration
- Increased search speed
- Streaming Lossless Data Compression (SLDC) algorithm

Figure 24 on page 40 illustrates the 3592 Tape Drive.



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Figure 24. 3592 Tape Drive

Native capacity of 3592 E05 Tape Drives and 3592 E06 Tape Drives

The TS7740 Virtualization Engine uses the native capacity of 3592 E05 Tape Drives and 3592 E06 Tape Drives with the following restrictions:

- If any 3592 E05 or E06 tape drives are installed and configured in their native mode, then no 3592 J1A drives can exist in the TS7740 Virtualization Engine configuration.
- All tape drives attached to the TS7740 Virtualization Engine must be 3592 E05 or E06 tape drives; the combination of encryption-capable and non-encryption-capable drives is not supported.
- Once the TS7740 Virtualization Engine is online and tape drives are running in native 3592 E05 or E06 mode, 3592 J1A Tape Drives may not be added to the configuration.
- Once physical volumes have been written in native 3592 E05 or E06 mode, the TS7740 Virtualization Engine can no longer operate in 3592 J1A emulation mode.

Note: If the TS7740 Virtualization Engine is returned to 3592 J1A emulation mode after physical volumes have been written in native 3592 E05 or E06 mode, the TS7740 Virtualization Engine cannot be returned to an online status.

TS1120 Tape Drives/3592 E05 Tape Drives operate in native E05 mode or in 3592 J1A emulation mode. However, all 3592 Tape Drives associated with the TS7740 Virtualization Engine must be TS1120 Tape Drives in order for 3592 E05 Tape Drives to operate in native E05 mode. To use 3592 E05 Tape Drives in native E05 mode, the drives must be set to E05 native mode. If you intend to use TS1120 Tape Drives in native E05 Mode, the minimum microcode levels are 8.0.1.xx for the TS7740 Virtualization Engine and 534.2x for the Library Manager. If you intend to use TS1130 Tape Drives, the minimum microcode level for the TS7740

Virtualization Engine is 8.5.0.xx. Use “FC 0521, Functional enhancement field” on page 110, to receive the most current levels of TS7740 Virtualization Engine and Library Manager code.

Related information

“3592 Tape Cartridges”

 <http://www.ibm.com/support/us/en/>

Secure Data Erasure:

The Secure Data Erasure function enables a secure data erasure reclamation policy for data stored on 3592 Tape Drives.

The Secure Data Erasure function monitors the age of expired data on a physical volume. When the age exceeds the customer-set limit, Secure Data Erasure forces a reclaim and physical overwrite of the data on the volume.

Note: If the TS7700 Virtualization Engine system must be taken offline while data is being erased from a 3592 Tape Drive, the Secure Data Erasure function is automatically cancelled during the offline process and resumes when the system is brought online.

Encryption and Secure Data Erasure

If a physical volume is encrypted, the TS7700 Virtualization Engine does not perform a physical overwrite of the data. Instead, the Encryption Key (EK) is shredded, or essential information is removed from the encrypted tape, rendering the encrypted data unrecoverable. This function matches an existing 3494 VTS function.

When compared to the normal, or long, erasure operation, EK shredding is a much faster procedure. Furthermore, normal erasure is always used for non-encrypted tapes, while EK shredding is the default used for encrypted tapes. However, the first time an encrypted tape is erased, a normal erasure is performed, followed by an EK shredding. The TS7700 Virtualization Engine can be configured to perform a normal erasure with every data operation, but this function must be configured by an IBM Service Representative.

Related information

“3592 Tape Cartridges”

“Tape encryption overview” on page 87

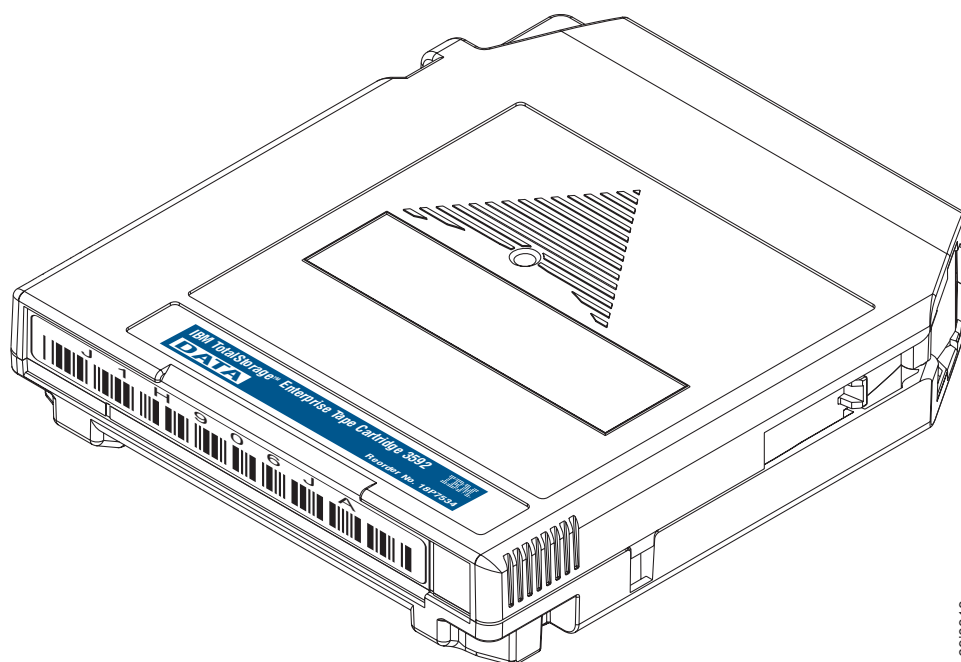
Tape media:

This section describes the tape media associated with the TS7700 Virtualization Engine.

3592 Tape Cartridges:

This section describes the tape cartridges that are used by 3592 Tape Drives in the TS3500 Tape Library.

Figure 25 on page 42 shows the IBM TotalStorage 3592 Enterprise Tape Cartridge.



a6910313

Figure 25. IBM 3592 Tape Cartridge

Tape cartridges can be distinguished by the text on the product label, as well as by the color of the label. Table 13 lists the characteristics of the 3592 Tape Cartridges.

Table 13. Types of IBM 3592 Tape Cartridges

Text on product label; media type	Native capacity		Color of case	Color of label, door, and write-protect switch
	TS1120	TS1130		
Data; JA	J1A format: 300 GB (279.39 GiB) E05 format: 500 GB (465.6 GiB)	640 GB (596.04 GiB)	Black	Dark blue
Data; JB	700 GB (651.93 GiB)	1 TB (931.32 GiB)	Black	Dark green
Economy; JJ	J1A format: 60 GB (58.88 GiB) E05 format: 100 GB (93.13 GiB)	128 GB (119.21 GiB)	Black	Light blue
Cleaning; CLNxxxJA	N/A	N/A	Black	Gray

Media Types

The media type is the format of the data cartridge. The media type of a cartridge is shown by the last two characters on standard bar code labels. Supported media types include:

JA An Enterprise Tape Cartridge (ETC)

A JA cartridge can be used in native mode in a 3592 J1A drive or a 3592 E05 Tape Drive operating in either native mode or J1A emulation mode.

The native capacity of a JA tape cartridge used in a 3592 J1A drive or a 3592 E05 Tape Drive in J1A emulation mode is 300 GB (279.39

GiB). The native capacity of a JA tape cartridge used in a 3592 E05 Tape Drive drive in native mode is 500 GB (465.6 GiB).

JB An Enterprise Extended-Length Tape Cartridge (ETCL)

Use of JB tape cartridges is supported only with TS1120 Tape Drives operating in native capacity mode. If your TS7700 Virtualization Engine shipped prior to January 26, 2007, and you intend to use JB tape cartridges, you should order “FC 0521, Functional enhancement field” on page 110.

TS1120 Tape Drives/3592 E05 Tape Drives operate in native E05 mode or in 3592 J1A emulation mode. However, all 3592 Tape Drives associated with the TS7700 Virtualization Engine must be TS1120 Tape Drives in order for 3592 E05 Tape Drives to operate in native E05 mode. To use 3592 E05 Tape Drives in native E05 mode, the drives must be set to E05 native mode. If you intend to use TS1120 Tape Drives in native E05 Mode, the minimum microcode levels are 8.0.1.xx for the TS7700 Virtualization Engine and 534.2x for the Library Manager. Use “FC 0521, Functional enhancement field” on page 110, to receive the most current levels of TS7700 and Library Manager code.

JJ An Enterprise Economy Tape Cartridge (EETC)

A JJ cartridge can be used in native mode in a 3592 J1A drive or a 3592 E05 Tape Drive operating in either native mode or J1A emulation mode.

The native capacity of a JJ tape cartridge used in a 3592 J1A drive or 3592 E05 Tape Drive in J1A emulation mode is 60 GB (58.88 GiB). The native capacity of a JJ tape cartridge used in a 3592 E05 Tape Drive in native mode is 100 GB (93.13 GiB).

Diagnostic and cleaning cartridges

CE Customer Engineer (CE) diagnostic cartridge for use only by IBM service representatives. The VOLSER for this cartridge is CE xxxJA, where a space occurs immediately after CE and xxx equals three numerals.

CLN Cleaning cartridge. The VOLSER for this cartridge is CLN xxxJA, where a space occurs immediately after CLN and xxx equals three numerals.

Notelist:

1. When 3592 J1A drives (or 3592 E05 Tape Drives in J1A emulation) are replaced with 3592 E06 Tape Drives, the TS7700 marks the J1A-formatted tapes with active data FULL. By marking these tapes full, the TS7700 does not append more data since the 3592 E06 Tape Drive cannot append data to a J1A-formatted tape. As the active data on the J1A gets reclaimed or expired, the tape goes back to the scratch pool and then eventually gets reformatted to the E06 data format.
2. If you have a tape that is written in E06 format, the capacity is 1 TB (931.32 GiB) for JB/JX media, 640 GB (596.04 GiB) for JA/JW media, and 128 GB (119.21 GiB) for JJ/JR media.

Related information

FC 0521, Functional enhancement field

Workload considerations

This topic highlights some of the considerations to bear in mind when deciding what workload to place in the TS7700 Virtualization Engine.

Like previous generations of VTS products, the TS7700 Virtualization Engine presents 3490 Tape Drive images. Any data that can reside on a 3480/3490/3590/3592, prior generations of VTS systems, or cartridges from other vendors can reside on the TS7700 Virtualization Engine. However, processing characteristics of workloads differ, so some data are more suited for the TS7700 Virtualization Engine than other data.

Throughput

The TS7700 Virtualization Engine has a finite bandwidth capability, as has any other device attached to a host system, so you should plan for workloads that fit the capabilities of the TS7700 Virtualization Engine. However, since the TS7700 Virtualization Engine possesses 8 Gb FICON channels and either Tape Volume Cache or TS7700 Cache, few workloads would not be suitable based on throughput.

Drive concurrency

The TS7700 Virtualization Engine appears to the host operating system as 256 (128 if the code level of your TS7700 Virtualization Engine is prior to 8.0.1.24.) 3490E drives. If you have periods of time during the day when your tape processing jobs are limited by drive availability, the TS7700 Virtualization Engine may help your processing considerably. The design of the TS7700 Virtualization Engine allows transparent access to multiple logical volumes on the same stacked physical volume because access to the logical volumes is solely through the TS7700 Cache. If you need access to more than one logical volume on a physical volume, it is provided without requiring any user involvement, unlike some alternatives such as stacking by using job control language (JCL).

Cartridge capacity utilization

One of the key benefits of the TS7700 Virtualization Engine is its ability to fully utilize the capacity of the 3592 Tape Cartridges independent of the data set sizes written; another is the ability to manage that capacity effectively without host or user involvement. A logical volume may contain up to 6.29 GB of data (18.87 GB assuming data compressibility of 3:1) using the extended logical volume sizes. The actual size of a logical volume is only the amount of data written by the host. Even if an application writes 20 MBs to a 4 GB volume, only the 20 MB is kept in the TS7700 Cache or on a physical volume in a TS7740 Virtualization Engine. Very large data sets may gain little from the TS7700 Virtualization Engine's ability to stack data, so you may decide to leave these on native 3590 or 3592 Tape Cartridges.

Volume caching

Often, one step of a job writes a tape volume and a subsequent step (or job) reads it. The TS7700 Virtualization Engine improves the efficiency of this process: As data is cached in the TS7700 Cache the rewind time, the robotics time, and load or thread times for the mount are effectively removed. When a job attempts to read a volume that is not in the TS7700 Cache the logical volume is recalled from a stacked physical volume back into the cache. When a recall is necessary, the time

to access the data is greater than if the data were already in the cache. The size of the cache and the use of cache management policies can reduce the number of recalls. Too much recall activity can negatively impact overall throughput of the TS7700 Virtualization Engine.

Scratch mount times

When a program issues a scratch mount to write data, the TS7700 Virtualization Engine completes the mount request without having to recall the logical volume into the cache. For workloads that create many tapes, this significantly reduces volume processing overhead times and improves batch window efficiencies.

Scratch mount times are further reduced when the optimal scratch allocation assistance function is enabled. This function designates one or more clusters as preferred candidates for scratch mounts using a Management Class construct defined from the TS7700 Management Interface. For additional information, refer to the *Optimal scratch allocation assistance* topic in the **Related information** section.

Disaster recovery

The TS7700 Virtualization Engine's Grid configuration is a perfect integrated solution for your disaster recovery data. Multiple TS7700 Clusters can be separated over long distances and interconnected using an IP infrastructure to provide for automatic data replication. Data written to a local TS7700 Virtualization Engine is accessible at the remote TS7700 Virtualization Engine just as if it had been created there. Flexible replication policies make it easy to tailor the replication of data to your business needs.

Another disaster recovery solution is the Copy Export function. Copy Export allows a copy of selected logical volumes written to the TS7740 Virtualization Engine to be removed and taken offsite.

For additional information on disaster recovery configuration, refer to “Configuring for disaster recovery” on page 202. For additional information on the Copy Export function, refer to “Copy export overview” on page 97.

Multifile volumes

If you currently stack multiple files onto volumes using JCL constructs or some other method, the reason you are stacking is most likely to better use cartridge capacity. Automatic utilization of physical cartridge capacity is one of the primary attributes of the TS7740 Virtualization Engine. Therefore, you should find that in many cases manual stacking of data sets onto volumes is no longer required. If you are planning a new application that would have used JCL to stack data sets onto a volume, the TS7740 Virtualization Engine makes this JCL step unnecessary. Multifile volumes moved to the TS7740 Virtualization Engine will work without modification to the stacking. However, the TS7740 Virtualization Engine recalls the complete logical volume to the TS7700 Cache if the volume is not in cache, rather than moving each file as you access it. Therefore, in some cases, it can be advantageous to let the TS7740 Virtualization Engine do the stacking automatically for you. It can save you manual management overhead and, in some cases, host CPU cycles, channel bandwidth, DASD space, or a combination of all of these.

Interchange/offsite storage

As currently delivered, the TS7700 Virtualization Engine does not support a capability to remove a stacked volume to be used for interchange. Native 3490, 3590, or 3592 tapes are better suited for interchange. For disaster recovery offsite data storage, the TS7740 Virtualization Engine provides the Copy Export function.

Grid network load balancing

For a given TS7700 Grid link, the dynamic load balancing function calculates and stores the following information:

- Instantaneous throughput
- Number of bytes queued to transfer
- Total number of jobs queued on both links
- Whether deferred copy throttling is enabled on the remote node
- Whether a new job will be throttled (is deferred or immediate)

As a new task starts, a link selection algorithm uses the stored information to identify the link that will most quickly complete the data transfer. The dynamic load balancing function also uses the instantaneous throughput information to identify degraded link performance.

With the wide range of capabilities provided by the TS7700 Virtualization Engine, unless your data sets are very large or require interchange or offsite storage, it is likely that the TS7700 Virtualization Engine is a very suitable place to store your data.

Related information

“Copy export overview” on page 97

“Configuring for disaster recovery” on page 202

“Allocation assistance” on page 199

System requirements

You must ensure that your facility meets the system requirements for the TS7700 Virtualization Engine when planning for installation.

Complete system installation requirements for the TS7700 Virtualization Engine are determined by your configuration. They include specifications for the common use of the 3952 Tape Frame and those specific to either the TS7720 Virtualization Engine or the TS7740 Virtualization Engine.

3952 Tape Frame specifications

The following specifications are for the 3952 Tape Frame, including its standard components.

Table 14 on page 47 displays the physical specifications of a 3952 Tape Frame configured as a 3952 F05 Base Frame and its individual standard components including:

- 3952 Tape Frame
- Ethernet router
- Ethernet switches

Coexistence of routers and switches in the same frame is not supported. Ethernet routers are present in existing, on site systems that shipped with microcode levels of 8.7.x.xx or earlier. Ethernet switches are shipped from manufacturing as part of new build systems operating a microcode level of 8.20.0.xx or later.

Note: Ethernet routers are configured as switches when the TS7700 Server is upgraded by MES to a 3957-VEB or 3957-V07.

Refer to the topic “TS7720 Virtualization Engine specifications and requirements” on page 48 for a description of the difference between a 3952 Tape Frame used as a TS7720 Base Frame and as a TS7720 Storage Expansion Frame.

Table 14. Specifications of the 3952 Tape Frame and its standard components

	3952 Tape Frame	Ethernet router (each of 2)	Ethernet switch (each of 2)
Width	644 mm (25.35 in.)	32.5 cm (12.80 in.)	44 cm (17.3 in.)
Depth	1098 mm (43.23 in.)	24.9 cm (9.7 in.)	23 cm (9.0 in.)
Height	1804 mm (71.02 in.)	4.82 cm (1.9 in.)	3.3 cm (1.7 in.)
Weight	270 kg (595.25 lb.) empty	2.76 kg (6.1 lb.)	2.87 kg (6.32 lbs.)
Power	240 V AC 15 amp (single phase)	100-240 V AC50/60 Hz	100-240 V AC 50/60 Hz (+/- 3 Hz)
Power consumption	200 watts (maximum)	Included in 3952 Tape Frame maximum	38 watts
Thermal output	2.046 KBtu/hour (maximum)	Included in 3952 Tape Frame maximum	Included in 3952 Tape Frame maximum
Power-source loading	0.2 kVA 3,048 (10,000 ft.) maximum altitude	Included in 3952 Tape Frame maximum	Included in 3952 Tape Frame maximum
Unit height	36 U	1 U	1 U

Related information

Table 42 on page 103

“TS7720 Virtualization Engine specifications and requirements” on page 48

“TS7740 Virtualization Engine specifications and requirements” on page 51

Ethernet switches

This topic describes the key characteristics of Ethernet switches contained by the 3952 Tape Frame.

A 3952 Tape Frame configured as a 3952 Base Frame contains two, 1 Gb intranet Ethernet switches used for private communication between components within a TS7700 Cluster. A customer network connects directly to the TS7700 Server and utilizes virtual IP address technology to virtualize one or more customer-provided IP address across two AIX® configured Ethernet connections.

Note: Intranet Ethernet switches are available only when installed from manufacturing with 3957-V07 or 3957-VEB servers. TS7700 Servers upgraded in the field to 3957-V07 or 3957-VEB servers continue to use Ethernet routers as switches.

Related information

“3952 Tape Frame specifications” on page 46

“Network switches and TCP/IP ports requirements” on page 68

“System requirements” on page 46

“TS7720 Virtualization Engine specifications and requirements”

“TS7740 Virtualization Engine specifications and requirements” on page 51

TS7720 Virtualization Engine specifications and requirements

The following specifications and requirements are specific to the TS7720 Virtualization Engine and its components.

The 3952 Tape Frame (3952 F05) houses the components of the TS7720 Virtualization Engine.

When designated as a TS7720 Base Frame (“FC 7322, TS7720 Base frame” on page 124), the 3952 F05 contains the following components:

- TS7720 Server (includes control unit and 2 I/O drawers)
- TS7720 Cache Controller
- TS7720 Cache Drawer(s)
- Internal power distribution units

Note: The standard 3952 Tape Frame ships with one internal power distribution unit. However, “FC 1903, Dual AC power” on page 112 is required to provide two power distribution units to support the availability characteristics of the TS7720 Virtualization Engine.

When designated as a TS7720 Storage Expansion Frame (“FC 7323, TS7720 Storage expansion frame” on page 124), the 3952 F05 contains the following components:

- TS7720 Cache Controllers
- TS7720 Cache Drawer(s)

Note: “FC 9323 Expansion frame attachment” on page 126 is also required to attach the base and expansion frames.

The distance between a TS7720 Storage Expansion Frame and the TS7720 Base Frame cannot exceed 10 meters, as per the prerequisites for “FC 7323, TS7720 Storage expansion frame” on page 124. This distance permits connection of the two frames using a 30 meter cable.

Table 15 displays the maximum configuration of a TS7720 Virtualization Engine. Table 16 on page 49 displays the physical specifications for each TS7720 Virtualization Engine component. Use these tables and the tape frame specifications, located from the links in the **Related information** section, to determine the correct physical requirements for your configuration.

Table 15. TS7720 Virtualization Engine maximum configuration

Component	Quantity of each component in 3952 Tape Frame as TS7720 Base Frame	Quantity of each component in 3952 Tape Frame as optional TS7720 Storage Expansion Frame
TS7720 Server	1	0
TS7720 Cache Controller	1	2
TS7720 Cache Drawers	6	10

Table 16. TS7720 Virtualization Engine component specifications

	TS7720 Server				TS7720 Cache Subsystem	
Type and Model	3957-VEA	I/O expansion drawer (each of 2)	3957-VEB	I/O expansion drawer (each of 2)	3956-CS8 cache controller	3956-XS7 cache expansion drawer
Width	437 mm (17.2 in.)	444.5 mm (17.5 in.)	443 mm (17.3 in.)	440 mm (17.32 in.) Total width of two joined drawers	0.4826 m (19.0 in.)	0.4826 m (19.0 in.)
Depth	508 mm (20.0 in.)	711.2 mm (28.0 in.)	730 mm (28.7 in.)	800 mm (31.5 in.)	0.5715 m (22.5 in.)	0.5715 m (22.5 in.)
Height	178 mm (7.0 in.)	175 mm (6.9 in.)	173 mm (6.81 in.)	220 mm (8.66 in.)	0.1295 m (5.1 in.)	0.1295 m (5.1 in.)
Weight	35.5 kg (78 lb.) minimum 43.0 kg (95 lb.) maximum	39.1 kg (86.0 lb.) weight of two combined	48.7 kg (107 lbs.)	42.2 kg (92.8 lb.) weight of two combined Reflects weight of each, without cassettes	40 kg (88 lbs.) fully configured	38.1 kg (84 lbs.) fully configured
Power	100-127 V AC 200-240 V AC (auto ranging) 47/63 Hz	200-240 V AC 50/60 Hz (+/- 3 Hz)	200-240 V AC 50/60 Hz (+/- 3 Hz)	200-240 V AC 50/60 Hz	90-136 RMS† V AC Low Range 198-264 RMS† V AC High Range 50/60 Hz	90-136 RMS† V AC Low Range 198-264 RMS† V AC High Range 50/60 Hz
Unit height	4 U	4 U	4 U	5 U	3 U	3 U
Temperature (non-operating)	5-45 degrees C (41-113 F)	Included in 3952 Tape Frame maximum	5-45 degrees C (41-113 F)	Included in 3952 Tape Frame maximum	-10-65 degrees C (14-149 F)	5-45 degrees C (41-113 F)
Temperature (operating)	5-35 degrees C (41-95 F)	Included in 3952 Tape Frame maximum	10-32 degrees C (50-89.6 degrees F) Recommended: 18-27 degrees C (64-80 degrees F)	Included in 3952 Tape Frame maximum	10-35 degrees C (50-95 F)	5-35 degrees C (41-95 F)
Relative humidity	8-80%	Included in 3952 Tape Frame maximum	Non-operating: 8-80% Operating: 20-60%	Included in 3952 Tape Frame maximum	8-80%	8-80%
Maximum wet bulb (power off)	27 degrees C (80 F)	Included in 3952 Tape Frame maximum	Non-operating: 28 degrees C (82 degrees F) Operating: 29 degrees C (84 degrees F)	Included in 3952 Tape Frame maximum	27 degrees C (80 F)	27 degrees C (80 F)
Power consumption	600	530 watts 1060 watts total for 2 drawers	1950 watts (maximum)	Included in 3952 Tape Frame maximum	447 watts	510 watts

Table 16. TS7720 Virtualization Engine component specifications (continued)

	TS7720 Server				TS7720 Cache Subsystem	
Thermal output	2,046 Btu/hour (maximum)	5.3 KBtu/hr (maximum) 10.6 KBtu/hr maximum total for 2 drawers	6655 Btu/hour (maximum)	Included in 3952 Tape Frame maximum	1,529 Btu/hr	5,000 Btu/hr
Power-source loading	0.632 kVA (maximum configuration) 3,048 m (10,000 ft.) maximum altitude	.53 kVa 1.06 kVa total for 2 drawers	2.0 kVA (maximum configuration) 3,048 m (10,000 ft.) maximum altitude	Included in 3952 Tape Frame maximum	0.496 kVa	0.5 kVa

† Root Mean Square. In a multi-drawer configuration, total power is predicted to be a root mean square of the individual drawer maximums.

TS7720 Base Frame power requirements

Your facility must ensure an available power supply to meet the input voltage requirements for the TS7720 Base Frame. Table 17 displays the maximum input power for a fully configured TS7720 Virtualization Engine.

Table 17. TS7720 Base Frame maximum input power requirements

Power requirement	Value
Voltage	200-240 V AC (single phase)
Frequency	50-60 Hz (+/- 3 Hz)
Current	20 amp
Inrush current	250 amp
Power (watt)	2910 watts
Input power required	4.0 kVa (single phase)
Thermal units	9.9 kBtu/hr

TS7720 Storage Expansion Frame power requirements

Your facility must ensure an available power supply to meet the input voltage requirements for the TS7720 Storage Expansion Frame. Table 18 displays the maximum input power for a fully configured TS7720 Virtualization Engine.

Table 18. TS7720 Storage Expansion Frame maximum input power requirements

Power requirement	Value
Voltage	200-240 V AC (single phase)
Frequency	50-60 Hz (+/- 3 Hz)
Current	20 amp
Inrush current	250 amp
Power (watt)	4,000 watts
Input power required	4.0 kVa (single phase)
Thermal units	16.4 kBtu/hr

Related information

- “3952 Tape Frame specifications” on page 46
- Table 42 on page 103
- “TS7720 Storage Expansion Frame” on page 27
- FC 9954, NEMA L6-30 power cord
- FC 9955, RS 9750 DP power cord
- FC 9956, IEC 309 power cord
- FC 9957, PDL 4.3 power cord
- FC 9958, Korean 4.3-m power cord
- FC 9959, Unterminated power cord
- FC 9966, Unterminated power cord (China)

TS7740 Virtualization Engine specifications and requirements

The following specifications and requirements are specific to the TS7740 Virtualization Engine and its components.

Table 19 displays the maximum configurations of a TS7740 Virtualization Engine in a 3952 Tape Frame. Table 20 displays the physical specifications for each TS7740 Virtualization Engine component. Use these tables and the tape frame specifications, located from the links in the **Related information** section, to determine the correct physical requirements for your configuration.

Table 19. TS7740 Virtualization Engine maximum configurations

Quantity	Component
1	TS7740 Server
1	TS7740 Cache Controller
3 3956-CX7 (new or existing)	TS7740 Cache Drawers

Table 20. TS7740 Virtualization Engine component specifications

Type and Model	TS7740 Server				TS7740 Cache Subsystem	
	3957-V06	I/O expansion drawer (each of 2)	3957-V07	I/O expansion drawer (each of 2)	3956-CC8 cache controller	3956-CX7 cache expansion drawer
Width	437 mm (17.2 in.)	444.5 mm (17.5 in.)	443 mm (17.3 in.)	440 mm (17.32 in.) Total width of two joined drawers	0.483 m (19.0 in.)	0.483 m (19.0 in.)
Depth	508 mm (20.0 in.)	711.2 mm (28.0 in.)	730 mm (28.7 in.)	800 mm (31.5 in.)	0.572 m (22.5 in.)	0.572 m (22.5 in.)
Height	178 mm (7.0 in.)	175 mm (6.9 in.)	173 mm (6.81 in.)	220 mm (8.66 in.)	0.130 m (5.1 in.)	0.130 m (5.1 in.)
Weight	35.5 kg (78 lb.) minimum 43.0 kg (95 lb.) maximum	39.1 kg (86.0 lb.) weight of two combined	48.7 kg (107 lbs.)	42.2 kg (92.8 lb.) weight of two combined	40.0 kg (88 lb.) fully configured	38.1 kg (84 lb.) fully configured
Power	100-127 V AC 200-240 V AC (auto ranging) 47/63 Hz	200-240 V AC 50/60 Hz (+/- 3 Hz)	200-240 V AC 50/60 Hz (+/- 3 Hz)	200-240 V AC 50/60 Hz	90-136 RMS+ V AC 198-264 RMS+ V AC	90-136 RMS+ V AC 198-264 RMS+ V AC

Table 20. TS7740 Virtualization Engine component specifications (continued)

	TS7740 Server				TS7740 Cache Subsystem	
Unit height	4 U	4 U	4 U	5 U	3 U	3U
Temperature (non-operating)	5-45 degrees C (41-113 F)	Included in 3952 Tape Frame maximum	5-45 degrees C (41-113 F)	Included in 3952 Tape Frame maximum	-10-65 degrees C (14-149 F)	5-45 degrees C (41-113 F)
Temperature (operating)	5-35 degrees C (41-95 F)	Included in 3952 Tape Frame maximum	10-32 degrees C (50-89.6 degrees F) Recommend: 18-27 degrees C (64-80 degrees F)	Included in 3952 Tape Frame maximum	10-35 degrees C (50-95 F)	5-35 degrees C (41-95 F)
Relative humidity	8-80%	Included in 3952 Tape Frame maximum	Non-operating: 8-80% Operating: 20-60%	Included in 3952 Tape Frame maximum	8-80%	8-80%
Maximum wet bulb (power off)	27 degrees C (80 F)	Included in 3952 Tape Frame maximum	Non-operating: 28 degrees C (82 degrees F) Operating: 29 degrees C (84 degrees F)	Included in 3952 Tape Frame maximum	27 degrees C (80 F)	27 degrees C (80 F)
Power consumption	600	530 watts 1060 watts total for 2 drawers	1950 watts (maximum)	Included in 3952 Tape Frame maximum	447 watts	510 watt
Thermal output	2,046 Btu/hour (maximum)	5.3 KBtu/hr (maximum) 10.6 KBtu/hr maximum total for 2 drawers	6655 Btu/hour (maximum)	Included in 3952 Tape Frame maximum	1,529 Btu/hr	5,000 Btu/hr
Power-source loading	0.632 kVA (max config) 3,048 m (10,000 ft.) maximum altitude	.53 kVa 1.06 kVa total for 2 drawers	2.0 kVA (max config) 3,048 m (10,000 ft.) maximum altitude	Included in 3952 Tape Frame maximum	0.496 kVa	0.5 kVa
† Root Mean Square. In a multi-drawer configuration, total power is predicted to be a root mean square of the individual drawer maximums.						

TS7740 Virtualization Engine 3952 Base Frame power requirements

Your facility must ensure an available power supply to meet the input voltage requirements for the IBM Virtualization Engine TS7740. Table 21 on page 53 displays the maximum input power for a fully configured TS7740 Virtualization Engine.

Table 21. TS7740 Virtualization Engine 3952 Base Frame maximum input power requirements

Power requirement	Value
Voltage	200-240 V AC (single phase)
Frequency	50-60 Hz (+/- 3 Hz)
Current	20 amp
Inrush current	250 amp
Power (watts)	2500 watts
Input power required	4.0 kVa (single phase)
Thermal units	8.6 kBtu/hr

The 3952 Tape Frame houses the components of the TS7740 Virtualization Engine. The standard 3952 Tape Frame ships with one internal power distribution unit. However, “FC 1903, Dual AC power” on page 112 is required to provide two power distribution units to support the availability characteristics of the TS7740 Virtualization Engine.

Related information

“3952 Tape Frame specifications” on page 46

Table 42 on page 103

FC 9954, NEMA L6-30 power cord

FC 9955, RS 9750 DP power cord

FC 9956, IEC 309 power cord

FC 9957, PDL 4.3 power cord

FC 9958, Korean 4.3-m power cord

FC 9959, Unterminated power cord

FC 9966, Unterminated power cord (China)

Cooling requirements

Your facility must meet the temperature requirements for the TS7700 Virtualization Engine.

The 3952 Tape Frame, which contains the components of the TS7700 Virtualization Engine, requires ambient room temperatures that are consistent with environmental specifications. See “Environmental requirements” on page 56 for more information. The heat load for the 3952 Tape Frame system can be found under “3952 Tape Frame specifications” on page 46. The total system heat load is the sum of the heat loads for all installed frames.

Related information

“3952 Tape Frame specifications” on page 46

Floor requirements

Your facility must meet specified floor leveling, loading, and weight distribution requirements before you can install the TS7700 Virtualization Engine.

Floor – general

A 3952 Tape Frame can be installed on a raised or solid floor meeting the minimum leveling and floor-loading capacity requirements. The floor under the

library must have a smooth surface with no ventilation grates under the frame's leveling pads. If the floor is carpeted, the carpeting must be approved for use in a computer environment (that is, it must display low electrostatic discharge characteristics).

Floor – leveling

The leveling pads on the 3952 Tape Frame can be adjusted to compensate for an uneven floor where the frame is to be installed. The maximum out-of-level condition is 25.4 mm (1 in.) over the frame's length and width.

Note: IBM strongly recommends that stringers be installed between all corner posts. In addition, a post should be placed under the areas where the frame's leveling pads sit. As an alternative to placing posts under the leveling pads, a post may be placed at the midpoint of the stringers in the areas where the frame sits.

Floor – weight distribution and loading

If the 3952 Tape Frame is installed on a raised floor, the raised floor should be stabilized to prevent a horizontal shift of the raised floor structure. The minimum overall floor load rating should be 256 kg/m² (52.6 lb./ft.²). However, IBM recommends a floor load rating of at least 341 kg/m² (70.0 lb./ft.²). These ratings do not include additional loading by personnel and equipment traffic.

In addition, the floor must support point loads exerted by the leveling pads of up to 4.8 kg/cm² (68.4 lb./in.²).

Dimension requirements

This topic lists the dimensions of the TS7700 Virtualization Engine.

Table 22 lists the dimensions of the frame enclosing the TS7700 Virtualization Engine.

Table 22. Physical characteristics of a maximally configured 3952 Tape Frame

Characteristic	Value
Height	1804 mm (71.0 in.)
Width	644 mm (25.4 in.)
Depth	1098 mm (43.23 in.)
Weight	270 kg (595.25 lbs.) empty 565.6 kg (1570 lbs.) maximally configured †
Power	240 Vac, 15 amp (single phase)
Unit height	36 U
†Refer to the topics “TS7720 Virtualization Engine specifications and requirements” on page 48 and “TS7740 Virtualization Engine specifications and requirements” on page 51 for maximum configurations for the TS7720 Virtualization Engine and the TS7740 Virtualization Engine.	

Clearance requirements

You must meet the specified clearance requirements when moving and positioning the 3952 Tape Frame.

Clearance – moving the frame

Two persons should be available to move system components between locations. Table 23 shows the minimum aisle and door dimensions for moving components from one location to another.

Table 23. Required clearances when moving the frame

Clearance item	Required clearance
Distance to ceiling†	1830 mm (72 in.)
Aisle and door width	736 mm (29 in.)
Corner radius	2237 mm (88 in.)
Ramp inclination	15°
†The 3952 Tape Frame is moved on casters and has four leveling pads. The frame's nominal height is 1.815 m (71.5 in.) from the bottom of the leveling pads to the top of the frame. The leveling pads can vary the height of the frame by up to 30 mm (1.2 in.). The pads are completely raised when the frame is shipped to allow it to roll on its casters. The shipping height of the frame on its casters is 1.8 m (70.9 in.).	

Clearance – frame in position

Clearances are required around system components for the operator to perform certain tasks and for the service representative to perform certain items. Table 24 lists specific clearance requirements for the 3952 Tape Frame.

Table 24. Required clearances when the frame is in position

Door or panel	Required clearance
Front	690 mm (27.2 in.)
Back	660 mm (26.0 in.)
Side	0 mm (0 in.) required, but 480 mm (18.9 in.) recommended for side panel removal.

Table 25 provides additional information about the frame.

Table 25. Physical characteristics of a maximally configured 3952 Tape Frame

Characteristic	Value
Height	1804 mm (71.0 in.)
Width	644 mm (25.4 in.)
Depth	1098 mm (43.23 in.)
Weight	270 kg (595.25 lbs.) empty 565.6 kg (1570 lbs.) maximally configured †
Power	240 Vac, 15 amp (single phase)
Unit height	36 U
†Refer to the topics “TS7720 Virtualization Engine specifications and requirements” on page 48 and “TS7740 Virtualization Engine specifications and requirements” on page 51 for maximum configurations for the TS7720 Virtualization Engine and the TS7740 Virtualization Engine.	

Related information

FC 5759, Integrated control path

Environmental requirements

Your facility should meet specified temperature and humidity requirements before installing the TS7700 Virtualization Engine.

Table 26 shows recommended environmental conditions for the TS7700 Virtualization Engine.

Table 26. Environmental specifications

Condition	Air temperature	Altitude	Relative humidity†	Wet bulb temperature
Operating (low altitude)	10°C to 32°C (50°F to 89.6°F)	up to 5000 ft amsl	20% to 60%	23°C (73°F)
Operating (high altitude)	10°C to 28°C (50°F to 82.4°F)	5001 ft amsl to 7000 ft amsl	20% to 60%	23°C (73°F)
Recommended Operating Range‡	20°C to 25°C (68°F to 77°F)	up to 7000 ft amsl	40% to 55%	—
Power Off	10°C to 43°C (50°F to 109°F)	—	8% to 80%	27°C (80°F)
Storage	1°C to 60°C (33.8°F to 140°F)	—	5% to 80%	29°C (84°F)
Shipping	-40°C to 60°C (-40°F to 140°F)	—	5% to 100%	29°C (84°F)

†non condensing

‡Although the TS7700 Virtualization Engine will operate outside this range, it is strongly advised that the user adhere to the Recommended Operating Range provided.

Acoustic requirements

This topic gives the acoustic requirements for the TS7700 Virtualization Engine.

Table 27 shows the acoustic specifications for the TS7720 Virtualization Engine.

Table 27. TS7720 Virtualization Engine acoustic requirements

Declared Sound Power Level, $L_{WA,d}$		Mean A-weighted sound pressure level at 1-m (bystander) positions, $\langle L_{pA} \rangle_m$	
Operating (bels)	Idling (bels)	Operating (decibels)	Idling (decibels)
7.7	7.7	58	58

Table 28 shows the acoustic specifications for the TS7740 Virtualization Engine.

Table 28. TS7740 Virtualization Engine acoustic requirements

Declared Sound Power Level, $L_{WA,d}$		Mean A-weighted sound pressure level at 1-m (bystander) positions, $\langle L_{pA} \rangle_m$	
Operating (bels)	Idling (bels)	Operating (decibels)	Idling (decibels)
7.0	7.0	53	53

Host compatibility

This section describes host compatibility requirements for installation of the TS7700 Virtualization Engine.

You must ensure that your hosts are compatible with the IBM Virtualization Engine TS7700 when planning for installation.

Supported hosts

This section describes hosts supported by the IBM TS7700 Virtualization Engine.

The TS7700 Virtualization Engine supports the following host attachments:

- IBM System z[®] mainframe
- IBM zSeries[®] server
- IBM s390 server

The TS7700 Virtualization Engine supports the following operating systems:

- z/OS[®], V1R10 and higher (earlier release levels were initially supported, however those release levels are no longer in service. Refer to Preventive Service Planning bucket D/T3957 from the *IBM Support and Downloads* link in the **Related information** section for the list of applicable maintenance)
- z/VM[®], V5.4.0 and higher
- z/VSE[®], 4.1 and higher
- zTPF, V1.1 and higher

Note: Later versions of host software may be required in order to fully utilize TS7700 Virtualization Engine enhancements.

Supported hosts connect to the TS7700 Virtualization Engine, which connects to a 3494 Tape Library or a TS3500 Tape Library.

A host connects to the TS7700 Virtualization Engine via the 8Gb FICON adapters. Each installed adapter supports 256 logical paths.

Related information

 <http://www.ibm.com/support/us/en/>

System z host attachment to the TS7700 Virtualization Engine

FICON attachments between a System z host and a TS7700 Virtualization Engine can be single-mode long wave laser or multi-mode short wave laser.

These attachments are abbreviated as:

- SM = Single Mode Fiber
- LW = Long Wave Laser
- MM = Multi-Mode Fiber
- SW = Short Wave Laser

Figure 26 on page 58 shows typical FICON attachments between a host and a TS7700 Virtualization Engine.

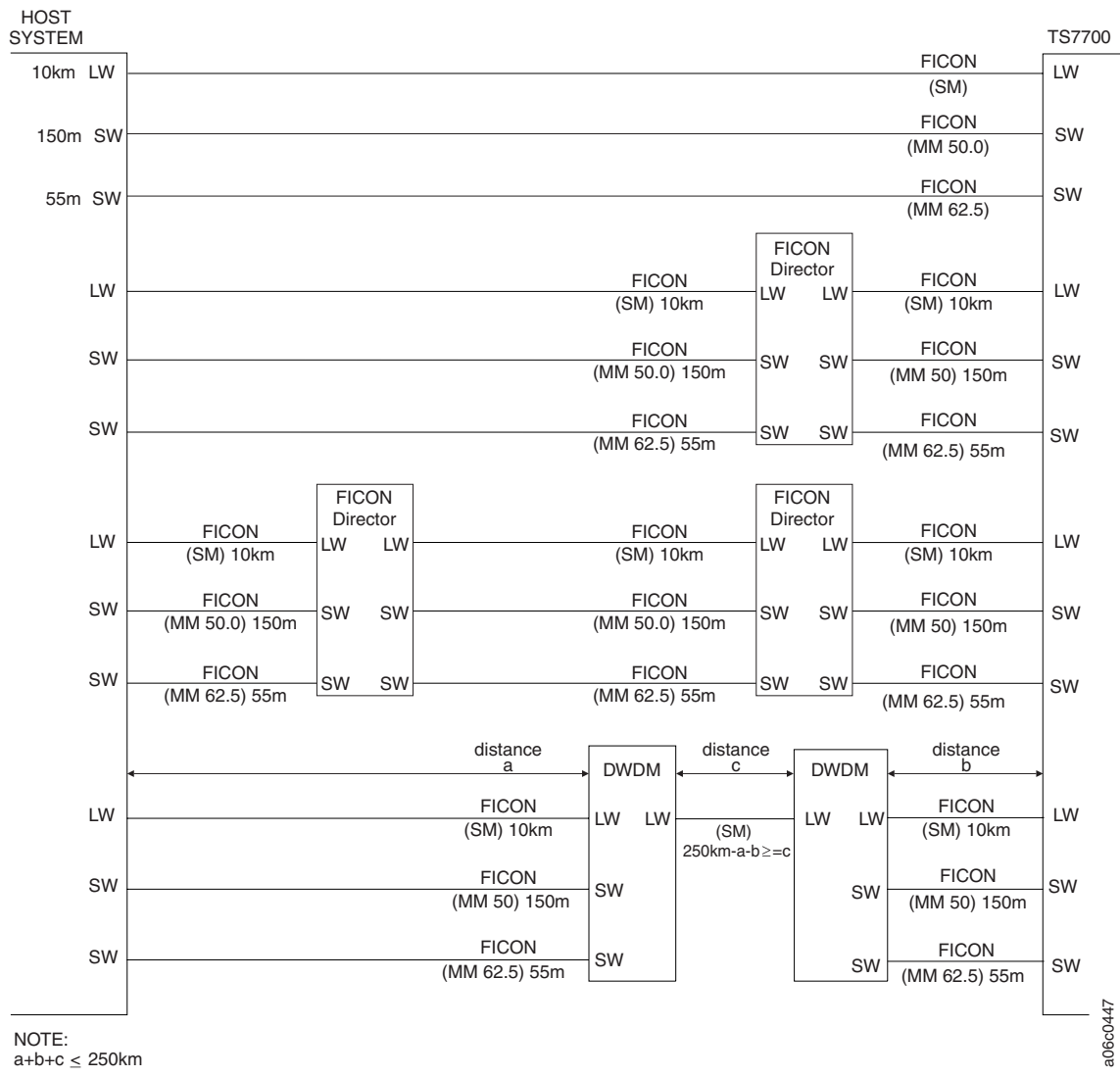


Figure 26. System z host attachment to TS7700 Virtualization Engine (at speed of 4 Gb/second)

Note: The FICON long-wavelength attachment shown in Figure 26 is “FC 3443, FICON 10-km long-wavelength attachment” on page 115, which has a maximum cable length of 10 km. When “FC 3442, FICON long-wavelength attachment” on page 114 is used, the maximum fibre cable length is 4 km.

Existing FICON adapters may be upgraded in number (two to four) and kind (shortwave and longwave) using “FC 3441, FICON short-wavelength attachment” on page 114, “FC 3442, FICON long-wavelength attachment” on page 114, and “FC 3443, FICON 10-km long-wavelength attachment” on page 115.

For the most recent list of supported FICON directors, refer to the *IBM Techdocs Library* web page linked in the **Related information** section.

Table 29 on page 59 shows FICON cabling information for the TS7700 Virtualization Engine.

Table 29. TS7700 Virtualization Engine FICON Cable Plug Connections

FICON Configuration	First I/O Drawer (Primary)		Second I/O Drawer (Secondary)	
	Slot 3	Slot 6	Slot 3	Slot 6
4 cards	FICON	FICON	FICON	FICON
2 cards		FICON		FICON

Related information

- FC 3441, FICON short-wavelength attachment
- FC 3442, FICON long-wavelength attachment
- FC 3443, FICON 10-km long-wavelength attachment

 <http://www.ibm.com/support/techdocs/atmsastr.nsf/WebIndex/FQ116133>

Host configurations

This section lists and describes host configurations for use with the TS7700 Virtualization Engine.

z/OS I/O definitions

This section defines the I/O of the z/OS operating system used by the System z host attached to the TS7700 Virtualization Engine.

Subsystem identification

Each logical controller, or 16-device group, must present a unique subsystem identification to the System z host. This ID is a 1-byte field that uniquely identifies each device associated with the logical controller within the larger storage controller. The value of this ID cannot be 0. The subsystem ID must match the LIBPORT-ID defined in the host Hardware Configuration Definition (HCD).

Table 30 shows required definitions of subsystem IDs.

Table 30. Subsystem identification definitions

Distributed Library	Logical CU	Subsystem ID/LIBPORT-ID†
0	0-F	0x01-0x10
1	0-F	0x41-0x50‡
2	0-F	0x81-0x90‡
3	0-F	0xC1-0xD0‡
4	0-F	0x21-0x30‡
5	0-F	0x61-0x70‡
6	0-F	0xA1-0xB0‡
7	0-F	0xE1-0xF0‡

Table 30. Subsystem identification definitions (continued)

Distributed Library	Logical CU	Subsystem ID/LIBPORT-ID†
†Identical to configured LIBPORT-ID		
‡Every logical controller image represents 16 tape device images and must have a unique LIBPORT-ID. The system has reserved ranges of LIBPORT-IDs to account for future node expansions at each distributed library. These reserved ranges represent the gap in the defined LIBPORT-IDs between the following IDs:		
<ul style="list-style-type: none"> • 0x51 - 0x81 • 0x91 - 0xC1 • 0xD1 - 0x21 • 0x31 - 0x61 • 0x71 - 0xA1 • 0xB1 - 0xE1 		

Cluster and grid reporting

Every virtual device attached to a System z host and the TS7700 Virtualization Engine must report the same library sequence number, known as the *composite library ID*. This is true whether the grid configuration is distributed across multiple sites, or consists of a single site. The composite library ID allows the host to consider the grid configuration as a single library.

Each cluster in a grid configuration possesses a unique library sequence number, known as the *distributed library ID*, that identifies it among the clusters in its grid. A distributed library ID is given to a cluster during the teach of the integrated Library Manager for the TS7700 Virtualization Engine partition. This ID is reported to the System z host upon request and is used to distinguish one cluster from another in a given grid.

Host console request facility

The TS7700 Virtualization Engine permits you to make problem determinations from the System z host console using the host console request (HCR) facility, or MVS™ Library Request command. This facility performs similarly to existing library query commands; it permits an operator to request TS7700 Virtualization Engine operational information or take a limited set of actions.

You can use this command to request information for:

- The current state of the grid links between the clusters
- The current state of the copy activity between the clusters
- The current state of the cache and the data managed within it associated with the specified distributed library
- A specific logical volume
- The physical drives and their current usage associated with the specified distributed library
- The media types and counts, associated with a specified distributed library, for volume pools beginning with the value in keyword 2
- A specific physical volume with the specified distributed library
- The content of the recall queue starting with the specified logical volume
- The copy, reconcile, and ownership takeover status of the libraries in a Grid configuration

- Whether a distributed library is attached to physical tape
- Whether a distributed library is part of a cluster family
- Any group name associated with a logical volume
- Whether a logical volume copy has been removed from a distributed library
- The number of logical volume copies removed from a domain
- Whether a logical volume is classified as LWORM (logical write once, read many)

You can also use this command to take the following actions:

- Promote the specified volume in the recall queue
- Make eligible for priority reclaim a specified physical volume that has been exported previously in a copy export operation
- Delete from the TS7700 Virtualization Engine database a specified physical volume that has been exported previously in a copy export operation (The volume must be empty to be deleted)
- Define threshold settings that generate an MVS console message for several of the resources of the TS7700 Virtualization Engine
- Define workflow management settings that control how the TS7700 Virtualization Engine manages data movement
- Enable or disable copies to and from the specified distributed library using the host copy enable function
- Establish thresholds for logical scratch volumes
- Modify logical volume cache management preferences
- Limit the number of reclaim operations using the reclaim request
- Control deferred copy throttling
- Enable or disable Scratch Allocation Assistance functionality

You can use HCR to temporarily override a logical volume's assigned disk cache preference group while the volume resides in disk cache. This function can also be used to update the last recently used position of the volume as if the volume had just been mounted. If you intend to access the volume again in the near future, you can use this function to retain the volume in cache for a longer period of time. Or, you can use this function to request that the volume be migrated from cache sooner.

For additional information regarding the MVS Library Request command syntax, refer to the white paper: *IBM Virtualization Engine TS7700 Series z/OS Host Command Line Request User's Guide* at the Techdocs Library link in the **Related information** section.

Presented drive image

The IBM Virtualization Engine TS7700 presents a tape drive image of a 3490 C2A, identical to that of current VTS and peer-to-peer (PtP) subsystems. Command set, responses to inquiries, and accepted parameters match the defined functional specifications of a 3490 drive.

Related information

“Copy export overview” on page 97

“Allocation assistance” on page 199

 <http://www-03.ibm.com/support/techdocs/atmastr.nsf/Web/WhitePapers>

Infrastructure requirements

You must ensure that your infrastructure meets TS7700 Virtualization Engine requirements when planning for installation.

Call Home infrastructure requirements

The TS3000 System Console (TSSC) enables remote enhanced service connection of a TS7700 Server to an IBM-supplied modem. This modem is used when Call Home settings are configured. You must ensure that either two analog telephone lines or a broadband connection are available to enable Call Home functionality.

TS7700 Grid interconnect LAN/WAN requirements

This topic gives LAN/WAN requirements for the TS7700 Virtualization Engine cross-site grid TCP/IP network infrastructure.

The TS7700 Grid TCP/IP network infrastructure must be in place before the grid is activated, so that the clusters can communicate with one another as soon as they are online. Two or four 1Gb Ethernet or two Grid Optical LW connections must be in place prior to grid installation and activation, including the following equipment:

Routers

Ethernet routers are used to connect the customer network to management interface services operating on a 3957-VEA or 3957-V06.

These routers are still present if the TS7700 Server is upgraded by MES to a 3957-VEB or 3957-V07, but they are configured as switches.

Note: If an existing 3957-V06 is configured with a 3956-CC6, IP connectivity to the cache controller still requires routing functions.

Intranet Ethernet switches

Intranet Ethernet switches are used primarily for private communication between components within a cluster. Ethernet switches are available from manufacturing with 3957-VEB or 3957-V07 model TS7700 Servers.

ATM switches

Ethernet extenders

An Ethernet extender or other extending equipment is used to complete extended distance Ethernet connections. Extended grid Ethernet connections can be any of the following:

1 Gb copper 10/100/1000 Base-TX

This adapter conforms to the IEEE 802.3ab 1000Base-T standard, which defines gigabit Ethernet operation over distances up to 100 meters using four pairs of CAT-6 copper cabling.

1 Gb optical shortwave

This SX adapter has a LC Duplex connector that attaches to 50-micron or 62.5 micron multimode fibre cable. It is a standard SW (850nm) adapter that conforms to the IEEE 802.3z standards. This adapter supports distances of 2 to 260 meters for 62.5 micron and 2 to 550 meters for 50.0 micron Multimode Fiber (MMF).

Optical longwave

This adapter supports a maximum of 10 kilometers of 1310nm, 9µm, single-mode fiber optic cable. It conforms to the IEEE

802.3ae standard. This adapter requires 9µm single-mode fiber optic cables and uses a LC connector to connect to network infrastructure components. This adapter must be used in conjunction with a 3957-VEB or 3957-V07.

The default configuration for a TS7700 Server from manufacturing (3957-VEB or 3957-V07) is two dual-ported PCIe 1Gb Ethernet adapters. You can use FC 1035, Grid optical LW connection to add support for two 10Gb optical longwave Ethernet adapters. This feature improves data copy replication while providing minimum bandwidth redundancy. Clusters configured using two 10Gb, four 1Gb, or two 1Gb clusters can be interconnected within the same TS7700 Grid, although explicit same port-to-port communications still apply.

Note: A network infrastructure and switches capable of supporting 10Gb adapters must be in place before installing FC 1035, Grid optical LW connection. If the TS7700 Server is a 3957-V07 or 3957-VEB, two instances of either FC 1036, 1Gb grid dual port copper connection, or FC 1037, 1Gb dual port optical SW connection, must be installed. If the TS7700 Server is a 3957-V06 or 3957-VEA, it must operate with a microcode level of 8.20.x.x or higher and two instances of either FC 1032, 1Gb grid dual port copper connection, or FC 1033, 1Gb grid dual port optical SW connection, must be installed. Refer to the *Feature details* topic in the section **Related information** for feature requirements and prerequisites.

Important: Identify, order, and install any new equipment to fulfill grid installation and activation requirements. Prior to grid activation, you must test connectivity and performance of the Ethernet connections. You must ensure installation and testing of this network infrastructure is complete before grid activation.

Bandwidth considerations

The customer network between the TS7700 Virtualization Engines should have sufficient bandwidth to account for the total replication traffic. For customers sharing network switches among multiple TS7700 Virtualization Engine paths or with other network traffic, the sum total of bandwidth on that network should be sufficient to account for all of the network traffic.

The TS7700 Virtualization Engine uses the TCP/IP protocol for moving data between each cluster. Bandwidth is a key factor that affects throughput for the TS7700 Virtualization Engine. Other key factors that can affect throughput include:

- Latency between the TS7700 Virtualization Engines
- Network efficiency (packet loss, packet sequencing, and bit error rates)
- Network switch capabilities
- Flow control to pace the data from the TS7700 Virtualization Engines
- Inter-switch link capabilities: flow control, buffering, and performance

The TS7700 Virtualization Engines attempts to drive the network links at the full 1Gb rate, which may exceed the network infrastructure capabilities. The TS7700 Virtualization Engine supports the IP flow control frames so that the network paces the level at which the TS7700 Virtualization Engine attempts to drive the

network. The best performance is achieved when the TS7700 Virtualization Engine is able to match the capabilities of the underlying network, resulting in fewer dropped packets.

Note: When the system exceeds the network capabilities, packets are lost. This causes TCP to stop, resync, and resend data, resulting in a much less efficient use of the network.

To maximize network throughput, ensure that the underlying network:

- Has sufficient bandwidth to account for all network traffic expected to be driven through the system to eliminate network contention.
- Can support flow control between the TS7700 Virtualization Engines and the switches. This allows the switch to pace the TS7700 Virtualization Engines to the WAN capability. Flow control between the switches is also a potential factor, to ensure that the switches can pace their rates to one another. The performance of the switch is capable of handling the data rates expected from all of the network traffic.

In short, latency between the sites is the primary factor. However, packet loss due to bit error rates or insufficient network capabilities can cause TCP to resend data, thus multiplying the effect of the latency. The TS7700 Virtualization Engine uses your LAN/WAN to replicate logical volumes, access logical volumes remotely, and perform cross-site messaging. The LAN/WAN should have adequate bandwidth to deliver the throughput necessary for your data storage requirements. The cross-site grid network is 1Gb Ethernet with either shortwave fibre or copper (RJ-45). For copper networks, Cat 5E or 6 Ethernet cabling may be used, but Cat 6 cabling is strongly recommended to achieve the highest throughput. Refer to the *Feature details* topic in the section **Related information** for requirements and prerequisites for the following grid network connections:

3957-V07 or 3957-VEB connections

- FC 1035, Grid optical LW connection
- FC 1036, 1Gb grid dual port copper connection
- FC 1037, 1Gb dual port optical SW connection

3957-V06 or 3957-VEA connections

- FC 1032, 1Gb grid dual port copper connection
- FC 1033, 1Gb grid dual port optical SW connection

The TS7700 Virtualization Engine does not encrypt the data it sends over the LAN/WAN.

Note: To avoid any network conflicts, the following subnets must **not** be used for LAN/WAN IP addresses or management interface primary, secondary, or virtual IP addresses:

- 192.168.251.xxx
- 192.168.250.xxx
- 172.31.1.xxx

Network redundancy

The TS7700 Virtualization Engine provides up to four independent 1Gb copper (RJ-45) or shortwave fibre Ethernet links for grid network connectivity. It is recommended that you connect each through an independent WAN

interconnection to be protected from a single point of failure that would disrupt service to both WAN paths from a node.

Related information

“Feature details” on page 108

Network adapter assignments

This topic gives required assignments for TS7700 Virtualization Engine network adapters.

Adapter assignments required for the TS7700 Virtualization Engine include:

- TCP/IP address
- Gateway IP address
- Subnet mask

TCP/IP addresses

Local IP addresses for management interface access

You must provide three TCP/IP addresses on the same subnet. Two of these are assigned to physical links, while the third is a virtual IP address used to connect to the TS7700 Virtualization Engine Management Interface.

The third IP address should be used to access a TS7700 Virtualization Engine; it automatically routes between the two addresses assigned to physical links. The virtual IP address enables access the TS7700 Virtualization Engine Management Interface using redundant paths, without the need to manually specify different IP addresses for the different paths. If one path is unavailable, the virtual IP address will automatically connect through the remaining path.

Note: If FC 9900, Encryption configuration, is installed, this same connection is used for communications between the TS7740 Virtualization Engine and the Encryption Key Server or Tivoli Key Lifecycle Manager (TKLM). Because encryption occurs on attached physical tape drives, the TS7720 Virtualization Engine does not support encryption and the virtual connection is used exclusively to create redundant paths.

You must provide one gateway IP address.

You must provide one subnet mask address.

Grid WAN IP addresses

For TS7700 Virtualization Engines configured in a Grid, the following additional assignments need to be made for the Grid WAN adapters. For each adapter, you must supply:

- A TCP/IP address
- A gateway IP address
- A subnet mask

TSSC Network IP addresses

For each cluster in your configuration, you must ensure the availability of three IP addresses on the TSSC network:

Table 31. Number of TSSC network IP addresses required per cluster

Number of clusters	Total number of IP addresses required on TSSC network
2	6
3	9
4	12
5	15
6	18

Note: The IP address used for the master console network must be entered as an increment of 10 between 10 and 240. The router configuration uses this address and the next nine sequential addresses for master console configuration. To prevent network problems, do **NOT** configure these addresses on this master console for another system.

To allow connection to a TSSC network, the IP addresses used by the TS7700 Virtualization Engine must not conflict with any other TS7700 Virtualization Engine connected to a common TSSC. Any IP addresses used are TSSC-assigned. Each TS7700 Virtualization Engine is assigned a range of ten IP addresses, where X is the lowest value in the IP address range and all components within a TS7700 Virtualization Engine are then assigned IP addresses as a value of X.

Table 32 displays the TCP/IP configuration for a TS7740 Virtualization Engine attached to a TS3500 Tape Library.

Note: If the TS7740 Virtualization Engine contains a 3956-CC6, 192.168.251.X-based addresses are not assigned by TSSC, but require Network Address Translation (NAT) of the router.

Table 32. TS7740 Virtualization Engine TCP/IP address assignments

Component	Location	Role	TCP/IP address
TS7740 Server	Slot 4, Port 0	TS7740 Cache Controller/TSSC	172.31.1.(X+7)
	Slot 5, Port 0	TS7740 Cache Controller/TSSC	172.31.1.(X+8)
	Slot 4, Port 1	Inbound management interface/customer key server/LDAP/SNMP	Customer assigned
	Slot 5, Port 1	Inbound management interface/customer key server/LDAP/SNMP	Customer assigned
	Slots 4 and 5, Ports 0	Inbound TSSC	172.31.1.X (Virtual IP address [VIPA])
	Slots 4 and 5, Ports 1	Inbound management interface	Customer assigned (VIPA)

Table 32. TS7740 Virtualization Engine TCP/IP address assignments (continued)

Component	Location	Role	TCP/IP address
I/O drawers	Drawer 0, Slot 1, Port 0	Cross-cluster WAN	Customer Assigned
	Drawer 0, Slot 1, Port 1 (dual port)		
	Drawer 1, Slot 1, Port 0		
	Drawer 1, Slot 1, Port 1 (dual port)		
TS7740 Cache Controller (3956-CC8)	CEC 0	3956-CC8	172.31.1.(X+1)
	CEC 1		172.31.1.(X+2)

Table 33 displays the TCP/IP configuration for a TS7720 Virtualization Engine.

Table 33. TS7720 Virtualization Engine TCP/IP address assignments

Component	Location	Role	TCP/IP address
TS7720 Server	Slot 4, Port 0	TS7720 Cache Controller/TSSC	172.31.1.(X+7)
	Slot 5, Port 0	TS7720 Cache Controller/TSSC	172.31.1.(X+8)
	Slot 4, Port 1	Inbound management interface/customer key server/LDAP/SNMP	Customer assigned
	Slot 5, Port 1	Inbound management interface/customer key server/LDAP/SNMP	Customer assigned
	Slots 4 and 5, Ports 0	Inbound TSSC	172.31.1.X (VIPA)
	Slots 4 and 5, Ports 1	Inbound management interface	Customer assigned (VIPA)
I/O drawers	Drawer 0, Slot 1, Port 0	Cross-cluster WAN	Customer Assigned
	Drawer 0, Slot 1, Port 1 (dual port)		
	Drawer 1, Slot 1, Port 0		
	Drawer 1, Slot 1, Port 1 (dual port)		

Table 33. TS7720 Virtualization Engine TCP/IP address assignments (continued)

Component	Location	Role	TCP/IP address
TS7720 Cache Controller (3956-CS8)	CEC 0, 3952 Base Frame	3956-CS8	172.31.1.(X+1)
	CEC 1, 3952 Base Frame		172.31.1.(X+2)
	Controller 0 (bottom) CEC 0, 3952 Storage Expansion Frame		172.31.1.(X+3)
	Controller 0 (bottom) CEC 1, 3952 Storage Expansion Frame		172.31.1.(X+4)
	Controller 1 (top) CEC 0, 3952 Storage Expansion Frame		172.31.1.(X+5)
	Controller 1 (top) CEC 1, 3952 Storage Expansion Frame		172.31.1.(X+6)

Related information

“Planning for new system arrival (customer tasks)” on page 145

Network switches and TCP/IP ports requirements

This topic gives network switch and TCP/IP ports requirements for the WAN of a TS7700 Virtualization Engine in grid configuration.

Note: These requirements apply only to the grid LAN/WAN; the TS7700 Virtualization Engine network is managed and controlled by internal code.

Table 34 displays TCP/IP port assignments for the grid WAN.

Table 34. Grid WAN TCP/IP port assignments

TCP/IP port	Role
7	Echo/ping port
9	Discard service (bandwidth measurement between grid clusters)
22	TSSC Network (Internet control message protocol [ICMP])
53	TSSC Network (ICMP)
80	Access the remote management interface when clusters are operating at different code levels (http, ICMP)
123	Network time protocol (NTP)
161	Simple network management protocols (SNMP)
162	TSSC Network (SNMP, ICMP)
350	TS7700 Virtualization Engine file replication (distributed library file transfer)
443	Access the TS7700 Virtualization Engine Management Interface (https/ssh, ICMP)
1415	TS7700 Virtualization Engine message exchange (grid-to-grid)
1416	TS7700 Virtualization Engine message exchange (HDM-to-HDM)
1443	Encryption key server (secure socket layer [SSL])

Table 34. Grid WAN TCP/IP port assignments (continued)

TCP/IP port	Role
3801	Encryption key server (TCP/IP)
5988	Access the TS7700 Virtualization Engine Management Interface
5989	Access the TS7700 Virtualization Engine Management Interface
7080	TSSC Network (ICMP)
9088	TSSC Network (ICMP)
9666	TSSC Network (ICMP)

It is requested that the following ports remain open for easier service of the subsystem:

- 20: FTP data
- 21: FTP control
- 23: Telnet

Related information

“Network adapter assignments” on page 65

Planning for logical and physical volumes

As part of your planning process, you need to determine the number of logical and stacked physical volumes required for your workload.

The topics in this section provide information to help you determine the total number of logical volumes required, suggestions about the volume serial number (VOLSER) ranges to define and the number of physical volumes required. The VOLSER of the logical and physical volumes must be unique throughout a system-managed storage complex (SMSplex) and throughout all storage hierarchies such as DASD, tape, and optical storage media.

Logical volumes

Use this section to determine the number of logical volumes required to accommodate the workload you are planning for the TS7700 Virtualization Engine.

A TS7700 Virtualization Engine supports a maximum of 2 million logical volumes. To determine the number of logical volumes required to accommodate your workload consider:

- The size of your logical volumes
- The number of scratch volumes needed per day
- The time required for return-to-scratch processing
- How often scratch processing is performed

Size of logical volumes

The TS7700 Virtualization Engine supports logical volumes with maximum sizes of 400, 800, 1000, 2000, 4000, and 6000 MB although effective sizes can be larger if data is compressed. For instance, if your data compresses with a 3:1 ratio, the effective maximum logical volume size for a 4000 MB logical volume is 12000 MB.

Important: Since immediate mode copies take place in their entirety after a volume is closed, the ability to replicate 6000 MB volumes increases the copy and Rewind-Unload (RUN) device end holding time by 50% over 4000 MB volumes. The immediate mode replication policy is not optimal for use with 6000 MB volumes.

Depending on the logical volume sizes that you choose, the number of volumes required to store your data can change depending on the media size from which you are converting. If you currently store your data on native 3490 cartridges, the number of logical volumes needed likely remains the same, with the exception of multi-volume data sets. If you migrate a multi-volume data set that uses native 3490 Enhanced Capacity cartridges (800 MB) and your target logical volume size is 4000 MB, then up to five of the original volumes of a multi-volume data set can fit on one logical volume. In this scenario, the number of logical volumes needed is reduced. If your data sets currently fill native 3590 volumes you would need many more logical volumes to store your data (as multi-volume sets), even using 4000 MB logical volumes.

A logical volume's size may be set by VOLSER and can change dynamically using the DFSMS (data facility system managed storage) Data Class storage construct. You can specify 400 MB CST (cartridge stored tape)-emulated cartridges or 800 MB with ECCST (extended capacity cartridge storage tape)-emulated cartridges when adding volumes to the TS7700 Virtualization Engine. You can use these sizes without modification or use policy management to override those sizes to provide for the 400, 800, 1000, 2000, 4000, and 6000 MB sizes.

The amount of data copied to the stacked cartridge is only the amount of data that has been written to a logical volume. The choice between all available logical volume sizes does not affect the real space used in either the TS7700 Cache or the stacked volume. In general, unless you have a special need for CST emulation (400 MB), specify the ECCST media type when inserting volumes in the TS7700 Virtualization Engine.

Number of scratch volumes needed per day

As you run your daily production workload, plan for enough logical volumes in scratch status to support the data that is written to the TS7700 Virtualization Engine. This could be hundreds or thousands of volumes, depending on your workload. More than a single day's worth of scratch volumes should be available at any point in time.

Time required for return-to-scratch processing

Return-to-scratch processing involves running a set of tape management tools that identifies the logical volumes that no longer contain active data and then communicating with the TS7700 Virtualization Engine to change the status of those volumes from private to scratch. The amount of time the process takes depends on the type of tape management system being employed as well as how busy the TS7700 Virtualization Engine is when it is processing the volume status change requests and whether a grid configuration is being used. You should expect that when a TS7700 Virtualization Engine is not handling a daily workload peak that up to 5000 logical volumes per hour can be returned to scratch for a single cluster and up to 2500 logical volumes per hour can be returned to scratch in a two-cluster grid configuration.

How often return-to-scratch processing is performed

If the number of logical volumes used on a daily basis is small (less than a few thousand), you may choose to perform return-to-scratch processing only every few days. A good rule of thumb is to plan for no more than a four-hour time period to run return to scratch. By ensuring a nominal run time of four hours, enough time exists during first shift to run the process twice should problems be encountered during the first attempt. For example, assume that you use 2000 scratch volumes per night on a two-cluster grid configuration. A four-hour return-to-scratch period returns up to 10000 logical volumes to scratch status. Running return-to-scratch processing every five days would just keep up with the rate at which the scratch logical volumes are being used. Therefore, running return-to-scratch every three or four days would provide some buffer in the number of available scratch logical volumes.

In planning for the number of logical volumes needed, first determine the number of private volumes that make up the current workload being migrated. One way to do this is by looking at the amount of data on your current volumes and then matching that to the supported logical volume sizes. You would match the volume sizes taking into account the compressibility of your data. If you do not know what the average ratio is, a conservative value of 2:1 may be used.

If you define more volumes than you need, at a later time you can delete the additional volumes; unused logical volumes do not consume space. Refer to the topic *Physical volumes* linked from the **Related information** section for implications of a large number of previously used, but now scratch, logical volumes.

Related information

“Allocation assistance” on page 199

“Physical volumes” on page 72

Volume serial numbering

This topic describes the volume serial numbers (VOLSERs) used to identify logical and physical volumes.

The TS7700 Virtualization Engine determines how to establish increments of VOLSER values based on whether the character in a particular position is a number or a letter. For example, inserts starting with ABC000 and ending with ABC999 add logical volumes with VOLSERs of ABC000, ABC001, ABC002...ABC999 into the inventory of the TS7700 Virtualization Engine.

Note: A valid volume serial number (VOLSER) is a 6-digit sequence number composed only of uppercase alphabetic characters [A-Z] and numerals in the range [0-9]. Embedded blank spaces cannot be used.

Plan for growth by reserving multiple ranges for each installed TS7700 Virtualization Engine.

Note: Multiple TS7700 Virtualization Engines in a grid configuration share the same ranges; reservation of multiple ranges applies only to TS7700 Virtualization Engines that are part of different composite libraries.

Related information

“Physical volumes” on page 72

Physical volumes

Use this section to determine the number of physical volumes required to accommodate the workload you are planning for the TS7740 Virtualization Engine.

To determine the number of physical volumes required to accommodate your workload, you must consider:

- The number of logical volumes you define
- The average amount of data on a volume
- The average compression ratio achieved for the data
- The Selective Dual Copy function to be used
- Whether the Delete Expired Volume Data setting is used
- The reclaim threshold settings
- The scratch physical volumes
- The number of physical volume pools

If you use the Copy Export function, plan for the additional physical volumes taken offsite.

Number of logical volumes

Since the data on a logical volume is stored on a physical volume, the number of logical volumes has a direct effect on the number of physical volumes required.

Average amount of data on a volume

The TS7700 Virtualization Engine only stores the amount of data you write to a logical volume plus a small amount of metadata.

Average compression ratio achieved for the data

The data that a host writes to a logical volume may be compressible. The space required on a physical volume is calculated after the effect of compression. If you do not know the average number for your data, assume a conservative 2:1 ratio.

Selective Dual Copy function

If you use this function for some or all your data, a logical volume can be written to a second physical volume, in addition to the first physical volume, resulting in two physical volumes in the same physical library.

Copy Export

The Copy Export function creates a disaster recovery solution by allowing physical volumes containing a copy of selected logical volumes to be ejected from the TS7740 Virtualization Engine and moved to an offsite location. If you use this function, plan for the number of additional physical volumes required and whether you want to use a specific VOLSER for them. The default number of managed, exported physical volumes is 2,000. However, this value can be adjusted to a maximum of 10,000 using the *Copy Export Settings* panel of the TS7700 Virtualization Engine Management Interface.

Delete Expired Volume Data setting

If an Expire Time is not set for a logical volume's Fast Ready Category, logical volumes occupy space on the physical volumes even after they have been returned to scratch. In that case, only when a logical volume is rewritten is the old data released to reduce the amount of active data on the physical volume. When the Fast Ready Category Expire Time is set, the data associated with volumes that have been returned to scratch are deleted after Reclamation is run. For example, assume that you have 20,000 logical volumes in scratch status at any point in time and that the average amount of data on a logical volume is 400 MB and that the data compresses at a 2:1 ratio. The space occupied by the data on those scratch volumes is 4,000,000 MBs or the equivalent of 14 3592 JA cartridges. By using the Fast Ready Category Expire Time, you could reduce the number of cartridges required in this example by 14.

Secure Data Erasure

Secure Data Erasure monitors the age of expired data on a physical volume and forces a reclaim and physical overwrite of the data on the volume when its age exceeds a limit set by you.

Secure Data Erasure also takes into account whether a volume has been encrypted. If a volume has not been encrypted or only a portion of it was encrypted, the non-encrypted area of the volume is erased by loading it on a drive and having the drive perform a Data Security Erase operation. If all of the data area on a volume was encrypted, then instead of performing the Data Security Erase operation, the volume is loaded on a drive and the externally encrypted data key is erased from the media, rendering the data un-recoverable. This reduces the amount of time to erase a volume from more than two hours to just a few minutes.

Reclaim threshold settings

The number of required physical volumes also depends on the reclaim threshold percentage that you have specified for the minimum amount of active data on a volume before it becomes eligible for reclamation. The default is set to 10%. The reclaim threshold setting can have a large impact on the number of physical volumes required. Physical volumes hold between the threshold value and 100% of data. On average, the percentage of active data on the physical volumes is $(100\% - 10\%) / 2$ or 45% (assuming a reclamation setting of 10%). Having too low a setting results in more physical volumes being needed; having too high a setting may impact the TS7740 Virtualization Engine's ability to perform host workload because it is using its resources to perform reclamation. Experiment to find a threshold that matches your needs.

Scratch physical volumes

You should plan for at least 10 scratch physical volumes to be available in the common media pool.

Number of physical volume pools

For each physical volume pool, plan to use at least three scratch physical volumes. These are in addition to the number of physical volumes calculated to hold the data on the logical volumes.

Here is a suggested formula to calculate the number of physical volumes needed:

Where:

Pv = Total number of physical volumes needed
Lv = Number of logical volumes defined
Lc = The number of dual copied logical volumes
(including those not yet exported)
Ls = The average logical volume size in MB
Cr = Compression ratio of your data
Rp = The reclamation percentage
Pc = Capacity of a physical volume in MB

Number of physical volumes:

$$Pv = ((Lv + Lc) \times Ls / Cr) / (Pc \times (((100 - Rp) / 100) / 2))$$

To this number you would then add scratch physical volumes based on the common media pool and the number of physical volume pools you plan on using. For example, using the following assumptions:

Lv = 82 500 (from the prior topic)
Lc = 10 000
Ls = 400 MB
Cr = 2
Rp = 10
Pc = 1 TB (1 048 576 MB) (capacity of a 3592-E06 and JB-written volume)
Common media scratch pool count of 10

5 physical volume pools

You would need to plan on the following number of physical volumes in the TS7740 Virtualization Engine:

$$(((82500 + 10000) \times 400 \text{ MB}) / 2) / (1048576 \text{ MB} \times (((100 - 90) / 100) / 2)) + 10 + 5 \times 3 = 1104 \text{ physical volumes}$$

If you put more physical volumes in the TS7740 Virtualization Engine than you need, you can eject them at a later time.

Migrating

You can migrate data from an existing media type to a new media type for use with a TS7700 Virtualization Engine.

Note: Migration from a VTS B10/B20 is a service now provided by Global Technical Services. For additional information concerning VTS features please refer to *IBM TotalStorage Virtual Tape Server: Planning, Implementing, and Monitoring Redbook, SG24-2229*, available from the [IBM Support & Downloads](#) web page link in the **Related information** section.

Three paths exist to migrate data to a new media type:

Natural reclamation

Natural reclamation is the most efficient method to migrate data to a new media type. Follow these steps to migrate data using natural reclamation:

1. Insert the new media type into the library.
2. Open the *Modify pool properties* panel of the management interface for the TS7700 Virtualization Engine attached to the library.

3. In the **First Media (Primary)** field, select the NEW media type that you want to migrate data to. All new physical mounts for volume stacking use this media type.
4. In the **Second Media (Secondary)** field, select **none**. Any data on the existing, OLD media becomes read only.
5. When natural reclamation occurs, data is migrated from the old media to the new media designated by the **First Media (Primary)** field. All empty, old media is returned to a scratch state.
6. Open the *Eject physical volumes* panel of the management interface.
7. Use the **Eject Range of Scratch Only Volumes** field to eject old media that is empty or has been returned to scratch. You can narrow the range of volumes ejected using the **Media Type** option.

Forced eject

You can use a forced eject to migrate data to a new media type. Follow these steps to migrate data using forced eject:

1. Insert the new media type into the library.
2. Open the *Modify pool properties* panel of the management interface for the TS7700 Virtualization Engine attached to the library.
3. In the **First Media (Primary)** field, select the NEW media type that you want to migrate data to. All new physical mounts for volume stacking use this media type.
4. In the **Second Media (Secondary)** field, select **none**. Any data on the existing, OLD media becomes read only.
5. Open the *Eject physical volumes* panel of the management interface.
6. Use the **Eject Range of Physical Volumes** field and the **Media Type** option to eject the old media. All empty media of the old media type are ejected. Any volumes on the old media type that have logical volume stacked content are first reclaimed, then ejected. The reclamation process moves content from the old media to the new media.

Note: You can use the force eject method in combination with the natural reclamation method to migrate data from outlier media that escape natural reclamation due to minimal data expiration.

Logical volume move

You can use a logical volume move operation to migrate data to a new media type, but this is the least optimal alternative. Follow these steps to migrate data using a logical volume move:

1. Insert the new media type into the library.
2. Open the *Modify pool properties* panel of the management interface for the TS7700 Virtualization Engine attached to the library.
3. For each pool currently in use (old pool), configure a new version (new pool) with the following media type settings:
 - In the **First Media (Primary)** field, select the NEW media type that you want to migrate data to. All new physical mounts for volume stacking use this media type.
 - In the **Second Media (Secondary)** field, select **none**. Any data on the existing, OLD media becomes read only.
4. Modify constructs through the management interface so that all new allocations use the newly created pools.
5. Open the *Move logical volumes* panel on the management interface.

6. In the **Existing Ranges** field, select a range that is associated with the old media type.
7. In the **Target Pool** field, select the new pool.
8. In the **Media Type** field, select the new media type.
9. Select **Move** to begin the move operation. Data on the old media is reclaimed and moved to the new pool on the new media.
10. Complete steps 6 through 9 for each pool on the old media. Each pool must be moved individually.
11. Open the *Eject physical volumes* panel of the management interface.
12. Use the **Eject Range of Physical Volumes** field and the **Media Type** option to eject the old media.
13. Open the *Modify pool properties* panel of the management interface for the TS7700 Virtualization Engine attached to the library.
14. Deconfigure each old pool no longer in use.

Related information

“Quick reference by component” on page 102

“Feature details” on page 108

 <http://www.ibm.com/support/us/en/>

Merging

You can add an existing TS7700 Cluster to an existing TS7700 Grid or to another existing TS7700 Cluster to form a grid for the first time.

An installed and operational TS7700 Cluster that contains data can be merged with a previously installed and operational TS7700 Cluster or TS7700 Grid.

Important:

- You cannot merge two existing TS7700 Grids.
- You cannot insert or eject any logical or physical volumes during a grid join. Do not begin the merge operation until all insert and eject operations are complete on all clusters in both grids.

Refer to the topic “Adding TS7720 Clusters or TS7740 Clusters to a grid” on page 82 in the **Related information** section for available merge scenarios.

Note: FC 4015, Grid enablement must be installed on all TS7700 Clusters that operate in a grid configuration, and all clusters must operate at microcode level 8.7.0.x or higher.

You might need to access the merging cluster before it becomes part of a grid (for example, to remove duplicate volumes that would prevent a successful grid join). Plan to complete any access to the soon-to-be merged (stand-alone) cluster before initiating any host configuration changes. Plan for the following host configuration changes, which must be completed before using the newly-joined cluster:

- All HCDs (hardware configuration definition: the MVS [multiple virtual storage] component that builds the I/O definitions), subsystem IDs, and Port IDs must be updated.
- The RMM (Removal Media Manager) and volcat (volume category) ranges must be updated within their respective storage groups. These updates are necessary to maintain continued access to the original volumes that were created when the system(s) were configured as stand-alone cluster(s).

Plan to define the following management and data policies after the TS7700 Cluster merge is complete:

- Define stacked volume ranges
- Define Fast Ready categories
- Define the expired logical volume data policy
- Define inhibit reclaim schedule

Note: Prior to microcode level 8.5.0.xx, inhibit reclaim schedules were designated using local time instead of Coordinated Universal Time (UTC). If you have upgraded from a microcode level of 8.4.0.xx, verify that your inhibit reclaim schedule displays the correct day and time before starting an inhibit reclaim operation using the new code version.

- Define reclaim threshold percentage
- Define free storage threshold

If categories and constructs are already defined on the merging cluster, verify that the total number of each category and construct that will exist in the grid following the merge does not exceed 256. If necessary, delete existing categories or constructs from the merging clusters before the grid join occurs.

Each TS7700 Grid supports a maximum of 256 of each of the following categories and constructs:

- Fast ready categories
- Management Classes
- Data Classes
- Storage Classes
- Storage Groups

Important: Each TS7700 Grid supports a maximum of 2 million logical volumes (available with FC5270 when operating a microcode level of 8.20.0.xx or higher, or by RPQ otherwise). Verify that the total number of logical volumes to exist in the grid following the merge does not exceed 2 million. If necessary, remove existing logical volumes from the merging clusters before the grid join occurs. Verify that no duplicate VOLSERS exist between the merging clusters. Each cluster within the TS7700 Grid must have at least 16 GB of physical memory installed before 2 million logical volumes are supported. Verify that each cluster possesses enough physical memory before merging clusters.

Related information

“Adding TS7720 Clusters or TS7740 Clusters to a grid” on page 82

“Feature details” on page 108

“TS7720 Cache thresholds and removal policies” on page 188

TS7700 Virtualization Engine upgrade options

This section contains information about field-installable upgrades that enable on-site configuration of the TS7700 Virtualization Engine.

Related information

“TS7700 Grid” on page 174

FC 1032, 1-Gb Grid copper connection

FC 1033, 1-Gb Optical SW connection

FC 1035, 10-Gb Optical LW connection
FC 3441, FICON short-wavelength attachment
FC 3442, FICON long-wavelength attachment
FC 3443, FICON 10-km long-wavelength attachment
FC 3461, 8 GB Memory upgrade, field
FC 4015, Grid enablement
FC 5240, Dual port fibre channel host bus adapter
FC 5267, 1-TB cache enablement
FC 5268, 100-MB/sec increment
FC 5642, Field install 3956-CX7
FC 5647, Field install 3956-XS7
FC 5649, Field install 3956-CX6
FC 9218, Attach to 3494 LM
FC 9323 Expansion frame attachment
Attach to TS3500

 <http://www.ibm.com/support/us/en/>

Concurrent TS7700 Virtualization Engine upgrade options

Concurrent system upgrades can be installed while the TS7700 Virtualization Engine is online and operating.

The following component upgrades can be made concurrently to an existing, on-site TS7700 Virtualization Engine:

FICON adapters

You can install FICON adapters to convert a two-FICON configuration to a four-FICON configuration, or to replace one pair of FICON adapters of a certain type with a pair of another type (shortwave/longwave or 4-km/10-km). Replacement of an existing FICON adapter requires removal of the original feature and addition of the new feature. Use "FC 3441, FICON short-wavelength attachment" on page 114, "FC 3442, FICON long-wavelength attachment" on page 114, and "FC 3443, FICON 10-km long-wavelength attachment" on page 115 to achieve these upgrades.

Note: FICON adapters may not be replaced concurrently when used with the 3957-VEB or 3957-V07.

Incremental disk cache capacity

You can add a 1 TB (0.91 TiB) increment of disk cache to store logical volumes, up to 28 TB (25.46 TiB). Use "FC 5267, 1 TB cache enablement" on page 117 to achieve this upgrade. This feature is only available with a TS7740 Virtualization Engine.

Incremental data throughput

You can add a 100-MB/sec increment of peak data throughput, up to your system's hardware capacity. When the maximum number of performance increments are installed, the system no longer restricts performance. Use "FC 5268, 100 MB/sec increment" on page 118 to achieve this upgrade.

Peak data throughput increments of 100 MB/sec are available as transferred from a host to a vNode prior to compression. If additional peak data throughput capacity is needed, up to six additional increments can be ordered for the 3957-V06/VEA and up to 10 can be ordered for the

3957-V07/VEB (to complement “FC 9268, Plant install 100 MB/s throughput” on page 126 installed at the plant). If the maximum number of increments is installed, the TS7700 Virtualization Engine places no limits on data transfers through the cluster. This installation is performed by you through the TS7700 Virtualization Engine Management Interface by entering the license key obtained with the purchase of “FC 5268, 100 MB/sec increment” on page 118.

Note: All host data transfers through the TS7740 Cluster are taken into consideration for the data transfer limit regardless of which TS7740 Cluster initiated or received the data transfer.

Selective device access control

You can grant exclusive access to one or more VOLSER ranges by only certain logical control units or subsystem IDs within a composite library for the purpose of host-initiated mounts, ejects, and changes to attributes or categories. Use “FC 5271, Selective device access control” on page 118 to add this upgrade. For additional information, refer to the topic *Selective device access control* in the **Related information** section. This feature is available only with a microcode level of 8.20.0.xx or higher.

Increased logical volumes

You can add support for additional logical volumes in 200,000 volume increments, up to a total of two million logical volumes. Use “FC 5270, Increased logical volumes” on page 118 to achieve this upgrade.

Note: In a grid configuration, the maximum number of supported logical volumes is determined by the cluster having the fewest installed instances of FC 5270, Increased logical volumes. In order to increase the number of supported logical volumes across a grid, the required number of FC 5270, Increased logical volumes, must be installed on each cluster in the grid.

Dual port grid connection

You can concurrently enable the second port of each dual port, 1Gb grid connection adapter in the following TS7700 Server configurations:

- On an existing 3957-V06 or 3957-VEA when “FC 1032, 1Gb grid dual port copper connection” on page 111 or “FC 1033, 1Gb grid dual port optical SW connection” on page 111 are present.
- Use “FC 1034, Enable dual port grid connection” on page 111 to achieve this upgrade.

On a new 3957-V07 or 3957-VEB you can enable the second port of each dual port, 1Gb grid connection, but this option is not available as a concurrent MES on these models. A non-concurrent MES is required to install “FC 1036, 1Gb grid dual port copper connection” on page 112 or “FC 1037, 1Gb dual port optical SW connection” on page 112 to achieve this upgrade.

TS7720 Storage Expansion Frame

You can add a cache expansion frame to a fully configured TS7720 Virtualization Engine using “FC 9323 Expansion frame attachment” on page 126 and applying “FC 7323, TS7720 Storage expansion frame” on page 124 to a 3952 F05 Tape Frame. For upgrade requirements, configurations, and feature details, refer to the topics *Upgrades specific to the TS7720 Virtualization Engine* and *Feature details* in the **Related information** section.

Related information

“Feature details” on page 108

“Selective device access control” on page 201

“TS7700 Grid” on page 174

“TS7700 Virtualization Engine feature codes” on page 102

“Upgrades specific to the TS7720 Virtualization Engine” on page 83

 <http://www.ibm.com/support/us/en/>

Non-concurrent TS7700 Virtualization Engine upgrade options

Non-concurrent upgrades require the TS7700 Virtualization Engine to be brought offline prior to installation.

The following component upgrades must be made non-concurrently to an existing, on-site TS7700 Virtualization Engine. In some instances, the targeted component must be reconfigured before the upgrade takes effect.

Ethernet adapters for grid communication

Shortwave fibre Ethernet

You can add a 1-Gb shortwave fibre Ethernet adapter for grid communication between TS7700 Virtualization Engines.

For a TS7720 Server (3957-V06 or 3957-VEA) use “FC 1033, 1Gb grid dual port optical SW connection” on page 111 to achieve this upgrade.

For a TS7740 Server (3957-V07 or 3957-VEB) use “FC 1037, 1Gb dual port optical SW connection” on page 112 to achieve this upgrade.

Longwave fibre Ethernet

You can add a longwave fibre Ethernet adapter for grid communication between TS7700 Virtualization Engines. Use “FC 1035, Grid optical LW connection” on page 111 to achieve this upgrade.

Copper Ethernet

You can add a 1-Gb copper Ethernet adapter for grid communication between TS7700 Virtualization Engines.

For a TS7720 Server (3957-V06 or 3957-VEA) use “FC 1032, 1Gb grid dual port copper connection” on page 111 to achieve this upgrade.

For a TS7740 Server (3957-V07 or 3957-VEB) use “FC 1036, 1Gb grid dual port copper connection” on page 112 to achieve this upgrade.

Enable four, 1 Gb grid Ethernet ports

You can enable two additional ports for grid communication between TS7700 Virtualization Engines, for a total of four, 1 Gb grid Ethernet connections. Use “FC 1034, Enable dual port grid connection” on page 111 to achieve this upgrade.

For a TS7720 Server (3957-V06 or 3957-VEA), “FC 1032, 1Gb grid dual port copper connection” on page 111 or “FC 1033, 1Gb grid dual port optical SW connection” on page 111 is also required.

For a TS7740 Server (3957-V07 or 3957-VEB) “FC 1036, 1Gb grid dual port copper connection” on page 112 or “FC 1037, 1Gb dual port optical SW connection” on page 112 is also required.

TS7740 Server 1 Gb single port to dual port Ethernet

You can replace a single port adapter in a TS7740 Server (3957-V06 only) with a dual port adapter to take advantage of support for four active, 1 Gb grid links. Use “FC 1032, 1Gb grid dual port copper connection” on page 111 (for dual copper) or “FC 1033, 1Gb grid dual port optical SW connection” on page 111 (for dual optical) to achieve this upgrade.

TS7700 Server dual copper/optical Ethernet swap

You can swap a dual port grid Ethernet adapter in a TS7700 Server for a dual port adapter of the opposite type. You can swap a dual port copper for a dual port optical Ethernet adapter, or swap a dual port optical for a dual port copper Ethernet adapter.

For a TS7720 Server (3957-V07 or 3957-VEB), use “FC 1036, 1Gb grid dual port copper connection” on page 112 or “FC 1037, 1Gb dual port optical SW connection” on page 112 to achieve this upgrade.

For a TS7740 Server (3957-V06 or 3957-VEA), use “FC 1032, 1Gb grid dual port copper connection” on page 111 or “FC 1033, 1Gb grid dual port optical SW connection” on page 111 to achieve this upgrade.

TS7700 Server physical memory upgrade

You can add 8 GB of physical memory to a 3957-V06 or 3957-VEA that contains 8 GB, for a resulting total of 16 GB of physical memory. Use “FC 3461, 8 GB Memory upgrade, field” on page 115 to achieve this upgrade.

TS7700 Server FICON adapter installation

You can install a FICON adapter to connect a TS7700 Server (3957-V07 or 3957-VEB) to a host system. FICON adapter replacement is non-concurrent when used with a 3957-V07 or 3957-VEB. Use “FC 3441, FICON short-wavelength attachment” on page 114, “FC 3442, FICON long-wavelength attachment” on page 114, or “FC 3443, FICON 10-km long-wavelength attachment” on page 115 to achieve this installation.

TS7720 Server Fibre Channel host bus adapter installation

You can install two Fibre Channel interface cards in the TS7720 Server (3957-VEB) to connect the TS7720 Server to the disk arrays in the TS7720 Storage Expansion Frame. Use “FC 5241, Dual port FC HBA” on page 117 to achieve this installation.

Related information

“TS7700 Grid” on page 174

FC 1032, 1Gb grid dual port copper connection

FC 1033, 1Gb grid dual port optical SW connection

FC 1035, Grid optical LW connection

FC 1036, 1Gb grid dual port copper connection

FC 1037, 1Gb dual port optical SW connection

FC 5267, 1 TB cache enablement

FC 5268, 100 MB/sec increment

 <http://www.ibm.com/support/us/en/>

Adding TS7720 Clusters or TS7740 Clusters to a grid

You can upgrade an existing, on-site TS7700 Grid by adding a TS7700 Cluster.

The following system configuration upgrades may be made to an existing, on-site TS7740 Cluster or TS7720 Grid:

To achieve any of the following upgrades, you must order “FC 4015, Grid enablement” on page 115 against the TS7700 Server.

Two-cluster TS7700 Grid

You can add a new, empty TS7700 Cluster to an existing TS7700 Cluster to create a two-cluster TS7700 Grid.

You can combine two existing TS7700 Clusters to create a two-cluster TS7700 Grid.

Three-cluster TS7700 Grid

You can add a new, empty TS7700 Cluster to an existing two-cluster TS7700 Grid to create a three-cluster TS7700 Grid.

You can add an existing TS7700 Cluster to an existing two-cluster TS7700 Grid to create a three-cluster TS7700 Grid.

Four-cluster TS7700 Grid

You can add a new, empty TS7700 Cluster to an existing three-cluster TS7700 Grid to create a four-cluster TS7700 Grid.

You can add an existing TS7700 Cluster to an existing three-cluster TS7700 Grid to create a four-cluster TS7700 Grid.

Note: You cannot combine two existing two-cluster TS7700 Grids to create a four-cluster TS7700 Grid.

Five-cluster TS7700 Grid

You can add a new, empty TS7700 Cluster to an existing four-cluster TS7700 Grid to create a five-cluster TS7700 Grid.

You can add an existing TS7700 Cluster to an existing four-cluster TS7700 Grid to create a five-cluster TS7700 Grid.

Note: This configuration is only available as an RPQ. You cannot combine two existing multiple-cluster TS7700 Grids to create a five-cluster TS7700 Grid.

Six-cluster TS7700 Grid

You can add two new, empty TS7700 Clusters to an existing four-cluster TS7700 Grid to create a six-cluster TS7700 Grid.

You can add two existing TS7700 Clusters to an existing four-cluster TS7700 Grid to create a six-cluster TS7700 Grid.

Note: This configuration is only available as an RPQ. You cannot combine two existing multiple-cluster TS7700 Grids to create a six-cluster TS7700 Grid.

Note: Attachment to a TS3500 Tape Library via a 3953 L05 Library Manager is only supported by TS7740 Virtualization Engine microcode levels prior to 8.5.0.xx. Attachment to a TS3500 Tape Library without a 3953 L05 Library Manager is supported by TS7740 Virtualization Engine microcode level 8.5.0.xx or later.

Important: Two TS7700 Virtualization Engines connected to a single tape library (TS3500 Tape Library or 3494 Tape Library) must not be combined to form a TS7740 Grid. Each TS7740 Cluster in a TS7740 Grid configuration must possess its own tape library (TS3500 Tape Library or 3494 Tape Library). For additional information about configuring a TS7700 Grid, refer to the topic *TS7700 Grid* in the **Related information** section.

Related information

“TS7700 Grid” on page 174

“FC 4015, Grid enablement” on page 115

 <http://www.ibm.com/support/us/en/>

Upgrades specific to the TS7720 Virtualization Engine

This section describes the use of miscellaneous equipment specifications (MES) to upgrade the TS7720 Virtualization Engine.

You can use FC 5647, Field install 3956-XS7, as an MES to add up to three TS7720 Cache Drawers to an existing 4-Drawer TS7720 Cache subsystem. Table 35 shows the resulting usable capacity associated with each upgrade configuration available to an existing 4-Drawer TS7720 Cache.

Table 35. Upgrade configurations for an existing 4-Drawer TS7720 Cache

Existing 4-Drawer TS7720 Cache configuration using 1 TB drives	Additional TS7720 Cache Drawer(s) using 2 TB drives	Total TS7720 Cache count	Usable capacity
1 TS7720 Cache Controller (3956-CS7) 3 TS7720 Cache Drawers (3956-XS7)	1 TS7720 Cache Drawer (3956-XS7)	1 TS7720 Cache Controller (3956-CS7)	58.89 TB (53.56 TiB)
	2 TS7720 Cache Drawer (3956-XS7)	4 TS7720 Cache Drawers (3956-XS7)	78.57 TB (71.46 TiB)
		1 TS7720 Cache Controller (3956-CS7)	
3 TS7720 Cache Drawer (3956-XS7)	3 TS7720 Cache Drawer (3956-XS7)	5 TS7720 Cache Drawers (3956-XS7)	98.24 TB (89.35 TiB)
		1 TS7720 Cache Controller (3956-CS7)	
		6 TS7720 Cache Drawers (3956-XS7)	

You can use FC 7323, TS7720 Storage expansion frame, as an MES to add a second expansion frame to a fully configured TS7720 Cache subsystem. The TS7720 Storage Expansion Frame contains two additional cache controllers, each controlling up to five additional expansion drawers. Table 36 on page 84 shows the resulting usable capacity associated with each upgrade configuration available to an existing 7-Drawer TS7720 Cache.

Note: This option is supported only by code levels of 8.7.0.xx and higher.

Table 36. Upgrade configurations for an existing 7-Drawer TS7720 Cache

Existing TS7720 Cache configuration	Additional TS7720 Storage Expansion Frame cache controllers (3956-CS8)†	Additional TS7720 Storage Expansion Frame cache drawers (3956-XS7)†	Total TS7720 Cache units (including TS7720 Base Frame)‡	Usable capacity (when TS7720 Base Frame contains only 1 TB drives)
1 TS7720 Cache Controller (3956-CS7) 6 TS7720 Cache Drawers (3956-XS7)	2	0	9	137.93 TB (125.44 TiB)
		1	10	161.76 TB (147.12 TiB)
		2	11	185.60 TB (168.80 TiB)
		3	12	209.44 TB (190.48 TiB)
		4	13	233.28 TB (212.16 TiB)
		5	14	257.11 TB (233.84 TiB)
		6	15	280.95 TB (255.52 TiB)
		7	16	304.79 TB (277.20 TiB)
		8	17	328.62 TB (298.88 TiB)
		9	18	352.46 TB (320.56 TiB)
		10	19	376.30 TB (342.24 TiB)
†The lower controller must have at most one more drawer than the upper controller.				
‡"Total cache units" refers to the combination of cache controllers and cache drawers.				

Related information

"TS7700 Virtualization Engine feature codes" on page 102

Upgrades specific to the TS7740 Virtualization Engine

This section describes the use of miscellaneous equipment specifications (MES) to upgrade the TS7740 Virtualization Engine.

Cache drawer upgrades

One to Two TS7740 Cache Drawers

You can add one TS7740 Cache Drawer to an existing one-drawer TS7740 Cache subsystem. Use "FC 5642, Field install 3956-CX7" on page 121 to achieve this upgrade.

Two to Four TS7740 Cache Drawers

You can add two TS7740 Cache Drawers to an existing two-drawer TS7740 Cache subsystem. Use "FC 5642, Field install 3956-CX7" on page 121 to achieve this upgrade.

Note: No MES is available to upgrade an existing one-drawer TS7740 cache subsystem directly to a four-drawer TS7740

cache subsystem. A one-drawer cache subsystem must be upgraded to a two-drawer cache subsystem before an upgrade to a four-drawer cache subsystem can occur.

TS7740 Server 1 Gb single port to dual port Ethernet

You can replace a single port adapter in a TS7740 Server (3957-V06 only) with a dual port adapter to take advantage of support for four active, 1 Gb grid links. Use “FC 1032, 1Gb grid dual port copper connection” on page 111 (for dual copper) or “FC 1033, 1Gb grid dual port optical SW connection” on page 111 (for dual optical) to achieve this upgrade.

TS7740 Server 1 Gb grid dual port copper connection

You can add a 1 Gb copper Ethernet adapter for grid communication between TS7740 Virtualization Engines with a single port enabled. Use “FC 1036, 1Gb grid dual port copper connection” on page 112 to achieve this upgrade on the 3957-V07.

TS7740 Server 1 Gb grid dual port optical connection

You can add a 1 Gb dual port optical shortwave Ethernet adapter for grid communication between TS7740 Virtualization Engines with a single port enabled. Use “FC 1037, 1Gb dual port optical SW connection” on page 112 to achieve this upgrade on the 3957-V07.

Related information

“System requirements” on page 46
5642, Field install 3956-CX7
FC 5649, Field install 3956-CX6

Incremental cache

Incremental features help tailor storage costs and solutions to your specific data requirements.

Subsets of total cache and peak data throughput capacity are available through incremental features “FC 5267, 1 TB cache enablement” on page 117 and “FC 5268, 100 MB/sec increment” on page 118. These features enable a wide range of factory-installed configurations and permit you to enhance and update an existing system. They can help you meet specific data storage requirements by increasing cache and peak data throughput capability to the limits of your installed hardware. Increments of cache and peak data throughput can be ordered and installed concurrently on an existing system through the TS7740 Virtualization Engine Management Interface.

Note: It is strongly recommended that you **do not** remove any installed peak data throughput features as removal can affect host jobs.

Incremental disk cache capacity

Incremental disk cache capacity is available in 1 TB (0.91 TiB) increments in a TS7740 Cluster. Disk cache is used for: data originated by a host through the vNode(s) of a local or remote cluster, data recalled from a physical tape drive associated with the cluster, or data copied from another cluster. Any excess installed capacity remains unused. Additional cache can be installed up to the maximum capacity of the installed hardware. , Table 37 on page 86 and Table 38 on page 86 display the maximum physical capacity of the TS7740 Cache configurations and the instances of “FC 5267, 1 TB cache enablement” on page 117 required to achieve each maximum capacity. Perform the installation of cache increments through the TS7740 Virtualization Engine Management Interface.

Note: A minimum of one instance of “FC 5267, 1 TB cache enablement” on page 117, can be ordered on the TS7740 Cache Controller and the required amount of disk cache capacity is 1 TB. When the single-drawer TS7740 Cache configuration is used, you must order four instances of “FC 5267, 1 TB cache enablement” on page 117 to use all available physical cache.

Note: Total cache capacity shown reflects raw capacity and does not directly correlate to usable capacity.

Table 37. Supported TS7740 Cache configurations using the 3956-CC7 cache controller†

Configuration	Physical capacity	Quantity of FC 5267‡
1 TS7740 Cache Controller (existing 3956-CC7) 1 TS7740 Cache Drawer (new 3956-CX7 with 600 GB drives)	10.8 TB (9.83 TiB)	10
1 TS7740 Cache Controller (existing 3956-CC7) 3 TS7740 Cache Drawers (existing 3956-CX7 with 300 GB drives)	14.4 TB (13.74 TiB)	14
1 TS7740 Cache Controller (existing 3956-CC7) 3 TS7740 Cache Drawers (new 3956-CX7 with 600 GB drives)	25 TB (23.25 TiB)	25
1 TS7740 Cache Controller (existing 3956-CC7) 1 TS7740 Cache Drawer (existing 3956-CX7 with 300 GB drives) 2 TS7740 Cache Drawers (new 3956-CX7 with 600 GB drives)	21 TB (19.53 TiB)	21
†Any configuration that includes a 3956-CC7 cache controller is only supported as an MES update to a TS7740 Cache containing an existing 3956-CC7 cache controller. ‡Number of instances required to use maximum physical capacity.		

Table 38. Supported TS7740 Cache configurations using the 3956-CC8 cache controller

Configuration	Physical capacity	Quantity of FC 5267‡
1 TS7740 Cache Controller (3956-CC8)	7 TB (6.51 TiB)	7
1 TS7740 Cache Controller (3956-CC8) 1 TS7740 Cache Drawer (3956-CX7)	14 TB (13.02 TiB)	14
1 TS7740 Cache Controller (3956-CC8) 3 TS7740 Cache Drawer (3956-CX7)	28.8 TB (26.21 TiB)	28
‡Number of instances required to use maximum physical capacity.		

Incremental data throughput

Incremental data throughput is available in 100-MB/sec increments, up to the limits of the installed hardware. Use “FC 5268, 100 MB/sec increment” on page 118 to add data throughput increments. Refer to the topic *Concurrent TS7700 Virtualization Engine upgrade options* in the **Related information** section for additional information.

Related information

“Concurrent TS7700 Virtualization Engine upgrade options” on page 78

FC 5267, 1-TB cache enablement

FC 5268, 100-MB/sec increment

“Planning for logical and physical volumes” on page 69

“Workload considerations” on page 44

Tape encryption and copy export

In the modern business environment, data must be both secure and portable. The TS7700 Virtualization Engine ensures both criteria are met.

Tape encryption protects your data, controls access to it, and can verify its authenticity. Copy Export and import functions help you backup critical data for remote storage.

Related information

“Tape encryption overview”

“Copy export overview” on page 97

Tape encryption overview:

Data is one of the most highly valued resources in a competitive business environment. Protecting that data, controlling access to it, and verifying its authenticity while maintaining its availability are priorities in a security-conscious world. Data encryption is a tool that answers many of these needs.

The IBM System Storage TS1120 Tape Drive (3592 Model E05) and TS1130 Tape Drive (3592 Model E06) are capable of encrypting data as it is written to any size IBM TotalStorage 3592 Enterprise Tape Cartridge, including WORM cartridges. Encryption is performed at full line speed in the tape drive after compression. (Compression is more efficiently done before encryption.) This new capability adds a strong measure of security to stored data without the processing overhead and performance degradation associated with encryption performed on the server or the expense of a dedicated appliance.

Note: Neither E06 nor EU6 tape drives can be intermixed with E05 or J1A tape drives. Encryption is supported on E06, EU6, and E05 drives.

Three major elements comprise the tape drive encryption solution:

Encryption-enabled tape drive

All TS1130 Tape Drives are *encryption-capable*. All TS1120 Tape Drives installed with FC 5592 or 9592 are *encryption-capable*. This means that they are functionally capable of performing hardware encryption, but this capability has not yet been activated. In order to perform hardware encryption, the TS1120 Tape Drives must be *encryption-enabled*. In an IBM System Storage TS3500 Tape Library, TS1120 Tape Drives or TS1130 Tape Drives can be encryption-enabled through the IBM System Storage Tape Library Specialist Web interface. When TS1130 or TS1120 tape drives are attached to a controller, this process consists of having an IBM representative set up the drive as encryption-enabled. Only encryption-enabled TS1120 and TS1130 tape drives can be used to read and write encrypted 3592 tape cartridges.

Encryption key management

Encryption involves the use of several kinds of keys in successive layers. How these keys are generated, maintained, controlled, and transmitted depends upon the operating environment in which the encrypting tape drive is installed. Some applications are capable of performing key management. For environments without such applications, IBM provides a key server such as the IBM Encryption Key Server component for the Javat platform or the Tivoli Key Lifecycle Manager to perform all necessary key management tasks. “Managing encryption” on page 93 describes these tasks in more detail.

Encryption policy configuration

Encryption policy configuration is the set of rules, or policies, that specify which volumes are to be encrypted. How and where these rules are established depends on the existing operating environment. See “Managing encryption” on page 93 for more information.

The tape drive encryption solution supports:

- Out-of-band key exchanges (network connection to encryption key servers)
- Key specification by one or two Key Encryption Key (KEK) labels
- Label and hash key methods
- Up to two encryption key servers

†Refer to the topic *Trademarks* in the **Related information** section for complete attribution.

Enabling encryption:

This topic provides an overview of how to enable encryption on the TS7700 Virtualization Engine. You can enable encryption on back-end drives so that virtual drive operations on your TS7700 Virtualization Engine do not change. You can also manage encryption key server or Tivoli Key Lifecycle Manager communications through the network to avoid interference with host operations. You can also control encryption by pools.

Before you begin

Before you enable encryption on the TS7700 Virtualization Engine, you must ensure that the correct minimum required levels of microcode are installed. You must also ensure that:

- The TS1120 and TS1130 Tape Drives are encryption-capable and enabled
- The encryption key server or TKLM (Tivoli Key Lifecycle Manager) is installed and configured on the network
- Key-encrypting keys (KEKs) are defined
- The license key for “FC 9900, Encryption configuration” on page 129 is installed and activated

No new host software is required.

Verify correct minimum microcode levels are installed

Use “FC 0521, Functional enhancement field” on page 110, to receive the most current level of TS7700 Virtualization Engine code.

1. In the address bar of a Web browser, enter the URL of the TS7700 Virtualization Engine. For example, type: `http://virtual IP/Console`
2. At the **TS7700 Virtualization Engine Sign on** screen, enter the userid and the password to log on to the TS7700 Virtualization Engine, and select **OK**, as shown in Figure 27 on page 89.

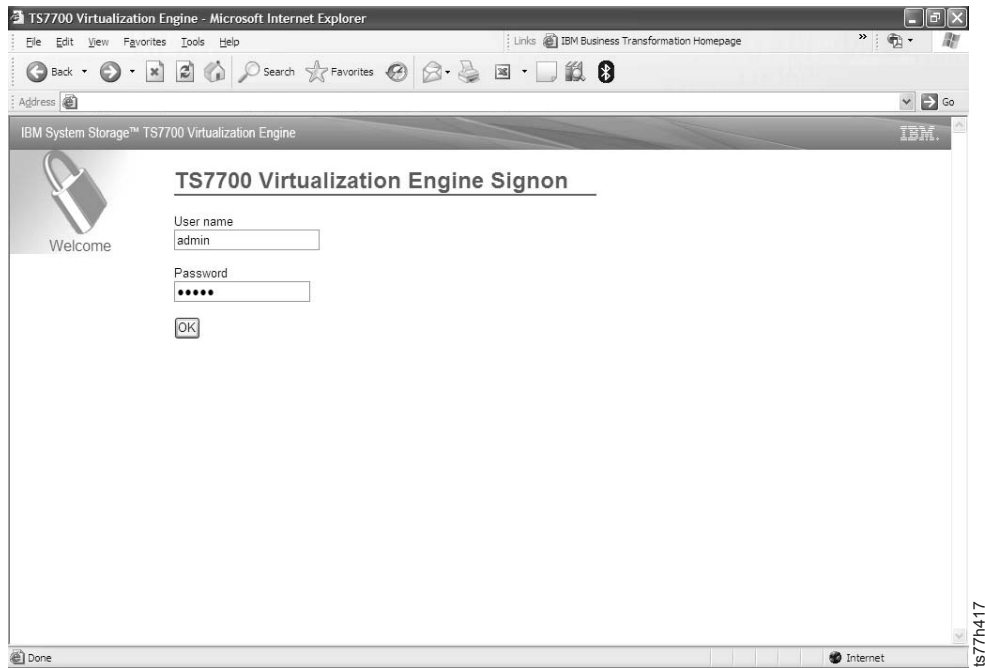


Figure 27. TS7700 Virtualization Engine Signon

3. In the left hand navigation panel, as shown in Figure 28, select **Configuration > Feature Licenses**.

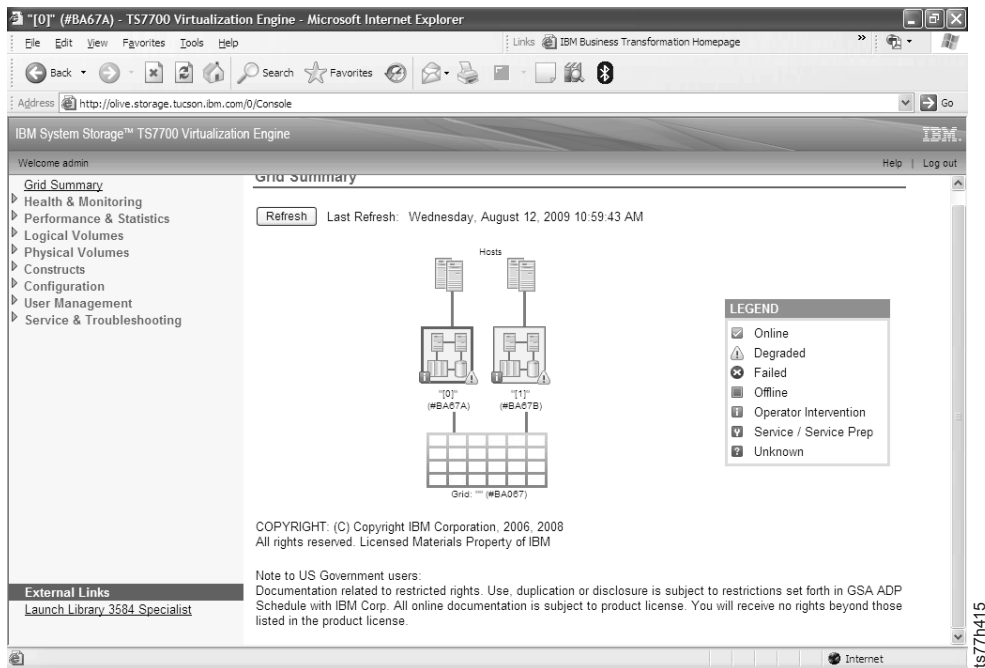


Figure 28. IBM Virtualization Engine TS7740 welcome screen

4. The *Feature Licenses* page is displayed, including the table **Currently activated feature licenses**, as shown in Figure 29 on page 90. Verify that FC 9900, Encryption configuration, displays on this table.

Currently activated feature licenses:

Select	Feature Code	Feature Description	License Key	Node	Node Serial Number	Activated	Expires
<input type="radio"/>	5267	1 TB Cache Enablement	af7e8176d542f27d7d1	"kuzHnode" (h0) hNode	78-68721	Tuesday, March 13, 2007 1:12:45 AM	Never
<input type="radio"/>	5267	1 TB Cache Enablement	af7e8176d542f27dfe2	"kuzHnode" (h0) hNode	78-68721	Tuesday, March 13, 2007 1:12:46 AM	Never
<input type="radio"/>	5267	1 TB Cache Enablement	af7e8176d542f27d51f	"kuzHnode" (h0) hNode	78-68721	Tuesday, March 13, 2007 1:12:48 AM	Never
<input type="radio"/>	5267	1 TB Cache Enablement	af7e8176d542f27d45f	"kuzHnode" (h0) hNode	78-68721	Tuesday, March 13, 2007 1:12:48 AM	Never
<input type="radio"/>	9900	Encryption Configuration	af7e8176d542f27d7df	"kuzHnode" (h0) hNode	78-68721	Tuesday, April 10, 2007 10:33:08 AM	Never
<input type="radio"/>	5267	1 TB Cache Enablement	af7e8176d542f27d71f	"kuzHnode" (h0) hNode	78-68721	Monday, July 9, 2007 11:14:20 PM	Never
<input type="radio"/>	5267	1 TB Cache Enablement	af7e8176d542f27dc6f	"kuzHnode" (h0) hNode	78-68721	Thursday, August 9, 2007 1:02:00 AM	Never
<input type="radio"/>	5268	100 MB/s Increment	af7e8176d542f27d88f	"kuzVnode" (v0) vNode	78-68721	Tuesday, March 13, 2007 1:12:40 AM	Never
<input type="radio"/>	5268	100 MB/s Increment	af7e8176d542f27dc6f	"kuzVnode" (v0) vNode	78-68721	Tuesday, March 13, 2007 1:12:41 AM	Never
<input type="radio"/>	5268	100 MB/s Increment	af7e8176d542f27d1bf	"kuzVnode" (v0) vNode	78-68721	Tuesday, March 13, 2007 1:12:42 AM	Never

Page 1 of 2 | 1 | Go | Total: 13 | Filtered: 13 | Displayed: 10

Figure 29. Currently active feature licenses

If using TS1120 Tape Drives, verify they are encryption-capable

1. In the left hand navigation panel, as shown in Figure 28 on page 89, select **Health and Monitoring > Physical Tape Drives**. The *Physical Tape Drives* page displays, as shown in Figure 30.

Select	Serial Number	Drive Type	Drive Format	Encryption	Online	Frame	Row	Health
<input type="radio"/>	000007819216	3592J1A	Not Available	Disabled	Yes	1	6	OK
<input type="radio"/>	000007819183	3592J1A	Not Available	Disabled	Yes	1	5	OK
<input type="radio"/>	000007819352	3592J1A	Not Available	Disabled	Yes	1	2	OK
<input type="radio"/>	000007808195	3592J1A	Not Available	Disabled	Yes	1	1	OK
<input type="radio"/>	000007819223	3592J1A	Not Available	Disabled	Yes	1	4	OK
<input type="radio"/>	000007819107	3592J1A	Not Available	Disabled	Yes	1	3	OK

Figure 30. Physical Tape Drives page

2. Click the radio button adjacent to the drive you want to verify and select **Details** from the **Select Action** drop-down menu. The *Physical Drive Details* page displays, as shown in Figure 31 on page 91.

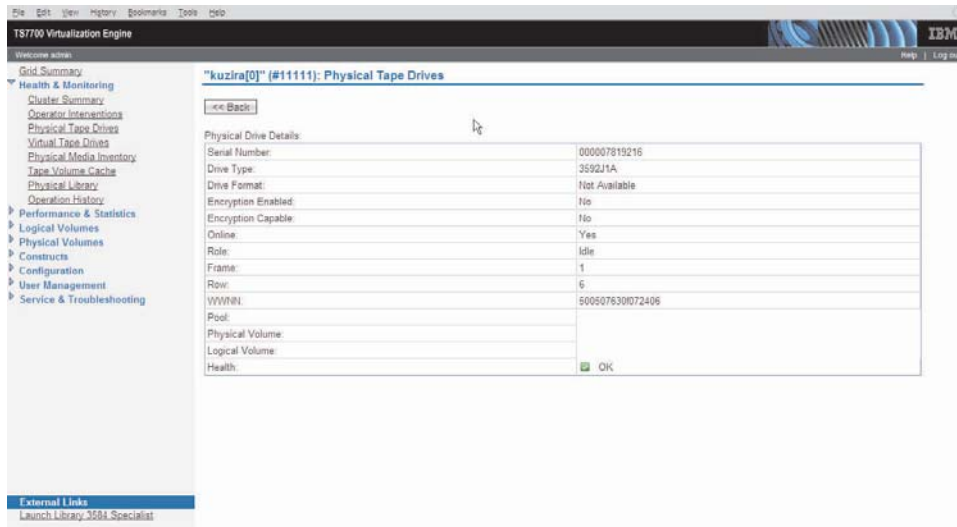


Figure 31. Physical Drive Details page

3. If **Yes** displays in the second column, adjacent to **Encryption Capable**, encryption capability and enablement are set. If **No** displays in the column adjacent to **Encryption Capable**, encryption capability and enablement are **NOT** set.

Attention: If encryption capability and enablement are not set, contact your IBM Service Representative to enable encryption following the procedures in the *IBM System Storage TS1120/TS1130 Tape Drive Model J1A, E05, E06, and EU6 Maintenance Information*.

Verify encryption key server or TKLM is installed and configured on the network

1. From the left hand navigation panel as shown in Figure 28 on page 89, select **Configuration > Encryption Key Server Addresses**.
2. Verify that at a minimum, the **Primary key server address** and **Port** fields are complete, as shown in Figure 32 on page 92.

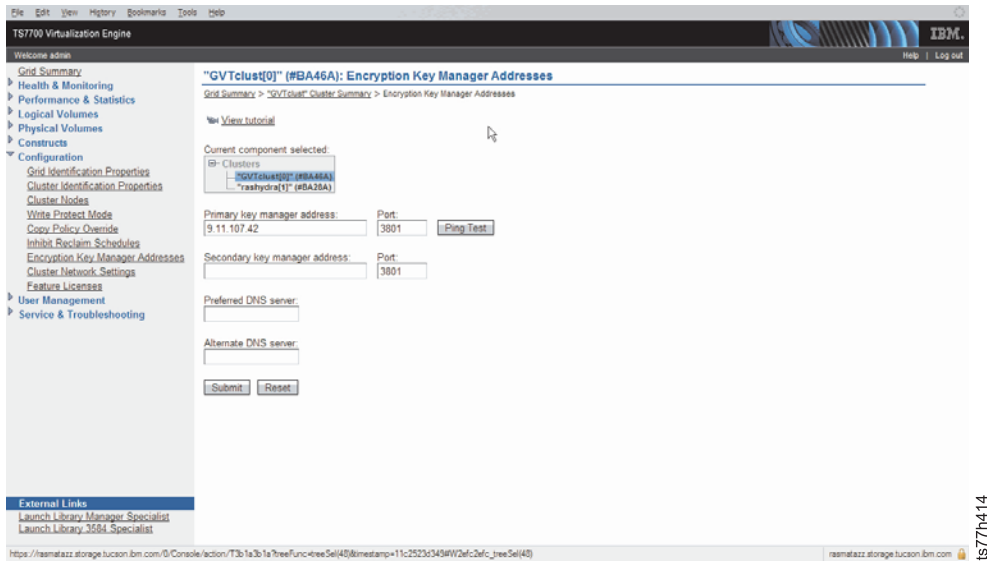


Figure 32. Encryption key server addresses

Attention: If encryption key server or TKLM is not installed and configured, contact your IBM Service Representative to enable encryption following the procedures in the *IBM Encryption Key Server component for the Java[®] platform Introduction, Planning, and User's Guide*, the *IBM Tivoli Key Lifecycle Manager Information Center*, or the *IBM Tivoli Key Lifecycle Manager Quick Start Guide*.

†Refer to the topic *Trademarks* in the **Related information** section for complete attribution.

About this task

To enable encryption on the TS7700 Virtualization Engine, you must enable the TS1120 and TS1130 Tape Drives for encryption, then install and activate the license key for “FC 9900, Encryption configuration” on page 129.

Enable the TS1120 and TS1130 Tape Drives for encryption.

Note: If you intend to use TS1120 and TS1130 Tape Drives in encryption mode, you must enable encryption on all TS1120 and TS1130 Tape Drives that you attach to the TS7700 Virtualization Engine.

Use “FC 0521, Functional enhancement field” on page 110, to receive the most current levels of TS7700 Virtualization Engine code.

Install and activate the encryption license key

Procedure

1. Enable the TS1120 and TS1130 Tape Drives for encryption.
 - a. Set the drives to native mode through the TS3500 Tape Library interface; do not use the TS7700 Virtualization Engine Management Interface.

Note: You must take the TS7700 Virtualization Engine offline to perform this task.

- b. Enable encryption on all drives.

Note: You can perform this task when the TS7700 Virtualization Engine is either online or offline.

2. Determine whether or not you have the license key. Do you have the license key?
 - **Yes**, go to step 3.
 - **No**, order “FC 9900, Encryption configuration” on page 129 to get the license key.
3. Install and activate the license key through the TS7700 Virtualization Engine Management Interface.

Related information

“Connecting to the management interface” on page 219

“About encryption keys” on page 94

FC 0521, Functional enhancement field

FC 9900, Encryption configuration

“Managing encryption”

Managing encryption:

This topic defines the encryption key server component used to manage encryption on the IBM Virtualization Engine TS7700.

The encryption key server component is a software program such as the IBM® Encryption Key Server component for the Java† platform or the Tivoli Key Lifecycle Manager that assists IBM encryption-enabled tape drives in generating, protecting, storing, and maintaining encryption keys used to encrypt information being written to, and decrypt information being read from, tape media (tape and cartridge formats). An encryption key server operates on z/OS, i5/OS®, AIX, Linux†, HP-UX, Sun Solaris, and Windows†, and is designed to be a shared resource deployed in several locations within an Enterprise. It is capable of serving numerous IBM encrypting tape drives, regardless of where those drives reside (for example, in tape library subsystems, connected to mainframe systems through various types of channel connections, or installed in other computing systems).

An encryption key server is a process that protects data using key generation and retrieval. Requests for key generation or retrieval are sent to the encryption key server through a TCP/IP connection from a tape library, subsystem, or drive. When a tape drive writes encrypted data, it first requests an encryption key from the encryption key server. Upon receipt of the request, the encryption key server generates an Advanced Encryption Standard (AES) key and serves it to the tape drives in two protected forms:

- Encrypted, or *wrapped*, using Rivest-Shamir-Adleman (RSA) key pairs. When using this form of protection, the tape drive writes this copy of the key to the cartridge memory and three additional places on the tape for redundancy.
- Separately wrapped for secure transfer to the tape drive, where it is unwrapped upon arrival and used to encrypt the data being written to tape.

When an encrypted tape cartridge is read by a TS1120 Tape Drive or TS1130 Tape Drive, the protected AES key on the tape is sent to the encryption key server where it is decrypted. The AES key is then wrapped for secure transfer back to the tape drive, where it is unwrapped and used to decrypt the data stored on the tape. The encryption key server also allows AES keys to be rewrapped, or *rekeyed*, using

RSA keys different from the original ones that were used. (See “About encryption keys” for more information.) Rekeying is useful when shipping tapes for use on external systems.

Three methods of encryption management exist; which you choose depends on your operating environment and where you locate your encryption key server application. The encryption key server and the encryption policy engine may be located in the application, system, or library layer, as illustrated by Figure 33.

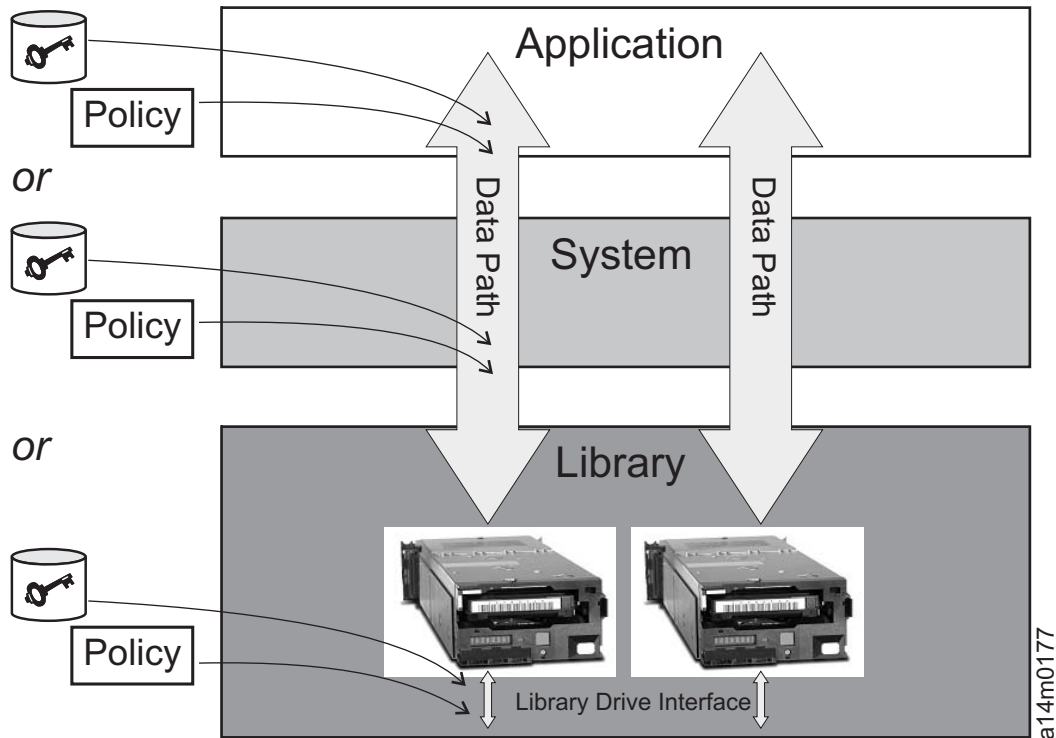


Figure 33. Three possible locations for encryption policy engine and key management.

Application Layer

The application layer initiates data transfer for tape storage, for example Tivoli Storage Manager (TSM).

System Layer

The system layer contains everything between the application and the tape drives, for example the operating system, z/OS DFSMS, device drivers, and FICON controllers.

Library Layer

The library layer contains the enclosure for tape storage, such as the TS3500 Tape Library. A modern tape library contains an internal interface to each tape drive.

†Refer to the topic *Trademarks* in the **Related information** section for complete attribution.

Related information

“Enabling encryption” on page 88

About encryption keys:

This topic describes the encryption keys that may be used by The IBM Encryption Key Server component for the Java[®] platform or the Tivoli Key Lifecycle Manager.

An AES encryption key is typically a random string of bits generated specifically to scramble and unscramble data. Encryption keys are created using algorithms designed to ensure that each key is unique and unpredictable. The longer the key string, the harder it is to break the encryption code. Both the IBM and T10 methods of encryption use 256-bit AES algorithm keys to encrypt data. 256-bit AES is the encryption standard currently recognized and recommended by the U.S. government.

Encryption method

Two types of encryption algorithms are used by the encryption key server: symmetric algorithms and asymmetric algorithms. Symmetric, or secret key encryption, uses a single key for both encryption and decryption. Symmetric key encryption is generally used for encrypting large amounts of data in an efficient manner. Asymmetric encryption, or public/private key encryption, uses a pair of keys. Data encrypted using one key can only be decrypted using the other key in the asymmetric key pair.

When an asymmetric key pair is generated, the public key is typically used to encrypt, and the private key is typically used to decrypt. The encryption key server uses both types: symmetric encryption for high-speed encryption of user or host data, and asymmetric encryption (which is necessarily slower) for protecting the symmetric key used to encrypt the data (key wrapping).

Encryption keys may be generated by the encryption key server, by applications such as Tivoli Storage Manager, or by a utility such as keytool. The responsibility for generating AES keys and the manner in which they are transferred to the tape drive depends on the tape drive type and the method of encryption management. However, it may be helpful to understand the difference between how the encryption key server uses encryption keys and how other applications use them.

How the encryption key server processes encryption keys

In system-managed and library-managed tape encryption, unencrypted data (clear text) is sent to the tape drive (TS1120 or TS1130) and converted to ciphertext using a symmetric 256-bit AES Data Key (DK) generated by the encryption key server. The ciphertext is then written to tape. The encryption key server uses a single, unique Data Key for each Enterprise Tape Cartridge. This Data Key is also encrypted, or wrapped, by the encryption key server using the public key from an asymmetric Key Encrypting Key (KEK) pair. This process creates an Externally Encrypted Data Key (EEDK). The EEDK is written to the cartridge memory and to three additional places on the tape media in the cartridge. The tape cartridge now holds both the encrypted data and the means to decrypt it for anyone holding the private part of the KEK pair.

The DK may also be wrapped a second time using the public key of another party to create an additional EEDK. Both EEDKs can be stored on the tape cartridge. In this way, the tape cartridge can be shipped to a business partner holding the corresponding private key. That private key would allow the DK to be unwrapped and the tape decrypted by the business partner. Figure 34 on page 96 illustrates the symmetric and asymmetric processes.

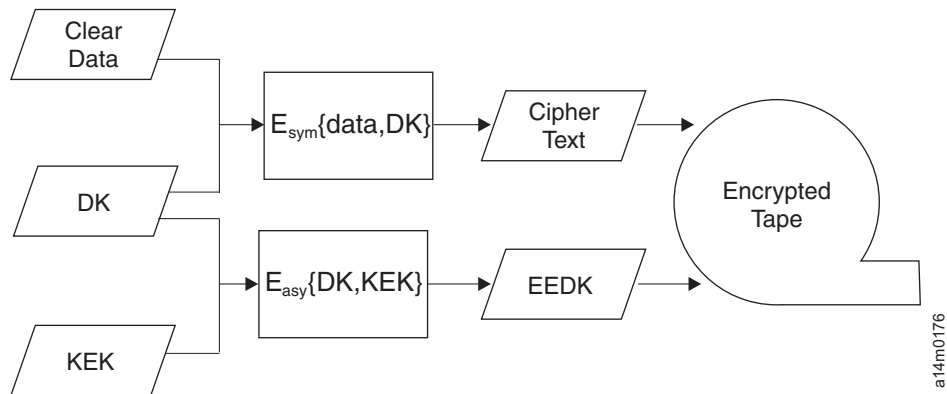


Figure 34. An encryption key server uses both symmetric and asymmetric encryption keys

Encryption key server default keys

This function introduces the ability to allow the TS7740 Virtualization Engine to utilize default keys defined within the external key server. If there are multiple libraries, this function is required so that key management and assignment can be done in an external centralized location instead of updating each library every time a key is changed or rolled.

Note: Your encryption key server software must support default keys to use this option.

The physical volume pool property settings continue to provide an option for two keys. In addition to providing a manually entered key, the management interface provides a mutually exclusive check box per key that states a default key should be used for that particular key. Each of the two keys for each pool can be set up differently, allowing one key to be the default while another is manually entered. For example, key 1 may be set up to use a default key while key 2 is manually provided. Or, both keys can use the default or both keys can be provided manually. When a physical volume is written from beginning of tape and one or both key settings are configured to use default keys, the TS7740 Virtualization Engine informs the drive that one or both keys are set up for default. The drive negotiates through the TS7740 Virtualization Engine to the key server and requests that the key server use default keys currently configured within the key server. Since the key is provided by the key server, the TS7740 Virtualization Engine is not aware of what key is used for the physical volume when default keys are used.

The user should be able to determine if either or both keys used for a particular encrypted physical volume are default keys or manually provided keys. To help with enhancements that require ranges of physical volumes based on when they were encrypted, a new time of encryption timestamp will be introduced into the physical volume table. Each time a physical volume is written from beginning of tape with encryption enabled using any key type, this timestamp will be updated to the current time. This new timestamp can be used to determine when the volume keyed and will be included in the physical volume BVIR output.

†Refer to the topic *Trademarks* in the **Related information** section for complete attribution.

Related information

“Secure Data Erasure” on page 73

“Enabling encryption” on page 88

“Managing encryption” on page 93

Copy export overview:

The copy export function allows a copy of selected logical volumes written to the TS7700 Virtualization Engine to be removed and taken offsite for disaster recovery purposes.

The copy export function builds on the existing capability to create a copy of logical volumes on a secondary physical volume pool. When a copy export is performed, physical volumes from the secondary physical volume pool are removed from the library associated with the TS7700 Virtualization Engine and sent to an offsite location for disaster recovery. The benefits of volume stacking, which places many logical volumes on a physical volume, are retained. Additionally, since the exported data is a copy of the logical volumes, it remains accessible to the production host system.

Note: The copy export function does not apply to TS7720s.

Similar to the traditional use of tape for disaster recovery, it is expected that the copy export operation is performed regularly and that additional physical volumes are sent offsite daily. Should the production site become unusable and it becomes necessary to use the offsite volumes for disaster recovery, access to the exported data is re-established through a disaster recovery procedure instead of a data import procedure:

1. All exported physical volumes are placed into a library attached to an empty TS7700 Virtualization Engine.
2. A disaster recovery procedure are invoked through the TS7700 Virtualization Engine Management Interface.

Note: You must also restore the host environment (tape catalog, tape management system, etc.).

3. The disaster recovery procedure re-establishes access to the logical volumes contained on the exported physical volume.

Although the exported physical volumes are removed from the TS7700 Virtualization Engine and located outside of the physical library, they continue to be managed by the source TS7700 Virtualization Engine in regards to space management. As logical volumes resident on the exported physical volumes are expired, rewritten, or otherwise invalidated, the amount of valid data on an exported physical volume decreases until the physical volume becomes eligible for reclamation based on your criteria. When an exported physical volume is reclaimed, it is not brought back to the source TS7700 Virtualization Engine for processing; instead, a new secondary copy of the remaining valid logical volumes is made using the primary logical volume copy as a source. The next time the copy export operation is performed, the physical volume with the new copies is also exported. The exported physical volumes that were reclaimed and are offsite no longer have valid data and can be returned to the source TS7700 Virtualization Engine to be used as new scratch volumes.

Note: If two or more TS7700 Virtualization Engines are configured in a Grid, only one TS7700 Virtualization Engine can perform a copy export operation at any time.

The Export List Volume is a logical volume that provides completion status and export operation information for the copy export function. The host that initiates

copy export creates an Export List Volume on the TS7700 Virtualization Engine that performs the operation. The TS7700 Virtualization Engine performing the operation uses the Export List Volume for project status, export information, and execution instructions. The TS7700 Virtualization Engine then creates response records in the Export List Volume that list the logical volumes exported and the physical volume that they reside on. You may use this information as a record for data that is offsite. Finally, the TS7700 Virtualization Engine writes records in the Export List Volume for any offsite physical volumes that have been reclaimed and no longer contain any active data. The Bulk Volume Information Retrieval (BVIR) function can provide a list of the offsite physical volumes that are empty in the Export List Volume and can be used to obtain a current list of exported physical volumes for a secondary pool. Information is provided for the amount of active data contained by each exported physical volume.

Host Console Request and Host Copy Enable. The Host Console Request (HCR) and Host Copy Enable functions expand the range of copy operations.

The copy export function is also supported by the HCR function. Through HCR, you can request that a physical volume exported with copy export be queued for reclamation, regardless of whether it has met any of the reclaim criteria you have established for the TS7700 Virtualization Engine. You can use the HCR function from the zOS host console to remove a physical volume exported with copy export that no longer has any valid data on it. For detailed information about the copy export function, please refer to the IBM White Paper, *IBM Virtualization Engine TS7700 Series Copy Export User's Guide*, WP101092, available at the *IBM Support & Downloads* web page linked in the **Related information** section.

Host Copy Enable permits the host to enable or disable copies to and from the specified distributed library. A request to disable copies permits any copies in progress to continue, but prevents initiation of additional copy operations to the specified distributed library. Copy operations continue to queue and operations between other distributed libraries in the TS7700 Grid remain unaffected. A request to enable copies allows the specified distributed library to again become a source for copies and initiate copy operations where it is the target.

Host Override for Cache Residency. You can also use the HCR function to modify how logical volumes are managed in the tape volume cache. The Host Override for Cache Residency function allows the preference group for a logical volume to be temporarily overridden while the volume is in cache. This function also permits you to keep a logical volume in cache longer by making it appear as the most recently accessed volume.

Copy Export Recovery Code Level Limitations. A copy export recovery can only occur within a TS7700 Virtualization Engine that is operating a code level equal to or later than the code level of the TS7700 Virtualization Engine that exported the physical volumes.

Related information

“Logical WORM” on page 183

 <http://www.ibm.com/support/us/en/>

Withdrawn hardware and features

This section lists TS7700 Virtualization Engine hardware and features scheduled for withdrawal, along with any replacements.

Table 39. Withdrawn TS7700 Virtualization Engine hardware

Hardware	Replaced by	Scheduled for withdrawal
TS7720 Server 3957-VEA	TS7720 Server 3957-VEB	August 2011
TS7740 Server 3957-V06	TS7740 Server 3957-V07	August 2011
TS7740 Cache Controller 3956-CC6	TS7740 Cache Controller 3956-CC7	February 2009
TS7740 Cache Controller 3956-CC7	TS7740 Cache Controller 3956-CC8	June 2010
TS7720 Cache Controller 3956-CS7	TS7720 Cache Controller 3956-CS8	June 2010

Table 40. Withdrawn TS7700 Virtualization Engine features

Associated machine type and model	Feature code withdrawn	Replacement feature code	Scheduled for withdrawal
3952 F05 Tape Frame	FC 2719, Console upgrade	No replacement	September 2010
	FC 2730, TS3000 System Console	No replacement	January 2010
	FC 5626, Plant install 3957-VEA	FC 5627, Install 3957-VEB	August 2011
	FC 5628, Plant install 3957-V06	FC 5629, Install 3957-V07	August 2011
	FC 5636, Plant install 3956-CS7	FC 5635, Plant install 3956-CS8	July 2010
	FC 5638, Plant install 3956-CC6	FC 5640, Plant install 3956-CC8	February 2009
	FC 5639, Plant install 3956-CC7	FC 5640, Plant install 3956-CC8	June 2010
	FC 5648, Plant install 3956-CX6	FC 5641, Plant install 3956-CX7	February 2009
	FC 5759, Integrated control path	FC 5758, Integrated control path	August 2011

Table 40. Withdrawn TS7700 Virtualization Engine features (continued)

Associated machine type and model	Feature code withdrawn	Replacement feature code	Scheduled for withdrawal
TS7740 Server 3957-V06	FC 0202, 9-micron LC/SC 31-meter	FC 0201, 9-micron LC/LC 31-meter	December 2009
	FC 0204, 50-micron LC/SC 31-meter	FC 0203, 50-micron LC/LC 31-meter	August 2011
	FC 0205, 62.5-micron LC/LC 31-meter	No replacement	December 2009
	FC 0206, 62.5-micron LC/SC 31-meter	No replacement	December 2009
	FC 1030, 1Gb grid copper connection	FC 1032, 1Gb grid dual port copper connection	February 2009
	FC 1031, 1Gb optical SW connection	FC 1033, 1Gb grid dual port optical SW connection	February 2009
	FC 2714, Console expansion	No replacement	August 2011
	FC 2719, Console upgrade	No replacement	December 2008
	FC 2720, TS3000 System Console	No replacement	December 2008
	FC 5240, Dual port fibre channel host bus adapter	No replacement	August 2011
	FC 9000, Mainframe attachment	No replacement	August 2011
	FC 9217, Attach to 3953 LM	No replacement	February 2009
	FC 9218, Attach to 3494 LM	No replacement	August 2011
	FC 9219, Attach to TS3500	No replacement	August 2011
	FC 9350, Plant install TS7700 Server in 3952 F05	No replacement	August 2011
	FC 9461, 8 GB Memory upgrade, plant	No replacement	August 2011
	FC 9700, No factory cables	No replacement	August 2011

Table 40. Withdrawn TS7700 Virtualization Engine features (continued)

Associated machine type and model	Feature code withdrawn	Replacement feature code	Scheduled for withdrawal
TS7740 Server 3957-VEA	FC 0202, 9-micron LC/SC 31-meter	FC 0201, 9-micron LC/LC 31-meter	December 2009
	FC 0204, 50-micron LC/SC 31-meter	FC 0203, 50-micron LC/LC 31-meter	August 2011
	FC 0205, 62.5-micron LC/LC 31-meter	No replacement	December 2009
	FC 0206, 62.5-micron LC/SC 31-meter	No replacement	December 2009
	FC 2714, Console expansion	FC 2715, Console attachment	August 2011
	FC 9000, Mainframe attachment	No replacement	August 2011
	FC 9268, Plant install 100 MB/s throughput	FC 5268, 100 MB/sec increment	August 2011
	FC 9350, Plant install TS7700 Server in 3952 F05	No replacement	August 2011
	FC 9461, 8 GB Memory upgrade, plant	FC 3461, 8 GB Memory upgrade, field	August 2011
	FC 9700, No factory cables	No replacement	August 2011
TS7740 Cache Controller 3956-CC6	FC 6003, Intraframe fibre cable to 3957-V06	No replacement	February 2009
	FC 7120, 1.7 TB fibre storage	No replacement	February 2009
	FC 9230, Attach to 3957-V06	No replacement	February 2009
	FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05	No replacement FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05 is available only for the following TS7740 Cache Controller feature: 3956-CC8	February 2009
TS7740 Cache Controller 3956-CC7	FC 7121, 3.43 TB fibre storage	No replacement	June 2010
	FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05	No replacement FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05 is available only for the following TS7740 Cache Controller feature: 3956-CC8	June 2010

Table 40. Withdrawn TS7700 Virtualization Engine features (continued)

Associated machine type and model	Feature code withdrawn	Replacement feature code	Scheduled for withdrawal
TS7720 Cache Controller 3956-CS7	FC 7113, 16TB SATA storage	No replacement	June 2010
	FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05	No replacement FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05 is available only for the following TS7720 Cache Controller feature: 3956-CS8	June 2010
TS7740 Cache Drawer 3956-CX6	FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05	No replacement FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05 is available only for the following TS7740 Cache Drawer feature: 3956-CX7	February 2009
TS7740 Cache Drawer 3956-CX7	FC 7121, 3.43 TB fibre storage	No replacement	June 2010
TS7720 Cache Drawer 3956-XS7	FC 7113, 16TB SATA storage	No replacement	June 2010

Related information

“Feature details” on page 108

“Quick reference by component”

TS7700 Virtualization Engine feature codes

This topic links to descriptions of TS7700 Virtualization Engine features according to component, feature code, and feature conversion (if applicable).

Quick reference by component

This topic lists feature codes for the TS7700 Virtualization Engine according to component machine type and model.

Note: All TS7700 Virtualization Engine features are shown on this page. Withdrawn features and components are included for reference purposes, but are marked by a footnote.

Table 41. TS7700 Tape Frame features

3952 F05 features
<ul style="list-style-type: none"> • “FC 1903, Dual AC power” on page 112 • “FC 1904, Redundant AC power” on page 113 • “FC 2719, Console upgrade” on page 113† • “FC 2730, TS3000 System Console” on page 114† • “FC 2732, TS3000 System Console” on page 114 • “FC 2733, Internal modem” on page 114 • “FC 4743, Remove 3957-V06/VEA” on page 116 • “FC 5626, Plant install 3957-VEA” on page 118† • “FC 5627, Install 3957-VEB” on page 119 • “FC 5628, Plant install 3957-V06” on page 119† • “FC 5629, Install 3957-V07” on page 119 • “FC 5635, Plant install 3956-CS8” on page 119 • “FC 5636, Plant install 3956-CS7” on page 120† • “FC 5638, Plant install 3956-CC6” on page 120† • “FC 5639, Plant install 3956-CC7” on page 120† • “FC 5640, Plant install 3956-CC8” on page 120 • “FC 5641, Plant install 3956-CX7” on page 121 • “FC 5642, Field install 3956-CX7” on page 121 • “FC 5646, Plant install 3956-XS7” on page 121 • “FC 5647, Field install 3956-XS7” on page 121 • “FC 5648, Plant install 3956-CX6” on page 121 • “FC 5649, Field install 3956-CX6” on page 122† • “FC 5758, Integrated control path” on page 122 • “FC 5759, Integrated control path” on page 122† • “FC 7312, TS7740 Base frame” on page 124 • “FC 7322, TS7720 Base frame” on page 124 • “FC 7323, TS7720 Storage expansion frame” on page 124 • “FC 9110, Ship with R1.7 machine code” on page 125 • “FC 9111, Ship with R2.0 machine code” on page 125 • “FC 9323 Expansion frame attachment” on page 126 • “FC 9954, NEMA L6-30 power cord” on page 129 • “FC 9955, RS 9750 DP power cord” on page 129 • “FC 9956, IEC 309 power cord” on page 129 • “FC 9957, PDL 4.3 power cord” on page 129 • “FC 9958, Korean 4.3-m power cord” on page 130 • “FC 9959, Unterminated power cord” on page 130 • “FC 9966, Unterminated power cord (China)” on page 130
†Withdrawn or to be withdrawn by August 2011.

Table 42. TS7700 Server features

3494 B10 and B20 VTS, 3957-V06, and 3957-VEA Server features
<p>3494 B10 and B20 VTS Server features</p> <ul style="list-style-type: none"> • “FC 3488, 4 Gb Fibre Channel Switch” on page 115†

Table 42. TS7700 Server features (continued)

3494 B10 and B20 VTS, 3957-V06, and 3957-VEA Server features
<p>3957-V06 Server features</p> <ul style="list-style-type: none"> • “FC 0201, 9-micron LC/LC 31-meter” on page 109 • “FC 0202, 9-micron LC/SC 31-meter” on page 109† • “FC 0203, 50-micron LC/LC 31-meter” on page 109 • “FC 0204, 50-micron LC/SC 31-meter” on page 109† • “FC 0205, 62.5-micron LC/LC 31-meter” on page 109† • “FC 0206, 62.5-micron LC/SC 31-meter” on page 110† • “FC 0521, Functional enhancement field” on page 110 • “FC 1030, 1Gb grid copper connection” on page 110† • “FC 1031, 1Gb optical SW connection” on page 110† • “FC 1032, 1Gb grid dual port copper connection” on page 111 • “FC 1033, 1Gb grid dual port optical SW connection” on page 111 • “FC 1034, Enable dual port grid connection” on page 111 • “FC 2714, Console expansion” on page 113† • “FC 2715, Console attachment” on page 113 • “FC 2719, Console upgrade” on page 113† • “FC 2720, TS3000 System Console” on page 113† • “FC 3441, FICON short-wavelength attachment” on page 114 • “FC 3442, FICON long-wavelength attachment” on page 114 • “FC 3443, FICON 10-km long-wavelength attachment” on page 115 • “FC 3461, 8 GB Memory upgrade, field” on page 115 • “FC 4015, Grid enablement” on page 115 • “FC 4016, Remove Cluster from Grid” on page 115 • “FC 4017, Cluster cleanup” on page 116 • “FC 5240, Dual port fibre channel host bus adapter” on page 117† • “FC 5267, 1 TB cache enablement” on page 117 • “FC 5268, 100 MB/sec increment” on page 118 • “FC 5270, Increased logical volumes” on page 118 • “FC 5271, Selective device access control” on page 118 • “FC 9000, Mainframe attachment” on page 124† • “FC 9217, Attach to 3953 LM” on page 125† • “FC 9218, Attach to 3494 LM” on page 125† • “FC 9219, Attach to TS3500” on page 126† • “FC 9350, Plant install TS7700 Server in 3952 F05” on page 127† • “FC 9351, Field merge TS7700 Server in 3952 F05” on page 127 • “FC 9461, 8 GB Memory upgrade, plant” on page 128† • “FC 9700, No factory cables” on page 128† • “FC 9900, Encryption configuration” on page 129

Table 42. TS7700 Server features (continued)

3494 B10 and B20 VTS, 3957-V06, and 3957-VEA Server features
<p>3957-V07 Server features</p> <ul style="list-style-type: none"> • “FC 0201, 9-micron LC/LC 31-meter” on page 109 • “FC 0203, 50-micron LC/LC 31-meter” on page 109 • “FC 0521, Functional enhancement field” on page 110 • “FC 1034, Enable dual port grid connection” on page 111 • “FC 1035, Grid optical LW connection” on page 111 • “FC 1036, 1Gb grid dual port copper connection” on page 112 • “FC 1037, 1Gb dual port optical SW connection” on page 112 • “FC 2714, Console expansion” on page 113 • “FC 2715, Console attachment” on page 113 • “FC 3441, FICON short-wavelength attachment” on page 114 • “FC 3442, FICON long-wavelength attachment” on page 114 • “FC 3443, FICON 10-km long-wavelength attachment” on page 115 • “FC 4015, Grid enablement” on page 115 • “FC 4016, Remove Cluster from Grid” on page 115 • “FC 4017, Cluster cleanup” on page 116 • “FC 5241, Dual port FC HBA” on page 117 • “FC 5267, 1 TB cache enablement” on page 117 • “FC 5268, 100 MB/sec increment” on page 118 • “FC 5270, Increased logical volumes” on page 118 • “FC 5271, Selective device access control” on page 118 • “FC 9000, Mainframe attachment” on page 124 • “FC 9111, Ship with R2.0 machine code” on page 125 • “FC 9219, Attach to TS3500” on page 126† • “FC 9350, Plant install TS7700 Server in 3952 F05” on page 127† • “FC 9351, Field merge TS7700 Server in 3952 F05” on page 127 • “FC 9700, No factory cables” on page 128 • “FC 9900, Encryption configuration” on page 129

Table 42. TS7700 Server features (continued)

3494 B10 and B20 VTS, 3957-V06, and 3957-VEA Server features
<p>3957-VEA Server features</p> <ul style="list-style-type: none"> • “FC 0201, 9-micron LC/LC 31-meter” on page 109 • “FC 0202, 9-micron LC/SC 31-meter” on page 109† • “FC 0203, 50-micron LC/LC 31-meter” on page 109 • “FC 0204, 50-micron LC/SC 31-meter” on page 109† • “FC 0205, 62.5-micron LC/LC 31-meter” on page 109† • “FC 0206, 62.5-micron LC/SC 31-meter” on page 110† • “FC 0521, Functional enhancement field” on page 110 • “FC 1032, 1Gb grid dual port copper connection” on page 111 • “FC 1033, 1Gb grid dual port optical SW connection” on page 111 • “FC 1034, Enable dual port grid connection” on page 111 • “FC 2714, Console expansion” on page 113† • “FC 2715, Console attachment” on page 113 • “FC 3441, FICON short-wavelength attachment” on page 114 • “FC 3442, FICON long-wavelength attachment” on page 114 • “FC 3443, FICON 10-km long-wavelength attachment” on page 115 • “FC 3461, 8 GB Memory upgrade, field” on page 115 • “FC 4015, Grid enablement” on page 115 • “FC 4016, Remove Cluster from Grid” on page 115 • “FC 4017, Cluster cleanup” on page 116 • “FC 5240, Dual port fibre channel host bus adapter” on page 117† • “FC 5268, 100 MB/sec increment” on page 118 • “FC 5270, Increased logical volumes” on page 118 • “FC 5271, Selective device access control” on page 118 • “FC 9000, Mainframe attachment” on page 124† • “FC 9268, Plant install 100 MB/s throughput” on page 126† • “FC 9350, Plant install TS7700 Server in 3952 F05” on page 127† • “FC 9461, 8 GB Memory upgrade, plant” on page 128† • “FC 9700, No factory cables” on page 128†

Table 42. TS7700 Server features (continued)

<p>3494 B10 and B20 VTS, 3957-V06, and 3957-VEA Server features</p> <p>3957-VEB Server features</p> <ul style="list-style-type: none"> • “FC 0201, 9-micron LC/LC 31-meter” on page 109 • “FC 0203, 50-micron LC/LC 31-meter” on page 109 • “FC 1034, Enable dual port grid connection” on page 111 • “FC 1035, Grid optical LW connection” on page 111 • “FC 1036, 1Gb grid dual port copper connection” on page 112 • “FC 1037, 1Gb dual port optical SW connection” on page 112 • “FC 2714, Console expansion” on page 113 • “FC 2715, Console attachment” on page 113 • “FC 3441, FICON short-wavelength attachment” on page 114 • “FC 3442, FICON long-wavelength attachment” on page 114 • “FC 3443, FICON 10-km long-wavelength attachment” on page 115 • “FC 4015, Grid enablement” on page 115 • “FC 4016, Remove Cluster from Grid” on page 115 • “FC 4017, Cluster cleanup” on page 116 • “FC 5241, Dual port FC HBA” on page 117 • “FC 5268, 100 MB/sec increment” on page 118 • “FC 5270, Increased logical volumes” on page 118 • “FC 5271, Selective device access control” on page 118 • “FC 9000, Mainframe attachment” on page 124 • “FC 9111, Ship with R2.0 machine code” on page 125 • “FC 9268, Plant install 100 MB/s throughput” on page 126 • “FC 9350, Plant install TS7700 Server in 3952 F05” on page 127 • “FC 9351, Field merge TS7700 Server in 3952 F05” on page 127 • “FC 9700, No factory cables” on page 128
<p>†Withdrawn or to be withdrawn by August 2011.</p>

Table 43. TS7700 Cache Controller features

<p>3956-CC6, 3956-CC7, 3956-CC8, and 3956-CS8 Cache Controller features</p> <p>3956-CC6† Cache Controller features</p> <ul style="list-style-type: none"> • “FC 6003, Intraframe fibre cable to 3957-V06” on page 122† • “FC 7120, 1.7 TB fibre storage” on page 123† • “FC 9230, Attach to 3957-V06” on page 126† • “FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05” on page 127†
<p>3956-CC7† Cache Controller features</p> <ul style="list-style-type: none"> • “FC 7121, 3.43 TB fibre storage” on page 123† • “FC 7403, Enable first expansion drawer” on page 124 • “FC 7404, Enable fourth expansion drawer” on page 124 • “FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05” on page 127† • “FC 9353, Field merge in 3952 F05” on page 127

Table 43. TS7700 Cache Controller features (continued)

3956-CC6, 3956-CC7, 3956-CC8, and 3956-CS8 Cache Controller features
3956-CC8 Cache Controller features <ul style="list-style-type: none"> • “FC 7123, 9.6 TB Fibre storage” on page 123 • “FC 7403, Enable first expansion drawer” on page 124 • “FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05” on page 127
3956-CS7† Cache Controller features <ul style="list-style-type: none"> • “FC 7113, 16TB SATA storage” on page 123† • “FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05” on page 127†
3956-CS8 Cache Controller features <ul style="list-style-type: none"> • “FC 7114, 32TB SATA storage” on page 123 • “FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05” on page 127
†Withdrawn or to be withdrawn by August 2011.

Table 44. TS7700 Cache Drawer features

3956-CX6, 3956-CX7, and 3956-XS7 Cache Drawer features
3956-CX6† Cache Drawer features <ul style="list-style-type: none"> • “FC 6000, Intraframe fibre cable to 3956-CC6” on page 122† • “FC 7120, 1.7 TB fibre storage” on page 123 • “FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05” on page 127† • “FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05” on page 128
3956-CX7 Cache Drawer features <ul style="list-style-type: none"> • “FC 7123, 9.6 TB Fibre storage” on page 123 • “FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05” on page 127 • “FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05” on page 128
3956-XS7 Cache Drawer features <ul style="list-style-type: none"> • “FC 7113, 16TB SATA storage” on page 123† • “FC 7114, 32TB SATA storage” on page 123 • “FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05” on page 127 • “FC 9353, Field merge in 3952 F05” on page 127
†Withdrawn or to be withdrawn by August 2011.

Related information

“Feature details”

Feature details

This topic describes feature codes for the TS7700 Virtualization Engine.

FC 0201, 9-micron LC/LC 31-meter

FC 0201, 9-micron LC/LC 31-meter, provides a 31-meter (101 ft.), 9-micron, single mode FICON cable with LC Duplex connectors on both ends for connection between the long wavelength FICON channel feature and a host system or a fibre component long wavelength channel with a 9-micron fibre cable LC Duplex adapter.

Refer to FC 0201, 9-micron LC/LC 31-meter in Table 45 on page 130 for requirements and other information.

FC 0202, 9-micron LC/SC 31-meter

FC 0202, 9-micron LC/SC 31-meter, provides a 31-meter, (101 ft.), 9-micron, single mode FICON cable with and LC Duplex connector on one end for connection to the long wavelength FICON channel feature, and an SC Duplex connector on the other end for connection to a host system or fibre component long wavelength channel with a 9-micron fibre cable SC Duplex adapter.

Note: This feature has been withdrawn.

Refer to FC 0202, 9-micron LC/SC 31-meter in Table 45 on page 130 for requirements and other information.

FC 0203, 50-micron LC/LC 31-meter

FC 0203, 50-micron LC/LC 31-meter, provides a 31-meter (101 ft.), 50-micron, single mode FICON cable with LC Duplex connectors on both ends for connection between the long wavelength FICON channel feature and a host system or a fibre component long wavelength channel with a 50-micron fibre cable LC Duplex adapter.

Refer to FC 0203, 50-micron LC/LC 31-meter in Table 45 on page 130 for requirements and other information.

FC 0204, 50-micron LC/SC 31-meter

FC 0204, 50-micron LC/SC 31-meter, provides a 31-meter, (101 ft.), 50-micron, single mode FICON cable with and LC Duplex connector on one end for connection to the long wavelength FICON channel feature, and an SC Duplex connector on the other end for connection to a host system or fibre component long wavelength channel with a 50-micron fibre cable SC Duplex adapter.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 0204, 50-micron LC/SC 31-meter in Table 45 on page 130 for requirements and other information.

FC 0205, 62.5-micron LC/LC 31-meter

FC 0205, 62.5-micron LC/LC 31-meter, provides a 31-meter (101 ft.), 62.5-micron, single mode FICON cable with LC Duplex connectors on both ends for connection between the long wavelength FICON channel feature and a host system or a fibre component long wavelength channel with a 62.5-micron fibre cable LC Duplex adapter.

Note: This feature has been withdrawn.

Refer to FC 0205, 62.5-micron LC/LC 31-meter in Table 45 on page 130 for requirements and other information.

FC 0206, 62.5-micron LC/SC 31-meter

FC 0206, 62.5-micron LC/SC 31-meter, provides a 31-meter, (101 ft.), 62.5-micron, single mode FICON cable with and LC Duplex connector on one end for connection to the long wavelength FICON channel feature, and an SC Duplex connector on the other end for connection to a host system or fibre component long wavelength channel with a 62.5-micron fibre cable SC Duplex adapter.

Note: This feature has been withdrawn.

Refer to FC 0206, 62.5-micron LC/SC 31-meter in Table 45 on page 130 for requirements and other information.

FC 0521, Functional enhancement field

FC 0521, Functional enhancement field, provides a one-time update to the microcode of an installed TS7700 Virtualization Engine to provide enhanced functions contained in the latest level of functional microcode firmware support. Newer microcode levels may be required when adding new functions.

Refer to FC 0521, Functional enhancement field in Table 45 on page 130 for requirements and other information.

FC 1030, 1Gb grid copper connection

FC 1030, 1Gb grid copper connection, provides an Ethernet 1000BaseT adapter for grid communication between TS7740 Virtualization Engines. You must supply your own Ethernet cables when FC 4015, Grid enablement, is installed. Cat-5 Ethernet cables are not allowed. This adapter has an RJ-45 connector and conforms to the IEEE 802.3ab 1000Base-T standard. The Ethernet cables used with the adapter must be Cat-5e or Cat-6, though Cat-6 is preferred. It supports distances of up to 100 meters using four pairs of Cat-5e or Cat-6 balanced copper cabling.

Note: This feature has been withdrawn.

Refer to FC 1030, 1Gb grid copper connection in Table 45 on page 130 for requirements and other information.

FC 1031, 1Gb optical SW connection

FC 1031, 1Gb optical SW connection, provides a 1-Gb shortwave adapter for grid communication between TS7740 Virtualization Engines. It replaces RPQ #Q8B3409. This adapter has an LC Duplex connector for attaching a 50.0- or 62.5-micron, multi-mode fibre cable. This is a standard shortwave (850 nm) adapter that conforms to the IEEE 802.3z standards. It supports distances of 2 to 260 meters for 62.5-micron cable and 2 to 550 meters for 50.0-micron cable. Multi-mode fibre cables must be used with the adapter when FC 4015, Grid enablement, is installed.

Note: This feature has been withdrawn.

Refer to FC 1031, 1Gb optical SW connection in Table 45 on page 130 for requirements and other information.

FC 1032, 1Gb grid dual port copper connection

FC 1032, 1Gb grid dual port copper connection, provides a dual port, 1-Gbps 10/100/1000Base-TX adapter for grid communication between TS7700 Virtualization Engines with a single port enabled. This adapter has an RJ-45 connector for attaching Cat-5e or Cat-6 cables. This adapter conforms to the IEEE 802.3ab 1000Base-T standard. It supports distances up to 100 meters using four pairs of Cat-5e or Cat-6 balanced copper cabling. You must supply Cat-5e or Cat-6 cables for use with the adapter when FC 4015, Grid enablement is installed. This feature is only supported on a 3957-V06 or 3957-VEA operating a microcode level of 8.5.0.xx or later.

Refer to FC 1032, 1Gb grid dual port copper connection in Table 45 on page 130 for requirements and other information.

FC 1033, 1Gb grid dual port optical SW connection

FC 1033, 1Gb grid dual port optical SW connection, provides a dual port, 1-Gbps Ethernet shortwave adapter for grid communication between TS7700 Virtualization Engines with a single port enabled. This adapter has an LC Duplex connector for attaching 50-micron or 62.5-micron, multimode fibre cable. This is a standard shortwave (850 nm) adapter that conforms to the IEEE 802.3z standards. It supports distances of 260 meters for 62.5-micron and 550 meters for 50.0-micron cable. Multi-mode fibre cables must be used with the adapter when FC 4015, Grid enablement is installed. This feature is only supported on a 3957-V06 or 3957-VEA operating a microcode level of 8.5.0.xx or later.

Refer to FC 1033, 1Gb grid dual port optical SW connection in Table 45 on page 130 for requirements and other information.

FC 1034, Enable dual port grid connection

FC 1034, Enable dual port grid connection, enables the second port of each dual port 1-Gb grid connection adapter provided by FC 1032, FC 1033, FC 1036, or FC 1037. This feature is only supported with a microcode level of 8.20.0.xx or higher.

All clusters on the grid must comply with the grid compatibility rules before this feature is enabled. If the TS7700 Server is currently configured as a stand-alone cluster but will be joined to one or more clusters in a grid you must replace the adapters of all other systems in the grid before joining the clusters. If the TS7700 Server is already part of a grid and IP addresses are being added or changed, you must activate the additional ports on the adapters of all other systems in the grid. Before you configure the TS7700 Grid communications for new IPs, verify that adapters are fully installed on all clusters, all grid adapter ports are activated and all clusters are properly cabled.

Refer to FC 1034, Enable dual port grid connection in Table 45 on page 130 for requirements and other information.

FC 1035, Grid optical LW connection

FC 1035, Grid optical LW connection, provides a single port, 10-Gbps Ethernet longwave adapter for grid communication between TS7700 Virtualization Engines.

This adapter has an LC Duplex connector for attaching 9-micron, single-mode fibre cable. This is a standard longwave (1,310 nm) adapter that conforms to the IEEE 802.3ae standards. It supports distances up to 10 km. This feature is only supported on a 3957-V07 or 3957-VEB operating a microcode level of 8.20.0.xx or later.

Note: These adapters cannot negotiate down to run at 1 Gb. They must be connected to a 10-Gb network device or light point.

Refer to FC 1035, Grid optical LW connection in Table 45 on page 130 for requirements and other information.

FC 1036, 1Gb grid dual port copper connection

FC 1036, 1Gb grid dual port copper connection provides a dual port 1-Gbps 10/100/1000 Base-TX PCIe Ethernet adapter for grid communication between TS7700 Virtualization Engines with a single port enabled. This adapter has an RJ-45 connector for attaching Cat6 cables. It conforms to the IEEE 802.3ab 1000 Base-T standard. It supports distances of up to 100 meters using four pairs of Cat6 balanced copper cabling. This feature is only supported on a 3957-V07 or 3957-VEB operating a microcode level of 8.20.0.xx or later.

When FC 4015, Grid enablement, is installed customer-supplied Cat6 cables must be used with this adapter.

Refer to FC 1036, 1Gb grid dual port copper connection in Table 45 on page 130 for requirements and other information.

FC 1037, 1Gb dual port optical SW connection

FC 1037, 1Gb dual port optical SW connection provides a dual port 1-Gbps shortwave PCIe Ethernet adapter for grid communication between TS7700 Virtualization Engines with a single port enabled. This adapter has an LC Duplex connector for attaching 50 micron or 62.5 micron multimode fibre cable. It is a standard shortwave (850 nm) adapter conforming to the IEEE 802.3z standards. It supports distances of up to 260 meters when used with a 62.5 micron cable and up to 550 meters when used with a 50.0 micron cable. This feature is only supported on a 3957-V07 or 3957-VEB operating a microcode level of 8.20.0.xx or later.

When FC 4015, Grid enablement, is installed multi-mode fiber cables must be used with this adapter.

Refer to FC 1037, 1Gb dual port optical SW connection in Table 45 on page 130 for requirements and other information.

FC 1903, Dual AC power

FC 1903, Dual AC power, provides a second power distribution unit (PDU) to allow connection to independent power sources. This feature supplies two power cords when ordered.

Refer to FC 1903, Dual AC power in Table 45 on page 130 for requirements and other information.

FC 1904, Redundant AC power

FC 1904, Redundant AC power provides power switching to allow a TS7720 Virtualization Engine or a TS7740 Virtualization Engine redundant attachment to the service network.

Refer to FC 1904, Redundant AC power in Table 45 on page 130 for requirements and other information.

FC 2714, Console expansion

FC 2714, Console expansion, provides an attachment cable, rack-mounted Ethernet switch, and associated mounting hardware to attach the TS7700 Server to an existing external TS3000 System Console (FC 2720, FC 2721, FC 2722, FC 2730, or FC 2732) or IBM System p5[®] Master Console for Service (FC 2718, obsolete).

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 2714, Console expansion in Table 45 on page 130 for requirements and other information.

FC 2715, Console attachment

FC 2715, Console attachment, provides a cable to attach a TS7700 Server to the Ethernet hub provided by an existing TS3000 System Console (FC 2720, FC 2721, FC 2722, FC 2730, or FC 2732), IBM TotalStorage Master Console for Service (FC 2718, obsolete), or Console expansion (FC 2714). A single TSSC facility can support a maximum of 40 instances of this feature.

Refer to FC 2715, Console attachment in Table 45 on page 130 for requirements and other information.

FC 2719, Console upgrade

FC 2719, Console upgrade, provides a second Ethernet network interface card to allow redundant attachment to the service network. This feature provides a memory upgrade to 2GB total RAM and a second Ethernet card to allow redundant connections into the service network. This feature only applies to consoles shipped with FC 2718, FC 2720, TS3000 System Console, or by FC 2721, Rack mountable TS3000 System Console. It is required for use with any TS7700 Virtualization Engine using features FC 2714, Console expansion, FC 2715, Console attachment, or FC 2720, TS3000 System Console.

Note: This feature has been withdrawn.

Refer to FC 2719, Console upgrade in Table 45 on page 130 for requirements and other information.

FC 2720, TS3000 System Console

FC 2720, TS3000 System Console, provides the IBM TotalStorage Master Console, an Ethernet hub, and a cable and connectors to enable remote enhanced service connection of a TS7740 Virtualization Engine to an IBM-supplied modem. The Ethernet hub provides 14 additional connections for cables supplied with FC 2714, Console expansion, or FC 2715, Console attachment. You should specify FC 2720, TS3000 System Console on the first unit in an installation connected to a master

console facility. Support for this feature on the 3957-V06 was withdrawn on December 5, 2008. To use this feature, order it against the 3953 F05 Tape Frame.

Note: Most customers prefer to use the rack mount TSSC on the 3953 F05 Tape Frame, (FC 2721, Rack mountable TS3000 System Console) instead of the desktop TSSC.

Refer to FC 2720, TS3000 System Console in Table 45 on page 130 for requirements and other information.

FC 2721, Rack mountable TS3000 System Console

FC 2721, Rack mountable TS3000 System Console, provides the rack mountable TS3000 System Console, an Ethernet switch for the Master Console and a cable and connector for connection of one subsystem.

Refer to FC 2721, Rack mountable TS3000 System Console in Table 45 on page 130 for requirements and other information.

FC 2730, TS3000 System Console

FC 2730, TS3000 System Console, provides a rack mount version of the TS3000 System Console for installation in a TS7720 Virtualization Engine or TS7740 Virtualization Engine 3952 F05 frame or a customer provided rack. FC 2730, TS3000 System Console provides a 1U server, keyboard, display, mouse, and Ethernet switch.

Note: This feature has been withdrawn.

Refer to FC 2730, TS3000 System Console in Table 45 on page 130 for requirements and other information.

FC 2732, TS3000 System Console

FC 2733, Internal modem

FC 3441, FICON short-wavelength attachment

FC 3441, FICON short-wavelength attachment, provides one short-wavelength 4-Gbps FICON adapter with an LC duplex connector for attachment to a FICON host system short-wavelength channel using a 50- or 62.5-micron multi-mode fibre cable. At 4 Gb/sec, the maximum fibre cable length allowed by 50-micron cable is 150 m (492 ft.), 55 m (180 ft.) if using 62.5-micron cable. Each 4-Gbps FICON attachment can support up to 256 logical channels.

Refer to FC 3441, FICON short-wavelength attachment in Table 45 on page 130 for requirements and other information.

FC 3442, FICON long-wavelength attachment

FC 3442, FICON long-wavelength attachment, provides one long-wavelength 4-Gbps FICON adapter with an LC duplex connector for attachment of a TS7700 Virtualization Engine to a FICON host system long-wavelength channel using a 9-micron single-mode fibre cable. The maximum fibre cable length is 4 km (2.48 mi.). Each 4-Gbps FICON attachment can support up to 256 logical channels.

Refer to FC 3442, FICON long-wavelength attachment in Table 45 on page 130 for requirements and other information.

FC 3443, FICON 10-km long-wavelength attachment

FC 3443, FICON 10-km long-wavelength attachment, provides one long-wavelength 4-Gbps FICON adapter with an LC duplex connector for attachment to a FICON host system long-wavelength channel using a 9-micron single-mode fibre cable. The maximum fibre cable length is 10 km (6.21 mi.). Each 4-Gbps FICON attachment can support up to 256 logical channels.

Refer to FC 3443, FICON 10-km long-wavelength attachment in Table 45 on page 130 for requirements and other information.

FC 3461, 8 GB Memory upgrade, field

FC 3461, 8 GB Memory upgrade, field, delivers a field-installable TS7700 Server memory upgrade to 16 GB RAM. This feature is only supported on the 3957-V06 or 3957-VEA and is required to install a code level of 8.20.0.xx code or later.

Refer to FC 3461, 8 GB Memory upgrade, field in Table 45 on page 130 for requirements and other information.

FC 3488, 4 Gb Fibre Channel Switch

FC 3488, 4 Gb Fibre Channel Switch, provides a 4 Gb fibre channel switch to attach to 3592 Tape Drives in the 3584 Tape Library. The 4 Gb fibre channel switch has dual power connection for optional attachment to separate power supplies. The fibre channel switch types must be the same (2 Gb or 4 Gb) and cannot be intermixed within FC 4888, Switch mount kit.

Note: This feature has been withdrawn.

Refer to FC 3488, 4 Gb Fibre Channel Switch in Table 45 on page 130 for requirements and other information.

FC 4015, Grid enablement

FC 4015, Grid enablement, provides a key to enable the communication function that allows a TS7700 Virtualization Engine to communicate with other TS7700 Virtualization Engines in a grid. Each TS7700 Virtualization Engine must have this feature to be able to participate in a grid configuration.

Note: If all clusters in a grid configuration already have FC 4015, Grid enablement installed, contact your IBM Service Representative to properly set up, connect, and configure the grid environment.

Refer to FC 4015, Grid enablement in Table 45 on page 130 for requirements and other information.

FC 4016, Remove Cluster from Grid

FC 4016, Remove Cluster from Grid, delivers instructions for a one-time process to remove a TS7700 Cluster from a TS7700 Grid. You must order this feature before you can perform a cluster cleanup (FC 4017, Cluster cleanup) on any TS7700 Cluster configured to participate in a TS7700 Grid. If a TS7700 Cluster is removed

from a TS7700 Grid, cleaned up using FC 4017, Cluster cleanup, and then joined to a new TS7700 Grid, another instance of FC 4016, Remove Cluster from Grid, is required to remove the cluster from the new Grid.

Note: If the cluster removal process is initiated from a cluster operating a microcode level lower than 8.7.0.134 , all clusters in the grid must be at the same level of code before this feature can be used. If the cluster removal process is initiated from a cluster operating a microcode level of 8.7.0.134 code or higher, then an intermix of code levels is permitted for use with this feature..

Refer to FC 4016, Remove Cluster from Grid in Table 45 on page 130 for requirements and other information.

FC 4017, Cluster cleanup

FC 4017, Cluster cleanup, facilitates a one-time cluster cleanup to clean the database, delete logical volumes from the Tape Volume Cache, and remove configuration data for host connections from a TS7700 Cluster. If the cluster is a member of a TS7700 Grid, the cluster must first be removed from the Grid using FC 4016, Remove Cluster from Grid. If another cleanup is required on this TS7700 Cluster, another instance of FC 4017, Cluster cleanup, is required.

Refer to FC 4017, Cluster cleanup in Table 45 on page 130 for requirements and other information.

FC 4743, Remove 3957-V06/VEA

FC 4743, Remove 3957-V06/VEA, directs the removal of the 3957-V06 or 3957-VEA from the 3952 F05 Tape Frame. A new 3957-V07 (FC 5629, Install 3957-V07) must be ordered to replace a removed 3957-V06. A new 3957-VEB (FC 5627, Install 3957-VEB) must be ordered to replace a removed 3957-VEA. The instructions for the field installation of a new model 3957-V07 or 3957-VEB are delivered with this feature.

Refer to FC 4743, Remove 3957-V06/VEA in Table 45 on page 130 for requirements and other information.

FC 4888, Switch mount kit

FC 4888, Switch mount kit, provides the mounting hardware for up to two fibre channel switches on the 3953 F05 Tape Frame that contains a 3592 J70 Controller or is attached to a VTS. It includes the required mounting hardware, bifurcated power cables, and instructions for installing up to two fibre channel switches in the 3953 F05 Tape Frame. The fibre channel switch types must be the same (2-Gb or 4-Gb) and cannot be intermixed within FC 4888, Switch mount kit.

Refer to FC 4888, Switch mount kit in Table 45 on page 130 for requirements and other information.

FC 4897, Reinstall 4Gb FC Switch

FC 4897, Reinstall 4Gb FC Switch, provides a customer-owned 4-Gb fibre channel switch to attach to 3592 Tape Drives in the 3584 Tape Library. The 4-Gb fibre channel switch has dual power connection for optional attachment to separate

power supplies. The fibre channel switch types must be the same (2-Gb or 4-Gb) and cannot be intermixed within FC 4888, Switch mount kit.

Refer to FC 4897, Reinstall 4Gb FC Switch in Table 45 on page 130 for requirements and other information.

FC 5240, Dual port fibre channel host bus adapter

FC 5240, Dual port fibre channel host bus adapter, installs two fibre channel interface cards in the TS7700 Server (3957-V06 or 3957-VEA) and provides two 31 Meter, 50 μ fibre channel cables to connect the TS7700 Server to the fibre channel switch.

When ordered against the TS7720 Server (3957-VEA), this feature connects the disk arrays in the 3952 Storage Expansion Frame with the 3957-VEA.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 5240, Dual port fibre channel host bus adapter in Table 45 on page 130 for requirements and other information.

For situations where customer-supplied fibre channel cables connect the TS7700 Virtualization Engine to the Fibre Channel switches, and a 4 Gb/second rate is expected, the following maximum length restrictions apply:

- 50 μ , 500 MHz multimode fibre channel cables cannot exceed 150 meters.
- 62.5 μ , 200 MHz fibre channel cables cannot exceed 70 meters.

FC 5241, Dual port FC HBA

FC 5241, Dual port FC HBA, installs two fibre channel interface cards in the TS7700 Server (3957-V07 or 3957-VEB) and provides two 31 Meter, 50 μ fibre channel cables to connect the TS7700 Server to the fibre channel switch.

When ordered against the TS7740 Server (3957-V07), this feature connects a fibre switch and back-end tape drives to the 3957-V07. When ordered against the TS7720 Server (3957-VEB), this feature connects the disk arrays in the 3952 Storage Expansion Frame with the 3957-VEB.

For situations where customer-supplied fibre channel cables connect the TS7700 Virtualization Engine to the Fibre Channel switches, and a 4 Gb/second rate is expected, the following maximum length restrictions apply:

- 50 μ , 500 MHz multimode fibre channel cables cannot exceed 150 meters.
- 62.5 μ , 200 MHz fibre channel cables cannot exceed 70 meters.

Refer to FC 5241, Dual port FC HBA in Table 45 on page 130 for requirements and other information.

FC 5267, 1 TB cache enablement

FC 5267, 1 TB cache enablement, delivers a key to enable a 1 TB increment of disk cache to store logical volumes. Enabling a cache increment does not guarantee that amount of additional cache capacity. The amount of additional cache capacity provided is limited by the capacity of the underlying physical cache installed.

Note: This feature is available only with the TS7740 Virtualization Engine.

Refer to FC 5267, 1 TB cache enablement in Table 45 on page 130 for requirements and other information.

FC 5268, 100 MB/sec increment

FC 5268, 100 MB/sec increment, delivers a key to enable an additional 100-MB/sec increment of potential Peak Data Throughput. Enabling a data throughput increment does not guarantee that the overall TS7700 Virtualization Engine performs at that data throughput level. However, installation of the maximum allowed feature codes results in unrestricted peak data throughput capabilities.

A maximum of 6 instances is allowed on a 3957-V06 or 3957-VEA, where FC 9268 represents the first instance. A maximum of 10 instances is allowed on the 3957-V07 or 3957-VEB, where FC 9268 represents the first instance.

Refer to FC 5268, 100 MB/sec increment in Table 45 on page 130 for requirements and other information.

FC 5270, Increased logical volumes

FC 5270, Increased logical volumes, increases by 200,000 the number of logical volumes supported on a cluster. You can use multiple increments of this feature to increase the maximum number of supported logical volumes from one million (default) to two million. Five instances of FC 5270, Increased logical volumes are required to support a new maximum of two million logical volumes. If FC 9110, Ship with R1.7 machine code, is installed this feature is available by RPQ only.

Note: In a grid configuration, the maximum number of supported logical volumes is determined by the cluster having the fewest installed instances of FC 5270, Increased logical volumes. In order to increase the number of supported logical volumes across a grid, the required number of FC 5270, Increased logical volumes, must be installed on each cluster in the grid.

Refer to FC 5270, Increased logical volumes in Table 45 on page 130 for requirements and other information.

FC 5271, Selective device access control

FC 5271, Selective device access control, authorizes the use of a set of Management Class policies that allow only certain logical control units or subsystem IDs within a composite library to have exclusive access to one or more volumes.

Note: In a grid configuration, FC 5271, Selective device access control, must be installed on each cluster in the grid before any selective device access control policies can be defined in that grid.

Refer to FC 5271, Selective device access control in Table 45 on page 130 for requirements and other information.

FC 5626, Plant install 3957-VEA

FC 5626, Plant install 3957-VEA, allows the factory installation of a TS7720 Server (3957-VEA) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9350, Plant install TS7700 Server in 3952 F05 against the 3957-VEA when ordering this feature.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 5626, Plant install 3957-VEA in Table 45 on page 130 for requirements and other information.

FC 5627, Install 3957-VEB

FC 5627, Install 3957-VEB allows installation of a TS7720 Server in a 3952 F05 Tape Frame. This feature occurs on the 3952 F05 Tape Frame order.

You must also order FC 4743, Remove 3957-V06/VEA to remove the existing 3957-VEA as well as FC 9350, Plant install TS7700 Server in 3952 F05 or FC 9351, Field merge TS7700 Server in 3952 F05 against the TS7720 Server when ordering this feature.

Refer to FC 5627, Install 3957-VEB in Table 45 on page 130 for requirements and other information.

FC 5628, Plant install 3957-V06

FC 5628, Plant install 3957-V06, allows plant installation of a TS7740 3957-V06 into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9350, Plant install TS7700 Server in 3952 F05, against the TS7740 3957-V06 when ordering this feature.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 5628, Plant install 3957-V06 in Table 45 on page 130 for requirements and other information.

FC 5629, Install 3957-V07

FC 5629, Install 3957-V07 allows installation of a TS7740 Server in a 3952 F05 Tape Frame. This feature occurs on the 3952 F05 Tape Frame order.

You must also order FC 4743, Remove 3957-V06/VEA to remove the existing 3957-V06, as well as FC 9350, Plant install TS7700 Server in 3952 F05 or FC 9351, Field merge TS7700 Server in 3952 F05 against the TS7740 Server when ordering this feature.

Refer to FC 5629, Install 3957-V07 in Table 45 on page 130 for requirements and other information.

FC 5635, Plant install 3956-CS8

FC 5635, Plant install 3956-CS8, allows the factory installation of a TS7720 Cache Controller (3956-CS8) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05 against the 3956-CS8 when ordering this feature.

Refer to FC 5635, Plant install 3956-CS8 in Table 45 on page 130 for requirements and other information.

FC 5636, Plant install 3956-CS7

FC 5636, Plant install 3956-CS7, allows the factory installation of a TS7720 Cache Controller (3956-CS7) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05 against the 3956-CS7 when ordering this feature.

Note: This feature has been withdrawn.

Refer to FC 5636, Plant install 3956-CS7 in Table 45 on page 130 for requirements and other information.

FC 5638, Plant install 3956-CC6

FC 5638, Plant install 3956-CC6, allows factory installation of a TS7740 Cache Controller (3956-CC6) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05, against the 3956-CC6 when ordering this feature.

Note: This feature has been withdrawn.

Refer to FC 5638, Plant install 3956-CC6 in Table 45 on page 130 for requirements and other information.

FC 5639, Plant install 3956-CC7

FC 5639, Plant install 3956-CC7 allows factory installation of a TS7740 Cache Controller (3956-CC7) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05 against the 3956-CC7 when ordering this feature.

Note: This feature has been withdrawn.

Refer to FC 5639, Plant install 3956-CC7 in Table 45 on page 130 for requirements and other information.

FC 5640, Plant install 3956-CC8

FC 5640, Plant install 3956-CC8, allows the factory installation of a TS7740 Cache Controller (3956-CC8) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05 against the 3956-CC8 when ordering this feature.

Refer to FC 5640, Plant install 3956-CC8 in Table 45 on page 130 for requirements and other information.

FC 5641, Plant install 3956-CX7

FC 5641, Plant install 3956-CX7, allows the factory installation of a TS7740 Cache Drawer (3956-CX7) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05 against the 3956-CX7 when ordering this feature.

Refer to FC 5641, Plant install 3956-CX7 in Table 45 on page 130 for requirements and other information.

FC 5642, Field install 3956-CX7

FC 5642, Field install 3956-CX7, allows the field installation of a TS7740 Cache Drawer (3956-CX7) into an existing customer 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 7312, TS7740 Base frame against the 3952 Tape Frame and FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05 against the 3956-CX7 when ordering this feature.

Refer to FC 5642, Field install 3956-CX7 in Table 45 on page 130 for requirements and other information.

FC 5646, Plant install 3956-XS7

FC 5646, Plant install 3956-XS7, allows the factory installation of a TS7720 Cache Drawer (3956-XS7) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 7322, TS7720 Base frame or FC 7323, TS7720 Storage expansion frame against the 3952 Tape Frame and FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05 against the 3956-XS7 when ordering this feature.

Refer to FC 5646, Plant install 3956-XS7 in Table 45 on page 130 for requirements and other information.

FC 5647, Field install 3956-XS7

FC 5647, Field install 3956-XS7, allows the field installation of a TS7720 Cache Drawer (3956-XS7) into an existing 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 7322, TS7720 Base frame or FC 7323, TS7720 Storage expansion frame against the 3952 Tape Frame and FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05 against the 3956-XS7 when ordering this feature.

Refer to FC 5647, Field install 3956-XS7 in Table 45 on page 130 for requirements and other information.

FC 5648, Plant install 3956-CX6

FC 5648, Plant install 3956-CX6, allows plant installation of a TS7740 Cache Drawer (3956-CX6) into a new 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05, against the 3956-CX6 when ordering this feature.

Note: This feature has been withdrawn.

Refer to FC 5648, Plant install 3956-CX6 in Table 45 on page 130 for requirements and other information.

FC 5649, Field install 3956-CX6

FC 5649, Field install 3956-CX6, allows the field installation of a TS7740 Cache Drawer (3956-CX6) into an existing customer 3952 Tape Frame. This feature occurs on the 3952 Tape Frame order.

You must also order FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05 against the 3956-CX6 when ordering this feature.

Note: This feature has been withdrawn.

Refer to FC 5649, Field install 3956-CX6 in Table 45 on page 130 for requirements and other information.

FC 5758, Integrated control path

FC 5758, Integrated control path, provides the switch and cables to manage the internal TS7700 Virtualization Engine network.

Refer to FC 5758, Integrated control path in Table 45 on page 130 for requirements and other information.

FC 5759, Integrated control path

FC 5759, Integrated control path, provides the router cables necessary to create the control path between the TS7740 Virtualization Engine and the Library Manager.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 5759, Integrated control path in Table 45 on page 130 for requirements and other information.

FC 6000, Intraframe fibre cable to 3956-CC6

FC 6000, Intraframe fibre cable to 3956-CC6, provides one 1m fibre cable and is also used to connect TS7740 Cache Drawers.

Note: This feature has been withdrawn.

Refer to FC 6000, Intraframe fibre cable to 3956-CC6 in Table 45 on page 130 for requirements and other information.

FC 6003, Intraframe fibre cable to 3957-V06

FC 6003, Intraframe fibre cable to 3957-V06, provides one 2m fibre cable.

Note: This feature has been withdrawn.

Refer to FC 6003, Intraframe fibre cable to 3957-V06 in Table 45 on page 130 for requirements and other information.

FC 7113, 16TB SATA storage

FC 7113, 16TB SATA storage, installs a complete set of 16 1000GB, 7,200rpm, SATA disk drive modules in a TS7720 Cache Controller (3956-CS7) or TS7720 Cache Drawer (3956-XS7), providing 16TB of unformatted disk storage capacity. Usable capacity is 10TB with RAID 6 formatting.

Note: This feature has been withdrawn.

Refer to FC 7113, 16TB SATA storage in Table 45 on page 130 for requirements and other information.

FC 7114, 32TB SATA storage

FC 7114, 32TB SATA storage, installs a complete set of 16 2000GB, 7200rpm, SATA disk drive modules in the TS7720 Cache Controller (3956-CS8), providing 32TB of unformatted disk storage capacity.

Note: Usable capacity is approximately 22TB when used with RAID 6 formatting.

Refer to FC 7114, 32TB SATA storage in Table 45 on page 130 for requirements and other information.

FC 7120, 1.7 TB fibre storage

FC 7120, 1.7 TB fibre storage, installs a complete set of 16 fibre channel-capable disk drive modules in the TS7740 Cache Controller (3956-CC6) or, TS7740 Cache Drawer (3956-CX6) providing 1.7 TB of usable storage capacity.

Note: This feature has been withdrawn.

Refer to FC 7120, 1.7 TB fibre storage in Table 45 on page 130 for requirements and other information.

FC 7121, 3.43 TB fibre storage

FC 7121, 3.43 TB fibre storage, installs a complete set of 16 300 GB, 15k rpm, fibre channel-capable disk drive modules in the TS7740 Cache Controller (3956-CC7) or TS7740 Cache Drawer (3956-CX7), providing 3.43 TB of usable storage capacity.

Note: This feature has been withdrawn.

Refer to FC 7121, 3.43 TB fibre storage in Table 45 on page 130 for requirements and other information.

FC 7123, 9.6 TB Fibre storage

FC 7123, 9.6 TB Fibre storage, installs a complete set of 16 600 GB, 15k rpm, fibre channel-capable disk drive modules in the TS7740 Cache Controller (3956-CC8), providing 9TB of unformatted storage capacity.

Note: Usable capacity is 6.86 TB when used with RAID 5 formatting.

Refer to FC 7123, 9.6 TB Fibre storage in Table 45 on page 130 for requirements and other information.

FC 7312, TS7740 Base frame

FC 7312, TS7740 Base frame, identifies this 3952 Tape Frame as the base unit for the TS7740 Virtualization Engine.

Refer to FC 7312, TS7740 Base frame in Table 45 on page 130 for requirements and other information.

FC 7322, TS7720 Base frame

FC 7322, TS7720 Base frame identifies a 3952 Tape Frame as the base unit for a TS7720 Virtualization Engine.

Refer to FC 7322, TS7720 Base frame in Table 45 on page 130 for requirements and other information.

FC 7323, TS7720 Storage expansion frame

FC 7323, TS7720 Storage expansion frame, identifies a 3952 Tape Frame as the disk storage expansion unit for a TS7720 Virtualization Engine.

Refer to FC 7323, TS7720 Storage expansion frame in Table 45 on page 130 for requirements and other information.

FC 7403, Enable first expansion drawer

FC 7403, Enable first expansion drawer, is required on a TS7740 Cache Controller (3956-CC7) to allow attachment of the first TS7740 Cache Drawer (3956-CX7) in its storage string. If no cache drawers are attached to the cache controller, this feature is not required.

Refer to FC 7403, Enable first expansion drawer in Table 45 on page 130 for requirements and other information.

FC 7404, Enable fourth expansion drawer

FC 7404, Enable fourth expansion drawer, is required on a TS7740 Cache Controller (3956-CC7) to allow attachment of the fourth TS7740 Cache Drawer (3956-CX7) in its storage string. If fewer than three cache drawers are attached to the cache controller, this feature is not required.

Refer to FC 7404, Enable fourth expansion drawer in Table 45 on page 130 for requirements and other information.

FC 9000, Mainframe attachment

FC 9000, Mainframe attachment, is a specify feature that indicates attachment to one of the following host platforms:

- z/OS 1.4 and higher
- z/VM, 5.4.0 and higher
- z/VSE, 4.1 and higher
- zTPF, V1.1 and higher

- TPF, 4.1 and higher

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 9000, Mainframe attachment in Table 45 on page 130 for requirements and other information.

FC 9013, Attach to TS7700

FC 9013, Attach to TS7700, is a specify feature that indicates attachment to a TS7700 Virtualization Engine. This feature cannot be used with TS7740 Virtualization Engines operating microcode levels of 8.5.0.x or higher.

Refer to FC 9013, Attach to TS7700 in Table 45 on page 130 for requirements and other information.

Note: This feature was withdrawn on December 5, 2008.

FC 9110, Ship with R1.7 machine code

FC 9110, Ship with R1.7 machine code, instructs factory installation of the latest manufacturing level of R1.7 machine code on the TS7700 Virtualization Engine. This feature is only supported on the 3957-V06 or 3957-VEA.

Refer to FC 9110, Ship with R1.7 machine code in Table 45 on page 130 for requirements and other information.

FC 9111, Ship with R2.0 machine code

FC 9111, Ship with R2.0 machine code, instructs factory installation of the latest manufacturing level of R2.0 machine code on the TS7700 Virtualization Engine.

Refer to FC 9111, Ship with R2.0 machine code in Table 45 on page 130 for requirements and other information.

FC 9217, Attach to 3953 LM

FC 9217, Attach to 3953 LM, is a specify feature that indicates that the TS7740 Server (3957-V06) attaches to a 3953 L05 Library Manager. This feature cannot be used with TS7740 Virtualization Engines operating microcode code levels of 8.5.0.x or higher.

Refer to FC 9217, Attach to 3953 LM in Table 45 on page 130 for requirements and other information.

Note: This feature was withdrawn on December 5, 2008.

FC 9218, Attach to 3494 LM

FC 9218, Attach to 3494 LM, is a specify feature that indicates that the TS7740 Server (3957-V06) attaches to a Library Manager in a 3494 Tape Library. Attachment to a 3494 Tape Library is not supported by microcode levels of 8.20.0.xx or later. This feature must be removed before installing a microcode level or 8.20.0.xx or later.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 9218, Attach to 3494 LM in Table 45 on page 130 for requirements and other information.

FC 9219, Attach to TS3500

FC 9219, Attach to TS3500 enables the TS7740 Server (3957-V06) to attach directly to the TS3500 Tape Library, without the use of the 3953 L05 Library Manager. 4-Gb Fibre Channel features are required in the 3584 Tape Library frames containing the backend drives.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 9219, Attach to TS3500 in Table 45 on page 130 for requirements and other information.

FC 9230, Attach to 3957-V06

FC 9230, Attach to 3957-V06, is a specify feature that indicates a TS7740 Cache Controller (3956-CC6) is attached to a TS7740 Server (3957-V06). This feature occurs on the 3956-CC6 order.

You must also order FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05, against the IBM Virtualization Engine TS7700 and FC 5638, Plant install 3956-CC6, against the 3952 Tape Frame when ordering this feature.

Note: This feature has been withdrawn.

Refer to FC 9230, Attach to 3957-V06 in Table 45 on page 130 for requirements and other information.

FC 9268, Plant install 100 MB/s throughput

FC 9268, Plant install 100 MB/s throughput, delivers a key to enable the first 100-MB/sec increment of potential peak data throughput on the TS7720 Server (3957-VEA or 3957-VEB). Enabling a data throughput increment does not guarantee that the overall TS7720 Virtualization Engine performs at that data throughput level. However, installation of the maximum allowed number of features results in unrestricted peak data throughput capabilities. This feature is restricted to new factory installation and represents the first 100-MB/s increment.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 9268, Plant install 100 MB/s throughput in Table 45 on page 130 for requirements and other information.

FC 9323 Expansion frame attachment

FC 9323 Expansion frame attachment indicates that a 3952 Tape Frame used with a TS7720 Virtualization Engine is a 3952 Base Frame and is attached to a 3952 Storage Expansion Frame.

Refer to FC 9323 Expansion frame attachment in Table 45 on page 130 for requirements and other information.

FC 9350, Plant install TS7700 Server in 3952 F05

FC 9350, Plant install TS7700 Server in 3952 F05, allows the plant installation of a TS7700 Server (3957-V06 or 3957-VEA) into a new 3952 Tape Frame. This feature occurs on the TS7700 Server order. You must also order FC 5628, Plant install 3957-V06, against the 3952 Tape Frame when ordering this feature for the 3957-V06.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 9350, Plant install TS7700 Server in 3952 F05 in Table 45 on page 130 for requirements and other information.

FC 9351, Field merge TS7700 Server in 3952 F05

FC 9351, Field merge TS7700 Server in 3952 F05, allows the field merge of a TS7700 Server into an existing installed 3952 Tape Frame.

You must also order FC 4743, Remove 3957-V06/VEA, against the 3952 Tape Frame. when ordering this feature.

Refer to FC 9351, Field merge TS7700 Server in 3952 F05 in Table 45 on page 130 for requirements and other information.

FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05

FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05, allows the factory installation of a TS7700 Cache Controller (3956-CC8, or 3956-CS8) into a new 3952 Tape Frame.

If installing a 3956-CC8, you must also order FC 5640, Plant install 3956-CC8 against the 3952 Tape Frame.

If installing a 3956-CS8, you must also order FC 5635, Plant install 3956-CS8 against the 3952 Tape Frame.

Note: This feature has been withdrawn for the 3956-CC6, 3956-CC7, and 3956-CS7.

Refer to FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05 in Table 45 on page 130 for requirements and other information.

FC 9353, Field merge in 3952 F05

FC 9353, Field merge in 3952 F05, allows the field merge of a TS7720 Cache Controller into a customer installed 3952 Tape Frame.

This feature must be installed on the TS7720 Cache Controller and FC 5637 must be ordered against the 3952 Tape Frame.

Refer to FC 9353, Field merge in 3952 F05 in Table 45 on page 130 for requirements and other information.

FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05

FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05 allows the factory installation of a TS7700 Cache Drawer (3956-CX6, 3956-CX7, or 3956-XS7) into a new 3952 Tape Frame.

If installing a 3956-CX6, you must also order FC 5648, Plant install 3956-CX6 against the 3952 Tape Frame.

If installing a 3956-CX7, you must also order FC 5641, Plant install 3956-CX7 against the 3952 Tape Frame.

If installing a 3956-XS7, you must also order FC 5646, Plant install 3956-XS7 against the 3952 Tape Frame.

Note: This feature has been withdrawn for the 3956-CX6.

Refer to FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05 in Table 45 on page 130 for requirements and other information.

FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05

FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05, is a specify code that allows the field merge of a TS7700 Cache Drawer (3956-CX6, 3956-CX7, or 3956-XS7) 3952 Tape Frame.

If installing a 3956-CX6, you must also order FC 5649, Field install 3956-CX6 against the 3952 Tape Frame.

If installing a 3956-CX7, you must also order FC 5642, Field install 3956-CX7 against the 3952 Tape Frame.

If installing a 3956-XS7, you must also order FC 5647, Field install 3956-XS7 against the 3952 Tape Frame.

Refer to FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05 in Table 45 on page 130 for requirements and other information.

FC 9461, 8 GB Memory upgrade, plant

FC 9461, 8 GB Memory upgrade, plant, allows the factory installation of 16 GB RAM in the TS7700 Server. This feature is supported only on the 3957-V06 or 3957-VEA.

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 9461, 8 GB Memory upgrade, plant in Table 45 on page 130 for requirements and other information.

FC 9700, No factory cables

FC 9700, No factory cables, instructs the plant not to ship any FICON cables with the TS7700 Server .

Note: This feature is withdrawn effective August 15, 2011.

Refer to FC 9700, No factory cables in Table 45 on page 130 for requirements and other information.

FC 9900, Encryption configuration

Order FC 9900, Encryption configuration when you use encryption with the TS7740 Virtualization Engine. This feature includes publication updates with information on how to enable and configure the library (virtual or real) to support encryption. This feature also provides an encryption key server publication. Customer initiated procedures must be completed to enable and configure the TS7740 Virtualization Engine to support encryption with the TS1120 encryption capable tape drive. This feature occurs on the 3957-V06 order.

Note: FC 9900, Encryption configuration is only supported with encryption-capable TS1120 3592 E05 Tape Drives. FC 9900, Encryption configuration, is not supported by 3592 J1A or 3590 Tape Drives.

Refer to FC 9900, Encryption configuration in Table 45 on page 130 for requirements and other information.

FC 9954, NEMA L6-30 power cord

FC 9954, NEMA L6-30 power cord, provides a National Electrical Manufacturers Association (NEMA) L6-30 non-watertight, 4.3-m (14-ft.) power cord, rated for 200 V ac to 208 V ac or 240 V ac and 24 A. This power cord is suggested for use in the USA, Canada, Latin America, and Japan. This feature occurs on the 3952 Tape Frame order.

Refer to FC 9954, NEMA L6-30 power cord in Table 45 on page 130 for requirements and other information.

FC 9955, RS 9750 DP power cord

FC 9955, RS 9750 DP power cord, provides a Russellstoll 3750 DP, watertight, 4.3-m (14-ft.) power cord, rated for 200 V ac to 208 V ac or 240 V ac and 24 A. This power cord is suggested for use in the USA (highly recommended in Chicago, Illinois, to conform with local requirements), Canada, Latin America, and Japan. This feature occurs on the 3952 Tape Frame order.

Refer to FC 9955, RS 9750 DP power cord in Table 45 on page 130 for requirements and other information.

FC 9956, IEC 309 power cord

FC 9956, IEC 309 power cord, provides an International Electrotechnical Commission (IEC) 309 p+n+g, 32 A plug, 4.3-m (14-ft.) power cord, rated for 230 V ac and can safely carry 24 A in all countries. This power cord is suggested for use in Europe, the Middle East, and Africa. This feature occurs on the 3952 Tape Frame order.

Refer to FC 9956, IEC 309 power cord in Table 45 on page 130 for requirements and other information.

FC 9957, PDL 4.3 power cord

FC 9957, PDL 4.3 power cord, provides a PDL 4.3-m (14-ft.) power cord, rated for 230 V ac to 240 V ac and 24 A. This power cord is suggested for use in Australia and New Zealand. This feature occurs on the 3952 Tape Frame order.

Refer to FC 9957, PDL 4.3 power cord in Table 45 for requirements and other information.

FC 9958, Korean 4.3-m power cord

FC 9958, Korean 4.3-m power cord, provides a NEMA L6-30 non-watertight, 4.3-m (14-ft.) power cord, rated for 200 V ac to 208 V ac or 240 V ac and 24 A, with a South Korean plug. This power cord is suggested for use in South Korea. This feature occurs on the 3952 Tape Frame order.

Refer to FC 9958, Korean 4.3-m power cord in Table 45 for requirements and other information.

FC 9959, Unterminated power cord

FC 9959, Unterminated power cord, provides an unterminated, non-watertight, 4.3-m (14-ft.) power cord, rated for 200 V ac to 208 V ac and 24 Amp, with IRAM and BSMI agency certifications. This is the recommended cord for Argentina and Taiwan. This feature occurs on the 3952 Tape Frame order.

Refer to FC 9959, Unterminated power cord in Table 45 for requirements and other information.

FC 9966, Unterminated power cord (China)

FC 9966, Unterminated power cord (China), provides an unterminated, non-watertight, 4.3-m (14-ft.) power cord, rated for 200 V ac to 208 V ac and 24 Amp, with CCC agency certifications. This is the recommended cord for China. This feature occurs on the 3952 Tape Frame order.

Refer to FC 9966, Unterminated power cord (China) in Table 45 for requirements and other information.

Table 45. TS7700 Virtualization Engine features

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 0201, 9-micron LC/LC 31-meter	2	4	You must order EITHER two instances of one of the following: <ul style="list-style-type: none"> • FC 0201 • FC 0202 • FC 0203 • FC 0204 • FC 0205 • FC 0206 OR , one instance of FC 9700	Plant or field	Yes

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 0202, 9-micron LC/SC 31-meter†	2	4	You must order EITHER two instances of one of the following: <ul style="list-style-type: none"> • FC 0201 • FC 0202 • FC 0203 • FC 0204 • FC 0205 • FC 0206 OR , one instance of FC 9700	Plant or field	Yes
FC 0203, 50-micron LC/LC 31-meter	2	4	You must order EITHER two instances of one of the following: <ul style="list-style-type: none"> • FC 0201 • FC 0202 • FC 0203 • FC 0204 • FC 0205 • FC 0206 OR , one instance of FC 9700	Plant or field	Yes
FC 0204, 50-micron LC/SC 31-meter†	2	4	You must order EITHER two instances of one of the following: <ul style="list-style-type: none"> • FC 0201 • FC 0202 • FC 0203 • FC 0204 • FC 0205 • FC 0206 OR , one instance of FC 9700	Plant or field	Yes
FC 0205, 62.5-micron LC/LC 31-meter†	2	4	You must order EITHER two instances of one of the following: <ul style="list-style-type: none"> • FC 0201 • FC 0202 • FC 0203 • FC 0204 • FC 0205 • FC 0206 OR , one instance of FC 9700	Plant or field	Yes
FC 0206, 62.5-micron LC/SC 31-meter†	2	4	You must order EITHER two instances of one of the following: <ul style="list-style-type: none"> • FC 0201 • FC 0202 • FC 0203 • FC 0204 • FC 0205 • FC 0206 OR , one instance of FC 9700	Plant or field	Yes

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 0521, Functional enhancement field	0	No Maximum	This feature is a one-time code update. It includes the minimum level of library manager microcode required to support the current level of TS7700 Virtualization Engine microcode.	Field only	No
FC 1030, 1Gb grid copper connection†	0	2	This feature is available as a concurrent MES. This feature is mutually exclusive with FC 1031. You must order two of EITHER FC 1030 OR FC 1031.	Plant or field	Yes
FC 1031, 1Gb optical SW connection†	0	2	This feature is available as a concurrent MES. This feature is mutually exclusive with FC 1030. You must order two of EITHER FC 1031 OR FC 1030.	Plant or field	Yes
FC 1032, 1Gb grid dual port copper connection	0	2	This feature is mutually exclusive with: <ul style="list-style-type: none"> • FC 1030 • FC 1031 • FC 1033 You must order two instances of one of the following: <ul style="list-style-type: none"> • FC 1030 • FC 1031 • FC 1032 • FC 1033 	Plant or field	Yes
FC 1033, 1Gb grid dual port optical SW connection	0	2	This feature is mutually exclusive with: <ul style="list-style-type: none"> • FC 1030 • FC 1031 • FC 1032 You must order two instances of one of the following: <ul style="list-style-type: none"> • FC 1030 • FC 1031 • FC 1032 • FC 1033 	Plant or field	Yes
FC 1034, Enable dual port grid connection	0	1	Prerequisites: Two instances of one of the following on the 3957-V06/VEA: <ul style="list-style-type: none"> • FC 1032 • FC 1033 or on the 3957-V07/VEB: <ul style="list-style-type: none"> • FC 1036 • FC 1037 	Plant or field	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 1035, Grid optical LW connection	0	2	<p>Mutually exclusive with:</p> <ul style="list-style-type: none"> • FC 1036 • FC 1037 <p>You must order two instances of one of the following:</p> <ul style="list-style-type: none"> • FC 1035 • FC 1036 • FC 1037 	Plant or field	Yes
FC 1036, 1Gb grid dual port copper connection	0	2	<p>Mutually exclusive with:</p> <ul style="list-style-type: none"> • FC 1035 • FC 1037 <p>You must order two instances of one of the following:</p> <ul style="list-style-type: none"> • FC 1035 • FC 1036 • FC 1037 	Plant or field	Yes
FC 1037, 1Gb dual port optical SW connection	0	2	<p>Mutually exclusive with:</p> <ul style="list-style-type: none"> • FC 1035 • FC 1036 <p>You must order two instances of one of the following:</p> <ul style="list-style-type: none"> • FC 1035 • FC 1036 • FC 1037 	Plant or field	Yes
FC 1903, Dual AC power	0	1	This feature is required if you are ordering FC 7312.	Plant	No
FC 1904, Redundant AC power	0	1	Prerequisite: FC 2730	Plant or field	No
FC 2714, Console expansion†	0	1	<p>Mutually exclusive with FC 2715. You must order one instance of either FC 2714 or FC 2715.</p> <p>Prerequisites: This feature must attach to one of the following:</p> <ul style="list-style-type: none"> • FC 2720 • FC 2721 • FC 2722 • FC 2730 • FC 2732 • FC 2718 (obsolete) <p>Attachment to FC 2713 is not allowed.</p>	Plant or field	Yes

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 2715, Console attachment	0	1	<p>Mutually exclusive with FC 2714. You must order one instance of either FC 2714 or FC 2715.</p> <p>Prerequisites: This feature must attach to one of the following:</p> <ul style="list-style-type: none"> • FC 2714 • FC 2720 • FC 2721 • FC 2722 • FC 2730 • FC 2732 • FC 2718 (obsolete) <p>Attachment to FC 2713 is not allowed.</p>	Plant or field	Yes
FC 2719, Console upgrade†	0	1	<p>When FC 2714/FC 2715 are installed on a 3957-V06, this feature and FC 2718, FC 2720, or FC 2721 must be installed on the same machine type model. Support for this feature on the 3957-V06 was withdrawn on December 5, 2008. To use this feature, order it against the 3953 F05 Tape Frame.</p>	Field	No
FC 2720, TS3000 System Console	0	1	<p>You must order one of FC 2714, FC 2715, or FC 2720. Support for this feature on the 3957-V06 was withdrawn on December 5, 2008. To use this feature, order it against the 3953 F05 Tape Frame.</p>	Plant only	No
FC 2721, Rack mountable TS3000 System Console	0	1	<p>You can install the TS3000 System Console FC 2721 on the 3953 F05 Tape Frame connecting to the TS7740 using FC 2714 or FC 2715.</p>	Plant and Field	Yes
FC 2730, TS3000 System Console†	0	1	<p>Prerequisites:</p> <ul style="list-style-type: none"> • FC 1904 • FC 2719 <p>You must order one instance of one of the following:</p> <ul style="list-style-type: none"> • FC 7312 • FC 7313 • FC 7322 	Plant or field	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 3441, FICON short-wavelength attachment	0	4	<p>This feature is available as a concurrent MES.</p> <p>You must order this feature in quantities of zero, two, or four. The total quantity of all the following features must be 2 or 4:</p> <ul style="list-style-type: none"> • FC 3441 • FC 3442 • FC 3443 	Plant or field	Yes
FC 3442, FICON long-wavelength attachment	0	4	<p>This feature is available as a concurrent MES.</p> <p>You must order this feature in quantities of zero, two, or four. The total quantity of all the following features must be 2 or 4:</p> <ul style="list-style-type: none"> • FC 3441 • FC 3442 • FC 3443 	Plant or field	Yes
FC 3443, FICON 10-km long-wavelength attachment	0	4	<p>This feature is available as a concurrent MES.</p> <p>You must order this feature in quantities of zero, two, or four. The total quantity of all the following features must be 2 or 4:</p> <ul style="list-style-type: none"> • FC 3441 • FC 3442 • FC 3443 	Plant or field	Yes
FC 3461, 8 GB Memory upgrade, field	0	1	Mutually exclusive with FC 9461	Field only	No
FC 3488, 4 Gb Fibre Channel Switch†	0	6	<p>You must order two instances of this feature for each of the following features ordered:</p> <ul style="list-style-type: none"> • FC 9013 • FC 9020 <p>Prerequisite: One instance of FC 4888 for each pair of FC 3488 ordered.</p>	Plant and Field	Yes

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 4015, Grid enablement	0	1	Prerequisites: When this feature is installed on a 3957-V06 or 3957-VEA you must order two instances of one of the following: <ul style="list-style-type: none"> • FC 1035 • FC 1036 • FC 1037 When this feature is installed on a 3957-V07 or 3957-VEB you must order two instances of EITHER FC 1032 OR FC 1033	Plant or field	No
FC 4016, Remove Cluster from Grid	0	99	Prerequisite: FC 4015	Field only	No
FC 4017, Cluster cleanup	0	99	Prerequisite: FC 4016 if cluster is part of a grid configuration	Field only	No
FC 4743, Remove 3957-V06/VEA	0	1	Mutually exclusive with FC 5638. Corequisites: FC 5627 or FC 5629	Field only	No
FC 4888, Switch mount kit	0	3	Fibre channel switch types must be the same (2-Gb or 4-Gb) and cannot be intermixed within FC 4888.	Plant or field	No
FC 4897, Reinstall 4Gb FC Switch	0	6	Prerequisites: One FC 4888 for each ordered pair of the following: <ul style="list-style-type: none"> • FC 3487 • FC 3488 • FC 4889 • FC 4890 • FC 4897 	Plant and Field	Yes
FC 5241, Dual port FC HBA	0	1	Corequisite: FC 9323 is required on the 3952 F05 when this feature is installed. Prerequisite: FC 5627	Plant or field	No
FC 5240, Dual port fibre channel host bus adapter†	1	1	You must order one instance of this feature. Corequisite: FC 9323 is required on 3952 F05 when FC 5626 is installed.	Plant	No
FC 5267, 1 TB cache enablement	1	28	This feature is available as a concurrent MES for the TS7740 Virtualization Engine only. It is not available for the TS7720 Virtualization Engine. Total hardware capacity may not be enabled unless appropriate quantities of FC 5267 are ordered. Total usable capacity is 13.42 TB.	Plant or field	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 5268, 100 MB/sec increment	1	6 for the 3957-V06/ VEA 10 for the 3957-V07/ VEB	This feature is available as a concurrent MES. You can order a maximum of 6 or 10 instances of this feature only if FC 9268, Plant install 100 MB/s throughput is not installed. If FC 9268 is installed, you can order a maximum of 5 or 9 instances of this feature, based on your TS7700 Server model.	Plant or field	No
FC 5270, Increased logical volumes	0	5	This feature is available as a concurrent, customer installed MES. It requires a microcode level of 8.20.0.xx or higher. In a grid configuration, FC 5270, Increased logical volumes, must be installed on every cluster in the grid to increase the number of supported logical volumes in that grid.Prerequisites (for use with 3957-V06 or 3957-VEA): <ul style="list-style-type: none"> • FC 3461 • FC 9461 	Plant or field	No
FC 5271, Selective device access control	0	1	This feature is available as a concurrent, customer installed MES. In a grid configuration,FC 5271, Selective device access control, must be installed on every cluster in the grid to increase the number of supported logical volumes in that grid.	Plant or field	No
FC 5626, Plant install 3957-VEA†	0	1	Prerequisites: <ul style="list-style-type: none"> • FC 7322 • At least one instance of FC 5636 • No more than six total instances of FC 5646 and FC 5647 Corequisite: FC 9350 on 3957-VEA	Plant only	Yes
FC 5627, Install 3957-VEB	0	1	Mutually exclusive with: <ul style="list-style-type: none"> • FC 5626 (if on 3957-VEA) • FC 5628 (if on 3957-V06) • FC 5629 (if on 3957-V07) Prerequisites: <ul style="list-style-type: none"> • FC 7322 • FC 4743 if this is a field-installed feature Corequisites: FC 9350 or FC 9351 on 3957-VEB	Plant or field	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 5628, Plant install 3957-V06†	0† 1‡	5† 6‡	Corequisite: FC 9350 against the IBM Virtualization Engine TS7700. If you have FC 7312 installed, the minimum requirement is 1. No minimum of this feature is required for the TS7720 Virtualization Engine since the first instance is shipped from the plant with FC 9268.	Plant only	Yes
	† for the TS7720 Virtualization Engine ‡ for the TS7740 Virtualization Engine				
FC 5629, Install 3957-V07	0	1	Mutually exclusive with: <ul style="list-style-type: none"> • FC 5626 (if on 3957-VEA) • FC 5627 (if on 3957-VEB) • FC 5628 (if on 3957-V06) Prerequisites: <ul style="list-style-type: none"> • FC 7312 • FC 4743 if this is a field-installed feature Corequisites: FC 9350 or FC 9351 on 3957-V07	Plant or field	No
FC 5635, Plant install 3956-CS8	0	2	Prerequisites: <ul style="list-style-type: none"> • One instance of EITHER FC 7322 OR FC 7323 • For each instance of FC 5635 ordered, exactly five instances of FC 5646 are required Corequisite: FC 9352 is required against the 3956-CS8	Plant only	No
FC 5636, Plant install 3956-CS7†	0	1	Prerequisites: <ul style="list-style-type: none"> • FC 5626 • FC 7322 Corequisite: FC 9352 on 3956-CS7	Plant only	No
FC 5638, Plant install 3956-CC6†	0	1	Corequisite: FC 9352 against the TS7700 cache controller. If you have FC 7312 installed, the minimum requirement is 1.	Plant only	No
FC 5639, Plant install 3956-CC7†	0	2	Prerequisites: One instance of one of the following: <ul style="list-style-type: none"> • FC 7312 • FC 7313 • FC 7324 Corequisite: FC 9352 is required on 3956-CC7	Plant only	No
FC 5640, Plant install 3956-CC8	0	1	Prerequisite: FC 7312 Corequisite: FC 9352 is required on 3956-CC8	Plant only	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 5641, Plant install 3956-CX7	0	6	<p>Prerequisites:</p> <p>One instance of one of the following:</p> <ul style="list-style-type: none"> • FC 7312 • FC 7313 • FC 7324 <p>FC 5639 is required. Valid total quantities of FC 5641 and FC 5642 are 0, 1, and 3.</p> <p>Corequisite: FC 9354 is required on 3956-CX6.</p>	Plant only	No
FC 5642, Field install 3956-CX7	0	6	<p>Prerequisites: One instance of one of the following:</p> <ul style="list-style-type: none"> • FC 7312 • FC 7313 • FC 7324 <p>FC 5639 is required. Valid total quantities of FC 5641 and FC 5642 are 0, 1, and 3.</p> <p>Corequisite: FC 9355 is required on 3956-CX7.</p>	Field only	No
FC 5646, Plant install 3956-XS7	0	10	<p>Prerequisites:</p> <ul style="list-style-type: none"> • One of FC 7322 or FC 7323 • FC 5626 • FC 5636 <p>Corequisite: FC 9354 on 3956-XS7</p> <p>Valid total quantities of FC 5646 and FC 5647 are:</p> <ul style="list-style-type: none"> • 1 to 6 when used with FC 7322 • 0 to 10 when used with FC 7323 	Plant only	No
FC 5647, Field install 3956-XS7	0	5	<p>Prerequisites:</p> <ul style="list-style-type: none"> • One of FC 7322 or FC 7323 • FC 5626 • FC 5636 <p>Corequisite: FC 9355 on 3956-XS7</p> <p>Valid total quantities of FC 5646 and FC 5647 are:</p> <ul style="list-style-type: none"> • 1 to 6 when used with FC 7322 • 0 to 10 when used with FC 7323 	Field only	No
FC 5648, Plant install 3956-CX6+	1	3	<p>Corequisite: FC 9354 against the TS7700 cache drawer.</p> <p>If you have FC 7312 installed, you must order a total of 0, 1, or 3 instances of FC 5648 and FC 5649.</p>	Plant only	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 5649, Field install 3956-CX6†	0	5	Prerequisites: <ul style="list-style-type: none"> • FC 7312 • FC 5638 Mutually exclusive with FC 5639. The total quantity ordered of FC 5649 and FC 5639 must be 0, 1, 3, or 5. When 5 are installed, the first 3 instances are achieved using FC 5648 and the last 2 instances using FC 5649.	Field only	No
FC 5758, Integrated control path	0	1	Prerequisite: One instance of FC 7312 or FC 7322	Plant only	No
FC 5759, Integrated control path†	0	1	Prerequisite: FC 7312	Plant	No
FC 6000, Intraframe fibre cable to 3956-CC6†	4	4	1-m Cable. One cable will be shipped per feature code.	Plant only	No
FC 6003, Intraframe fibre cable to 3957-V06†	4	4	2-m cable	Plant only	No
FC 7113, 16TB SATA storage†	1	1	None.	Plant only	No
FC 7114, 32TB SATA storage	1	1	None	Plant only	No
FC 7120, 1.7 TB fibre storage, for the TS7740 cache controller†	1	1	1.7 TB is usable capacity.	Plant only	No
FC 7121, 3.43 TB fibre storage, for the TS7740 cache controller†	1	1	None. Note: This feature has been withdrawn.	Plant only	No
FC 7123, 9.6 TB Fibre storage	1	1	None	Plant only	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 7312, TS7740 Base frame	0	1	<p>Mutually exclusive with the following:</p> <ul style="list-style-type: none"> • FC 7310 • FC 7311 • FC 7315 • FC 7316 • 7317 • 7318 • 7319 • 7320 <p>Prerequisites:</p> <ul style="list-style-type: none"> • FC 1903 • FC 5629 • FC 5758 • One instance of FC 5638, FC 5639, OR FC 5640 <ul style="list-style-type: none"> – If ordering FC 5638, you must also order FC 5648 OR FC 5649 in quantities of: 0, 1, or 3 – If ordering FC 5639 or FC 5640, you must also order FC 5641 OR 5642 in quantities of: 0, 1, 3 	Plant only	No
FC 7322, TS7720 Base frame	0	1	<p>Mutually exclusive with:</p> <ul style="list-style-type: none"> • FC 7310 • FC 7311 • FC 7312 • FC 7313 • FC 7314 • FC 7315 • FC 7316 • FC 7318 • FC 7319 • FC 7320 • FC 7323 <p>Prerequisites:</p> <ul style="list-style-type: none"> • FC 1903 • FC 5758 • FC 5627 • FC 5635 OR FC 5636 • Between one and six instances of FC 5647 	Plant only	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 7323, TS7720 Storage expansion frame	0	1	<p>Mutually exclusive with:</p> <ul style="list-style-type: none"> • FC 7310 • FC 7311 • FC 7312 • FC 7313 • FC 7314 • FC 7315 • FC 7316 • FC 7318 • FC 7319 • FC 7320 • FC 7322 <p>Prerequisites:</p> <ul style="list-style-type: none"> • One additional 3952 F05 with FC 7322 must be located within 10 meters of this frame. • FC 1903 • Two instances of FC 5635 • Up to 10 total instances of FC 5646 and FC 5647 	Plant only	
FC 7403, Enable first expansion drawer, for the TS7740 cache controller	0	1	If at least one cache expansion drawer is attached to the TS7740 Cache Controller, then this feature is required.	Plant or field	No
FC 7404, Enable fourth expansion drawer, for the TS7740 cache controller	0	1	If four or more cache expansion drawers are attached to the TS7740 Cache Controller, then this feature is required.	Plant or field	No
FC 9000, Mainframe attachment†	1	1	<p>Prerequisite: up to four total instances of any of the following</p> <ul style="list-style-type: none"> • FC 3441 • FC 3442 • FC 3443 	Plant only	No
FC 9013, Attach to TS7700†	0	1	<p>Prerequisites: FC 3488 and FC 1901</p> <p>Mutually exclusive with FC 9010 and FC 9015</p>	Plant and Field	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 9110, Ship with R1.7 machine code	0	1	Prerequisites: One of the following feature sets: <ul style="list-style-type: none"> • FC 7312 • FC 5628 • FC 5640 OR <ul style="list-style-type: none"> • FC 7322 • FC 5626 • FC 5635 	Plant only	No
FC 9111, Ship with R2.0 machine code	1	1	This feature is required on the 3952 F05 Tape Frame. Prerequisites: One of the following feature sets: <ul style="list-style-type: none"> • FC 7312 • FC 5629 • FC 5640 OR <ul style="list-style-type: none"> • FC 7322 • FC 5627 • FC 5635 	Plant only	No
FC 9217, Attach to 3953 LM†	0	1	This feature is mutually exclusive with FC 9218.	Plant only	Yes
FC 9218, Attach to 3494 LM†	0	1	This feature is mutually exclusive with FC 9217. This feature is not supported by microcode levels of 8.20.0.xx or later and must be removed before upgrading to 8.20.0.xx or later.	Plant or field	Yes
FC 9219, Attach to TS3500†	0	1	None	Plant or field	No (initially)
FC 9230, Attach to 3957-V06†	1	1	Prerequisite: Four instances of FC 6003.	Plant only	No
FC 9268, Plant install 100 MB/s throughput†	1	1	In addition to this feature, you can order up to five instances of FC 5268, 100 MB/sec increment against the TS7720 Virtualization Engine.	Plant only	No
FC 9323 Expansion frame attachment	0	1	Prerequisites: <ul style="list-style-type: none"> • FC 7322 • A total of six instances of FC 5646 and FC 5647 • Either FC 3461 or FC 9461 Corequisite: FC 5240 against the 3957-VEA	Plant or field	No
FC 9350, Plant install TS7700 Server in 3952 F05†	0	1	Mutually exclusive with FC 9351. Mutually exclusive with FC 4743 on the 3952 F05 Tape Frame. Corequisite: FC 5628 against 3952 F05	Plant only	No

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 9351, Field merge TS7700 Server in 3952 F05	0	1	Mutually exclusive with FC 9350 Corequisite: FC 4743 against the 3952 F05	Plant only	
FC 9352, Plant install a TS7700 Cache Controller in a 3952 F05†	1	1	You must order one instance of FC 9352 OR FC 9353. Corequisites: <ul style="list-style-type: none"> • FC 5640 against the 3952 F05 if installing a 3956-CC8 • FC 5635 against the 3952 F05 if installing a3956-CS8 	Plant only	No
FC 9353, Field merge in 3952 F05	0	1	You must order one of EITHER FC 9352 OR FC 9353. Corequisite: FC 5637 against the 3952 F05	Plant only	No
FC 9354, Plant install a TS7700 Cache Drawer in a 3952 F05†	0	1	You must order one total instance of FC 9354 OR FC 9355 Corequisite: FC 5648 against the 3952 F05	Plant only	No
FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05	0	1	You must order one total instance of FC 9354 OR FC 9355 Corequisite: FC 5649 against the 3952 F05	Plant only	No
FC 9461, 8 GB Memory upgrade, plant†	0	1	Mutually exclusive with FC 3461 This feature is required on all new 3957-V06/VEA TS7700 Servers released with code level 8.7.0.xx or higher.	Plant only	No
FC 9700, No factory cables†	0	1	You must order EITHER one instance of FC 9700 OR two instances of one of the following: <ul style="list-style-type: none"> • FC 0201 • FC 0202 • FC 0203 • FC 0204 • FC 0205 • FC 0206 	Plant only	Yes
FC 9900, Encryption configuration	0	1	This feature is available as a concurrent MES if the TS1120 drives were running in native mode prior to the TS7700's current online process.	Plant or Field	No
FC 9954, NEMA L6-30 power cord	0	1	One of FC 9954, 9955, 9956, 9957, 9958, 9959, or 9966	Plant or field	Not applicable
FC 9955, RS 9750 DP power cord	0	1	One of FC 9954, 9955, 9956, 9957, 9958, 9959, or 9966	Plant or field	Not applicable

Table 45. TS7700 Virtualization Engine features (continued)

Feature	Minimum	Maximum	Requirements	Installation	Removable?
FC 9956, IEC 309 power cord	0	1	One of FC 9954, 9955, 9956, 9957, 9958, 9959, or 9966	Plant or field	Not applicable
FC 9957, PDL 4.3 power cord	0	1	One of FC 9954, 9955, 9956, 9957, 9958, 9959, or 9966	Plant or field	Not applicable
FC 9958, Korean 4.3-m power cord	0	1	One of FC 9954, 9955, 9956, 9957, 9958, 9959, or 9966	Plant or field	Not applicable
FC 9959, Unterminated power cord	0	1	One of FC 9954, 9955, 9956, 9957, 9958, 9959, or 9966	Plant or field	Not applicable
FC 9966, Unterminated power cord (China)	0	1	One of FC 9954, 9955, 9956, 9957, 9958, 9959, or 9966	Plant or field	Not applicable

† Withdrawn for at least one component. Refer to the *Quick reference by component* topic in the **Related information** section to verify availability.

Related information

“System requirements” on page 46

“Quick reference by component” on page 102

Feature conversions

This section lists supported TS7700 Virtualization Engine feature conversions.

Table 46 displays supported TS7700 Virtualization Engine feature code conversions.

Table 46. Supported TS7700 Virtualization Engine feature code conversions

Feature code	May be converted to
FC 9217, Attach to 3953 LM	FC 9219, Attach to TS3500
FC 9218, Attach to 3494 LM	

Checklists

This section links to checklists that help you plan for the arrival of your new TS7700 Virtualization Engine and ensure completion of post-installation tasks.

Planning for new system arrival (customer tasks)

Use this section to locate and collect information required to install a TS7700 Virtualization Engine.

As you plan for the installation of your new system, consult the following tables and consider the values that you would provide to match the information listed in the **Field** column. This information will be used to install your TS7700 Virtualization Engine and as reference during any future service actions. If you are working from an electronic copy of the Information Center, consider printing this topic to use it as a working document.

Note: Additional Tape Control Units (3592-J70/C06), and/or Virtual Tape Subsystems (3494-B10/B20/B16/B18) may be attached to the same TS3500

Tape Library (3584 Tape Library) and/or 3494 Tape Library. The installation and/or configuration of these devices is not within the scope of this document. In most cases these devices should be installed using documentation provided with the devices.

Table 47. Applicable checklist fields by number of installed clusters

If you are installing this number of TS7700 Virtualization Engine Clusters then complete all fields for
1 (stand-alone, non-grid)	CLUSTER 0
2 (two-cluster grid)	CLUSTER 0 and CLUSTER 1
3 (three-cluster grid)	CLUSTER 0 through CLUSTER 2
4 (four-cluster grid)	CLUSTER 0 through CLUSTER 3
5 (five-cluster grid)	CLUSTER 0 through CLUSTER 4
6 (six-cluster grid)	CLUSTER 0 through CLUSTER 5

The term **CLUSTER *n*** refers to a single TS7700 Virtualization Engine participating in a grid (multi-cluster) configuration. In this section, the term TS7700 Cluster, or cluster, is synonymous with TS7700 Server.

If you are installing a TS7700 Virtualization Engine that **does not** attach to a physical tape library, complete only the following tables:

- Table 48
- Table 53 on page 155
- Table 54 on page 158
- Table 55 on page 161
- Table 56 on page 163

If you are installing a TS7700 Virtualization Engine attached to a physical tape library, complete all of the tables in this section.

Cluster Descriptions

Provide the serial number and location of the machines that make up each TS7700 Cluster. The information in Table 48 will help the installer know which TS7700 Server is designated as which cluster.

Note: Fill in the **Description of Location** column with geographical information that is unique to each cluster. Fill in as much information as possible, some suggestions for descriptions are the x, y coordinates within a data center, room number, floor number, building number, city, etc.

Table 48. Cluster descriptions

Cluster	Component Serial Numbers	Description of Location
Cluster 0	3957-V06/3957-V07:	
	or 3957-VEA/3957-VEB:	
	3952 F05:	
	3584 Lxx: (if installing a 3957-V06 or 3957-V07)	

Table 48. Cluster descriptions (continued)

Cluster	Component Serial Numbers	Description of Location
Cluster 1	3957-V06/3957-V07: or 3957-VEA/3957-VEB:	
	3952 F05:	
	3584 Lxx: (if installing a 3957-V06 or 3957-V07)	
Cluster 2	3957-V06/3957-V07: or 3957-VEA/3957-VEB:	
	3952 F05:	
	3584 Lxx: (if installing a 3957-V06 or 3957-V07)	
Cluster 3	3957-V06/3957-V07: or 3957-VEA/3957-VEB:	
	3952 F05:	
	3584 Lxx: (if installing a 3957-V06 or 3957-V07)	
Cluster 4	3957-V06/3957-V07: or 3957-VEA/3957-VEB:	
	3952 F05:	
	3584 Lxx: (if installing a 3957-V06 or 3957-V07)	
Cluster 5	3957-V06/3957-V07: or 3957-VEA/3957-VEB:	
	3952 F05:	
	3584 Lxx: (if installing a 3957-V06 or 3957-V07)	

Tape Library Attachment Configuration.

Provide values for each of the 3584 Tape Library configuration fields defined in Table 49 on page 148 and Table 50 on page 151. Required information includes:

- Network Ethernet configuration method
- Network Ethernet IP address for 3584 Tape Library Web Specialist access
- 3584 Tape Library Ethernet hostname
- Network Ethernet gateway
- Network Ethernet submask
- Maximum number of physical cartridges
- Logical library name for 3584 Tape Library
- Physical position and World Wide Node Name (WWNN) of each drive in the 3584 Tape Library, according to cluster

Table 49. 3584 Tape Library configuration information

Field	Value	Notes®
3584 Tape Library Ethernet Network Configuration Method (customer network).	Cluster 0: DHCP [] Fixed IP []	The network configuration method is specified by the customer's LAN administrator. It is either Fixed IP or Dynamic Host Configuration Protocol (DHCP). Note: Fixed IP is recommended
	Cluster 1: DHCP [] Fixed IP []	
	Cluster 2: DHCP [] Fixed IP []	
	Cluster 3: DHCP [] Fixed IP []	
	Cluster 4: DHCP [] Fixed IP []	
	Cluster 5: DHCP [] Fixed IP []	
3584 Tape Library Ethernet IP Address (customer network) (used for 3584 Tape Library Web Specialist access)	----- CLUSTER 0	If Network Configuration Method is DHCP then this field is not used. Note: The Ethernet ports are 10/100 Mb only
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	
3584 Tape Library Ethernet Hostname	CLUSTER 0	The entry in this field is used to identify the machine in remote support logs. Note: Even if hostnames are not typically used by the customer, this hostname is still required. A typical hostname is ATL1.
	CLUSTER 1	
	CLUSTER 2	
	CLUSTER 3	
	CLUSTER 4	
	CLUSTER 5	

Table 49. 3584 Tape Library configuration information (continued)

Field	Value	Notes®
3584 Tape Library Ethernet Gateway (customer network).	----- CLUSTER 0	If Network Configuration Method is DHCP then this field is not used.
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	
3584 Tape Library Ethernet Subnet Mask (customer network)	----- CLUSTER 0	If Network Configuration Method is DHCP then this field is not used.
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	
Max Cartridges	CLUSTER 0	<p>This value defaults to the number of physical cartridge slots currently installed in the 3584 Tape Library library.</p> <p>Valid values range from 1 to 6260. You may want to set a different value in the following cases:</p> <ul style="list-style-type: none"> You want to restrict the number of cartridges in the logical library to manage the cost of application licensing. The 3584 Tape Library will be expanded at a later date and you want to avoid re-configuring the host at that time.
	CLUSTER 1	
	CLUSTER 2	
	CLUSTER 3	
	CLUSTER 4	
	CLUSTER 5	

Table 49. 3584 Tape Library configuration information (continued)

Field	Value	Notes®
3584 Tape Library Logical Library Name (for TS7740 Cluster attachment)	CLUSTER 0	<p>Each TS7740 Cluster must be connected to a single 3584 Tape Library logical library. This logical library must have a name, which should have been assigned when the logical library was created. Record the logical library name (assign it if necessary). The logical library name is needed when performing the following tasks:</p> <ul style="list-style-type: none"> • Configuring the logical library • Obtaining the Starting Element Address for the logical library • Obtaining the physical position of tape drives within the logical library • Obtaining the WWNNs of those tape drives • Setting the Cartridge Assignment Policy • Configuring ALMS
	CLUSTER 1	
	CLUSTER 2	
	CLUSTER 3	
	CLUSTER 4	
	CLUSTER 5	

Table 50. 3584 Tape Library drive information

Field	Values	
<p>Tape Drive Physical Positions (Fn,Rnn) in the 3584 Tape Library for the drives assigned to each 3957-V06 Record the physical position and the last two digits of the World Wide Node Name (WWNN) for each tape drive.Circle the drives that will be control paths. Refer to the control path rules listed in <i>Assign Control Paths to the New Logical Library</i> found in <i>TS7700 Virtualization Engine Install with a 3584 Library</i>.Refer to the notelist for guidance in completing this table.</p>	<p>Cluster 0 F=Frame R=Row WWNN =World Wide Node Name</p> <ol style="list-style-type: none"> 1. F __,R __ WWNN __ 2. F __,R __ WWNN __ 3. F __,R __ WWNN __ 4. F __,R __ WWNN __ 5. F __,R __ WWNN __ 6. F __,R __ WWNN __ 7. F __,R __ WWNN __ 8. F __,R __ WWNN __ 9. F __,R __ WWNN __ 10. F __,R __ WWNN __ 11. F __,R __ WWNN __ 12. F __,R __ WWNN __ 13. F __,R __ WWNN __ 14. F __,R __ WWNN __ 15. F __,R __ WWNN __ 16. F __,R __ WWNN __ 	<p>Cluster 1 F=Frame R=Row WWNN =World Wide Node Name</p> <ol style="list-style-type: none"> 1. F __,R __ WWNN __ 2. F __,R __ WWNN __ 3. F __,R __ WWNN __ 4. F __,R __ WWNN __ 5. F __,R __ WWNN __ 6. F __,R __ WWNN __ 7. F __,R __ WWNN __ 8. F __,R __ WWNN __ 9. F __,R __ WWNN __ 10. F __,R __ WWNN __ 11. F __,R __ WWNN __ 12. F __,R __ WWNN __ 13. F __,R __ WWNN __ 14. F __,R __ WWNN __ 15. F __,R __ WWNN __ 16. F __,R __ WWNN __
	<p>Cluster 2 F=Frame R=Row WWNN =World Wide Node Name</p> <ol style="list-style-type: none"> 1. F __,R __ WWNN __ 2. F __,R __ WWNN __ 3. F __,R __ WWNN __ 4. F __,R __ WWNN __ 5. F __,R __ WWNN __ 6. F __,R __ WWNN __ 7. F __,R __ WWNN __ 8. F __,R __ WWNN __ 9. F __,R __ WWNN __ 10. F __,R __ WWNN __ 11. F __,R __ WWNN __ 12. F __,R __ WWNN __ 13. F __,R __ WWNN __ 14. F __,R __ WWNN __ 15. F __,R __ WWNN __ 16. F __,R __ WWNN __ 	<p>Cluster 3 F=Frame R=Row WWNN =World Wide Node Name</p> <ol style="list-style-type: none"> 1. F __,R __ WWNN __ 2. F __,R __ WWNN __ 3. F __,R __ WWNN __ 4. F __,R __ WWNN __ 5. F __,R __ WWNN __ 6. F __,R __ WWNN __ 7. F __,R __ WWNN __ 8. F __,R __ WWNN __ 9. F __,R __ WWNN __ 10. F __,R __ WWNN __ 11. F __,R __ WWNN __ 12. F __,R __ WWNN __ 13. F __,R __ WWNN __ 14. F __,R __ WWNN __ 15. F __,R __ WWNN __ 16. F __,R __ WWNN __

Table 50. 3584 Tape Library drive information (continued)

Field	Values	
<p>Tape Drive Physical Positions (Fn,Rnn) in the 3584 Tape Library for the drives assigned to each 3957-V06 Record the physical position and the last two digits of the World Wide Node Name (WWNN) for each tape drive. Circle the drives that will be control paths. Refer to the control path rules listed in <i>Assign Control Paths to the New Logical Library</i> found in <i>TS7700 Virtualization Engine Install with a 3584 Library</i>. Refer to the notelist for guidance in completing this table.</p>	<p>Cluster 4 F=Frame R=Row WWNN =World Wide Node Name</p>	<p>Cluster 5 F=Frame R=Row WWNN =World Wide Node Name</p>
	1. F __,R __ WWNN __	1. F __,R __ WWNN __
	2. F __,R __ WWNN __	2. F __,R __ WWNN __
	3. F __,R __ WWNN __	3. F __,R __ WWNN __
	4. F __,R __ WWNN __	4. F __,R __ WWNN __
	5. F __,R __ WWNN __	5. F __,R __ WWNN __
	6. F __,R __ WWNN __	6. F __,R __ WWNN __
	7. F __,R __ WWNN __	7. F __,R __ WWNN __
	8. F __,R __ WWNN __	8. F __,R __ WWNN __
	9. F __,R __ WWNN __	9. F __,R __ WWNN __
	10. F __,R __ WWNN __	10. F __,R __ WWNN __
	11. F __,R __ WWNN __	11. F __,R __ WWNN __
	12. F __,R __ WWNN __	12. F __,R __ WWNN __
	13. F __,R __ WWNN __	13. F __,R __ WWNN __
	14. F __,R __ WWNN __	14. F __,R __ WWNN __
	15. F __,R __ WWNN __	15. F __,R __ WWNN __
	16. F __,R __ WWNN __	16. F __,R __ WWNN __
<p>Notelist:</p> <ol style="list-style-type: none"> 1. It is recommended that the drives for a single TS7740 Virtualization Engine be listed in order using the frame and row. As an example, if VTS-1 has 8 drives that are located in F4,R01- F4,R08 then drive 1 should be F4,R01, drive 2 should be F4,R02, etc. If VTS-2 has 4 drives located in F2,R11, F2,R12, F3R1, and F3R2; then drive 1 should be F2,R11, drive 2 should be F2, R12, drive 3 should be F3,R01, and drive 4 should be F3,R02. This is not a requirement, but it may help avoid confusion when identifying drives during future troubleshooting. 2. A TS7740 Cluster must have a minimum of four and a maximum of 16 tape drives that can be connected. Distributing the tape drives across two 3584 Tape Library frames is recommended to improve availability. Placing eight drives (two control path drives) in one frame and eight drives (two control path drives) in a second frame is recommended. 3. To obtain the WWNN select Menu > Vital Product Data > World Wide Node Names. 		

Media VOLSER Range Information

Complete Table 52 on page 154 with the requested information. There may be one or many Media Volume VOLSER Ranges; fill in as many rows as apply to your system. Refer to the following list for a description of the values needed for Table 52 on page 154

From, To

This is a range containing the bar code label VOLSERs of all the cartridges assigned to a single TS7700 Virtualization Engine. As an example, if cartridges assigned to a TS7700 Virtualization Engine have bar code labels in the range from A00000 - A00500, then record the following:

- From: __A00000__
- To: __A00500

Media Type

The type is indicated by the last two characters of the 8-character

bar code label VOLSER on the cartridges. As an example, if the cartridges are labeled 123456JA then the media type is JA. Label rules are defined as follows:

- JA and JJ tape cartridges are supported and can be mixed in a TS7700 Virtualization Engine.
- JB tape cartridges are also supported (and can be mixed with JA and JJ tape cartridges) if all of the tape drives associated with the TS7700 Virtualization Engine are 3952 E05/E06/EU6 Tape Drives and no E05 Tape Drives are in J1A emulation mode.
- No other tape types are currently supported for use with the TS7700 Virtualization Engine.
- If there is at least one 3592 model J1A tape drive associated with the TS7700 Virtualization Engine then ALL model 3592 E05/EU5 Tape Drives associated with the TS7740 must be in J1A emulation mode.
- If at least one tape cartridge associated with a TS7700 Virtualization Engine has been written by a 3592 E05/EU5 Tape Drives that is **NOT** in 3592 J1A emulation mode, then the TS7700 Virtualization Engine will no longer support any 3592 J1A Tape Drives or any 3592 E05/EU5 Tape Drive that is in J1A emulation mode. Once the 3592 "E05 Native" mode has been used, you may not return to J1A mode. This is because the 3592 J1A Tape Drives cannot read or write a tape cartridge written in E05 mode and the TS7700 Virtualization Engine does not currently support mixed 3592 J1A and E05 Tape Drives (unless all E05 Tape Drives are in J1A emulation mode. To use E05 Tape Drives in native mode, the drives must be set to E05 native mode.
- Tape cartridge capacities are as follows:

Table 51. Tape cartridge capacities

Media type	Format	Capacity
JJ	J1A format, including E05 drives in J1A emulation mode	60 GB (58.88 GiB)
	E05 format	100 GB (93.13 GiB)
JA	J1A format, including E05 drives in J1A emulation mode	300 GB (279.39 GiB)
	E05 format	500 GB (465.6 GiB)
JB	JB format	700 GB (651.93 GiB)

Using the rules defined in the previous step, determine whether you want any drives attached to the TS7700 Virtualization Engine to be in J1A emulation mode or in E05/EU5/E06/EU6 "native" mode. Record this in the **Tape Drive Format** entry in Table 53 on page 155.

(Distributed) Library Sequence Number

The Library Sequence Number is assigned by your administrator. This is a 5-character name that is used as an identifier for a specific cluster in a grid configuration.

It is required even if the TS7700 Virtualization Engine is not in a Grid configuration.

Note: Each VTS partition must have a single, unique value for the Distributed Library Sequence Number. For the TS7700 Virtualization Engine, a typical value is the last five digits of the 3952 F05 frame serial number.

Home Pool

Also called Scratch Pool. A pool is a group of physical tape cartridges. A scratch pool is a group of cartridges that are considered to be scratch, meaning that they are ready for use by any write job.

You may have assigned a Home Pool value. If one has not been set, the default value is 00.

Table 52. Media VOLSER range

Cluster (0 to 5)	From	To	Media Type	(Distributed) Library Sequence Number	Home Pool	Fast Ready Category

TS7700 Virtualization Engine configuration

Provide values for each of the defined TS7700 Virtualization Engine configuration fields defined in Table 53 on page 155. Required information includes:

- Library sequence numbers (composite and distributed)
- Disk cache type
- IP addresses (virtual, primary, alternate, NTP)
- Subnet mask
- Gateway
- Tape drive format
- Network speed settings

Table 53. TS7700 Virtualization Engine configuration information

Field	Value	Notes						
Composite Library Sequence Number		This 5-character hexadecimal name must be the same on all clusters (peers) within the same grid. This identifier is specified in the TS7700 Virtualization Engine configuration. It is required even if the machine is not in a grid configuration. Note: This is the Composite Library ID. It must be different than the Distributed Library Sequence number.						
Distributed Library Sequence Number		This 5-character hexadecimal number is assigned by the customer's administrator, and used as an identifier for a specific cluster. Each TS7700 Virtualization Engine must have a single, unique value for the Distributed Library Sequence Number. A typical value is the last five digits of the 3952 Tape Frame serial number. Note: This number must be different than the Composite Library Sequence number.						
Disk Cache Type		The TS7720 Cache uses a 3956-CS7/CS8/XS7 cache, which is a DS4000® cache type. The TS7740 Cache uses a 3956-CC6/CX6 or 3956-CC7/CC8/CX7 cache, which is a DS6000™ or a DS4000 cache type.						
Customer IP 1 (Virtual)	<table border="1"> <tr><td>----- CLUSTER 0</td></tr> <tr><td>----- CLUSTER 1</td></tr> <tr><td>----- CLUSTER 2</td></tr> <tr><td>----- CLUSTER 3</td></tr> <tr><td>----- CLUSTER 4</td></tr> <tr><td>----- CLUSTER 5</td></tr> </table>	----- CLUSTER 0	----- CLUSTER 1	----- CLUSTER 2	----- CLUSTER 3	----- CLUSTER 4	----- CLUSTER 5	Used for TS7700 Virtualization Engine web Management Interface Note: This number is a virtual IP that is not associated with a physical cable. It will communicate through the Primary IP, and will automatically fail over to the Alternate IP when required.
----- CLUSTER 0								
----- CLUSTER 1								
----- CLUSTER 2								
----- CLUSTER 3								
----- CLUSTER 4								
----- CLUSTER 5								
Customer IP 2 (Primary)	<table border="1"> <tr><td>----- CLUSTER 0</td></tr> <tr><td>----- CLUSTER 1</td></tr> <tr><td>----- CLUSTER 2</td></tr> <tr><td>----- CLUSTER 3</td></tr> <tr><td>----- CLUSTER 4</td></tr> <tr><td>----- CLUSTER 5</td></tr> </table>	----- CLUSTER 0	----- CLUSTER 1	----- CLUSTER 2	----- CLUSTER 3	----- CLUSTER 4	----- CLUSTER 5	This is the IP address used to connect to the TS7700 Virtualization Engine through the internal primary network. This IP address should not be used by the customer unless the Virtual IP is inaccessible. Note: The Ethernet ports are 10/100 Mb only.
----- CLUSTER 0								
----- CLUSTER 1								
----- CLUSTER 2								
----- CLUSTER 3								
----- CLUSTER 4								
----- CLUSTER 5								

Table 53. TS7700 Virtualization Engine configuration information (continued)

Field	Value	Notes
Customer IP 3 (Alternate)	----- CLUSTER 0	This is the IP address used to connect to the TS7700 Virtualization Engine through the internal alternate network. This IP address should not be used by the customer unless the Virtual IP is inaccessible. Note: The Ethernet ports are 10/100 Mb only
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	
Customer Subnet Mask	----- CLUSTER 0	This is used with the virtual, primary, and alternate customer IP addresses.
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	
Customer Gateway	----- CLUSTER 0	This is used with the virtual, primary, and alternate customer IP addresses.
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	
NTP server IP Address (if used) Note: Using an NTP server is strongly recommended to ensure that all components have consistent time settings.	-----	This address is assigned by the customer's network administrator. Note: The TCP/IP address is either the NTP server at the work site (if it is maintained locally), or an Internet server. Use of an Internet server assumes that the customer allows access to the Internet on the NTP services port (TCP/IP port 123).

Table 53. TS7700 Virtualization Engine configuration information (continued)

Field	Value	Notes
Tape Drive Format	Cluster 0: <input type="checkbox"/> J1A emulation mode <input type="checkbox"/> E05 native mode <input type="checkbox"/> E06 native mode <input type="checkbox"/> EU6 native mode	To determine whether to use J1A emulation mode or E05/E06/EU6 native mode, refer to the rules listed under Media Type .
	Cluster 1: <input type="checkbox"/> J1A emulation mode <input type="checkbox"/> E05 native mode <input type="checkbox"/> E06 native mode <input type="checkbox"/> EU6 native mode	
	Cluster 2: <input type="checkbox"/> J1A emulation mode <input type="checkbox"/> E05 native mode <input type="checkbox"/> E06 native mode <input type="checkbox"/> EU6 native mode	
	Cluster 3: <input type="checkbox"/> J1A emulation mode <input type="checkbox"/> E05 native mode <input type="checkbox"/> E06 native mode <input type="checkbox"/> EU6 native mode	
	Cluster 4: <input type="checkbox"/> J1A emulation mode <input type="checkbox"/> E05 native mode <input type="checkbox"/> E06 native mode <input type="checkbox"/> EU6 native mode	
	Cluster 5: <input type="checkbox"/> J1A emulation mode <input type="checkbox"/> E05 native mode <input type="checkbox"/> E06 native mode <input type="checkbox"/> EU6 native mode	
Customer Network Speed/Duplex Setting		This is the network setting the customer wants to use for their customer interface. The default value is Auto-Negotiate. The customer can specify one of the following values: <ul style="list-style-type: none"> • Auto-Negotiate • 100 Full Duplex • 100 Half Duplex • 10 Full Duplex • 10 Half Duplex

TS3000 System Console remote support information

Provide values for each of the TS3000 System Console remote support fields defined in Table 54 on page 158. Required information includes:

- Dial-out prefixes
- Call-home modem number
- Call-home Ethernet IP, subnet, and gateway
- Customer name
- Customer contact information

Table 54. TS3000 System Console remote support information

Field	Value	Notes
Dial-out Prefix (if required)	CLUSTER 0	If you need to dial a prefix to get an outside line, specify it here. As an example, if you need to dial 9 to get an outside line, record a 9 in this field.
	CLUSTER 1	
	CLUSTER 2	
	CLUSTER 3	
	CLUSTER 4	
	CLUSTER 5	
Call-home Modem Number	CLUSTER 0	This is the telephone number assigned to the analog phone line where the call-home modem will be connected.
	CLUSTER 1	
	CLUSTER 2	
	CLUSTER 3	
	CLUSTER 4	
	CLUSTER 5	
Customer Company Name	CLUSTER 0	This value will be sent out with the call home records.
	CLUSTER 1	
	CLUSTER 2	
	CLUSTER 3	
	CLUSTER 4	
	CLUSTER 5	
Customer Contact Phone Number	CLUSTER 0	This is the phone number that IBM contacts when call-home indicates a failure.
	CLUSTER 1	
	CLUSTER 2	
	CLUSTER 3	
	CLUSTER 4	
	CLUSTER 5	
Off-Shift Customer Contact Phone Number	CLUSTER 0	This is the alternate phone number that IBM contacts when call-home indicates a failure.
	CLUSTER 1	
	CLUSTER 2	
	CLUSTER 3	
	CLUSTER 4	
	CLUSTER 5	

Table 54. TS3000 System Console remote support information (continued)

Field	Value	Notes
IP Address (for optional Ethernet Call Home)	----- CLUSTER 0	<p>This is an optional (but strongly recommended) IP address on the customer network that will allow the TS3000 System Console to Call Home using a high speed connection through the customer network to the Internet. Ports 443 (https) and 80 (http) on this IP address must be free for outbound traffic through the customer network to the Internet.</p> <p>Note: The modem is still needed for Call In (remote support). Call Home through an Ethernet connection greatly improves the speed of the data transfer, making the data available to support personnel more quickly. At this time the Call Home through an Ethernet connection is only used for Call Home (outbound). IBM recommends enabling Call Home to improve data collection when a problem occurs. Call Home through an Ethernet connection provides better throughput and lower cost than Call Home through a modem connection.</p> <p>The following list provides the IP addresses that ECC Broadband Call Home needs to get through the firewall:</p> <ul style="list-style-type: none"> • www6.software.ibm.com (207.25.253.41) • eccgw01.boulder.ibm.com (129.42.26.224) • eccgw02.rochester.ibm.com (129.42.34.224) • www.ibm.com (129.42.42.224) • www-03.ibm.com (192.109.81.20)
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	
Subnet Mask (for optional Ethernet Call Home)	----- CLUSTER 0	<p>This is the subnet mask associated with the IP Address (for optional Ethernet Call Home)</p>
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	

Table 54. TS3000 System Console remote support information (continued)

Field	Value	Notes
Gateway (for optional Ethernet Call Home)	----- CLUSTER 0	This is the gateway associated with the IP Address (for optional Ethernet Call Home)
	----- CLUSTER 1	
	----- CLUSTER 2	
	----- CLUSTER 3	
	----- CLUSTER 4	
	----- CLUSTER 5	

TS7700 Grid local addresses

The following notes apply to Table 55 on page 161.

1. If the TS7700 Virtualization Engine being installed is a stand-alone machine (not part of a grid configuration), then you should not complete Table 55 on page 161.
2. The TS7700 Grid interfaces are the 1 Gb internet connections between TS7740 Clusters that allow the clusters to automatically remain synchronized.
3. IBM strongly recommends that the primary and alternate Grid interfaces be on separate subnets. As an example, 10.10.1.n for the primary interface and 10.11.1.n for the alternate interface. Notice that the second set of octets must be different. If the Grid interfaces are directly connected (without using Ethernet switches) then using separate subnets is required.
4. The Grid interfaces require connections using the following TCP/IP ports:
 - 7 (Ping)
 - 9 (Discard service, for bandwidth measuring tools)
 - 123 (Network Time Protocol)
 - 350 (Distributed Library to Distributed Library file transfer)
 - 1415 (Websphere message queues Grid to Grid)
 - 1416 (Websphere message queue HDM to HDM)
5. The following TCP/IP ports are useful in service scenarios if allowed:
 - 20 (FTP)
 - 21 (FTP)
 - 23 (Telnet)

Table 55. TS7700 Grid local addresses

Field	Value	Notes
Primary Grid Interface IP Address	CLUSTER 0: -----	The Primary Grid Interface is the 1 Gb Ethernet Adapter located in slot C4 of the 3957-V06 or 3957-VEA. The Primary Grid Interface at each cluster connects to the Primary Grid Interface at each of the other clusters in the same TS7700 Grid.
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	
Primary Grid Interface Network Mask	CLUSTER 0: -----	
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	
Primary Grid Interface Gateway	CLUSTER 0: -----	If a Gateway is not used, leave this field blank. If using crossover cables you must not specify a Gateway.
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	
Alternate Grid Interface IP Address	CLUSTER 0: -----	The Alternate Grid Interface is the 1 Gb Ethernet Adapter located in slot C5 of the 3957-V06 or 3957-VEA. Alternate Grid Interface at each cluster will connect to the Alternate Grid interface at each of the other clusters in the same TS7700 Grid.
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	

Table 55. TS7700 Grid local addresses (continued)

Field	Value	Notes
Alternate Grid Interface Network Mask	CLUSTER 0: -----	
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	
Alternate Grid Interface Gateway	CLUSTER 0: -----	If a Gateway is not used, leave this field blank. If using crossover cables you must not specify a Gateway.
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	

TSSC grid configuration information

The following notes apply to Table 56 on page 163.

- If the TS7700 Virtualization Engine you are installing is a stand-alone machine (not part of a grid configuration) then leave Table 56 on page 163 blank.
- If you will be using the TS7700 Grid in a Cascade Deferred style then you do not need the Autonomic Ownership Takeover Manager (AOTM) and should leave Table 56 on page 163 blank. Cascade Deferred means one or more clusters do not have host FICON connections enabled in normal operation. There is no need to use AOTM on a cluster that does not have host FICON connections enabled in normal operation.
- Refer to “Ownership takeover” on page 194 and “The Autonomic Ownership Takeover Manager” on page 195 for more information on AOTM before you continue. Do **NOT** attempt to configure ATOM. Use these sections to make an informed decision whether to use AOTM.
- If you do not want to use AOTM then leave Table 56 on page 163 blank.
- The TSSC grid interface is only used for AOTM.
- Each cluster can be configured to use AOTM to provide ownership takeover for one cluster.
- The AOTM requires the following TCP/IP ports:
 - 7 (Ping)
 - 80 (HTTP)

Table 56. TSSC grid configuration information

Field	Value	Notes
TSSC Grid Interface IP Address	CLUSTER 0: -----	The TSSC Grid Interface is used to allow the TSSC at one cluster to communicate with the TSSC at another cluster. This is required if AOTM will be used.
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	
TSSC Grid Interface Subnet Mask	CLUSTER 0: -----	
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	
TSSC Grid Interface Gateway	CLUSTER 0: -----	
	CLUSTER 1: -----	
	CLUSTER 2: -----	
	CLUSTER 3: -----	
Takeover Mode	CLUSTER 0: 	The Takeover Mode must be either Read Only Takeover (ROT) or Write Only Takeover (WOT). ROT is recommended, because it will automatically give you read access to any consistent copies of data without any requirement for manual intervention during reconciliation after the failed cluster is repaired. WOT is appropriate if your application must be able to update existing logical volumes, but it can cause different copies of a logical volume to be inconsistent, requiring manual intervention during reconciliation after the failed cluster is repaired.
	CLUSTER 1: 	
	CLUSTER 2: 	
	CLUSTER 3: -----	

Table 56. TSSC grid configuration information (continued)

Field	Value	Notes
Grace Period (Minutes)	CLUSTER 0:	When a cluster detects that another cluster in the same TS7700 Grid has failed, it will wait for the number of minutes specified as the Grace Period before it attempts to take over the volumes of the failed cluster. A typical Grace Period is 25 minutes. In most cases this will be the same for both clusters.
	CLUSTER 1:	
	CLUSTER 2:	
	CLUSTER 3: -----	
Retry Period (Minutes)	CLUSTER 0:	The retry period is the number of minutes between attempts to take over ownership of the volumes associated with a failed cluster. A typical retry period is 5 minutes. In most cases this will be the same for both clusters.
	CLUSTER 1:	
	CLUSTER 2:	
	CLUSTER 3: -----	

Related information

“Post-installation tasks”

Post-installation tasks

If you are a customer, use the checklist in this section to prepare your TS7700 Virtualization Engine for use after installation.

- __ 1. Define data ranges, categories, and policies.

If your IBM System Service Representative (SSR) has installed your TS7700 Virtualization Engine, perform the following definitions at the TS7700 Virtualization Engine Management Interface:

Note: Links to all related topics are collected in the **Related information** section.

- __ a. Define stacked volume ranges.

Refer to the topic *Define VOLSER ranges for physical volumes*, and the management interface help topic *Physical volume ranges*, for more information.

- __ b. Define Fast Ready categories.

Refer to the topic *Define Fast Ready categories*, and the management interface help topic *Fast Ready categories*, for more information.

Note: The Fast Ready category number you define is the same value as defined for MEDIA1 or MEDIA2, as specified in the DEVSUPxx PARMLIB number.

- __ c. Define the expired logical volume data policy.

Refer to the topic *Define logical volume expiration time* and the management interface help topic *Add Fast Ready category*, for more information.

- ___ d. Define the following TS7700 Virtualization Engine management policies:

- Inhibit reclaim schedule

Note: Prior to microcode level 8.5.0.xx, inhibit reclaim schedules were designated using local time instead of Coordinated Universal Time (UTC). If you have upgraded from a microcode level of 8.4.0.xx, verify that your inhibit reclaim schedule displays the correct day and time before starting an inhibit reclaim operation using the new code version.

- Reclaim threshold percentage
- Free storage threshold

Refer to the topic *Physical volumes* and the management interface help topics *Inhibit reclaim schedules* and *Active data distribution*, for more information.

- ___ 2. If stacked volume media are available, insert the physical volumes using one of the following methods:
 - Open the library doors and directly insert the volumes into tape library storage cells
 - Use the TS3500 Tape Library I/O station
- ___ 3. Create TCDB. Refer to *z/OS DFSMS Object Access Method Planning, Installation, and Storage Administration Guide, SC35-0427* for instructions to create TCDB as part of the tape library support installation. This publication can be accessed from the web link in the **Related information** section.
- ___ 4. Insert logical volumes
- ___ 5. The TS7700 Virtualization Engine is now ready for use.

Tip: For help in navigating the ISMF screens, as well as detailed information pertaining to the defining of the DFSMS constructs, refer to the following publications, available from the web link in the **Related information** section:

- *IBM TotalStorage 3494 Tape Library: A Practical Guide to Tape Drives and Tape Automation, SG24-46322*
- *z/OS DFSMSdfp Storage Administrator Reference, SC35-0422*

Related information

“z/OS I/O definitions” on page 59

 <http://www.ibm.com/support/us/en/>

Define VOLSER ranges for physical volumes

This topic provides instructions to define VOLSER ranges for physical volumes.

Once a cartridge is assigned to a partition, the TS7700 Virtualization Engine uses the VOLSER ranges defined in its VOLSER Range table to direct the cartridge to the proper partition and assigns to it the proper category. Best practices recommend defining the proper policies in the VOLSER Range table before inserting the cartridges into the tape library.

Important:

- When using a TS3500 Tape Library, you must assign Cartridge Assignment Policies (CAP) at the library hardware level before using the library with System z hosts.
- When using a TS3500 Tape Library, the native physical volume ranges must fall within the ranges assigned with CAP to System z host logical libraries.
- The policies for the System z host cartridge ranges must match any host tape management policies.

Use the following panels of the TS7700 Virtualization Engine management interface to manage physical volume ranges or unassigned physical volumes in a library attached to a TS7700 Virtualization Engine.

- *Physical volume ranges*

Use this panel to view a range or ranges of physical volumes recently added to an attached physical library. The **Physical Volume Ranges** table displays the list of defined VOLSER ranges for a given cluster

- *Add physical volume range*

Use this panel to add a range of unassigned physical volumes to a library attached to a TS7700 Virtualization Engine.

Note: The VOLSER ranges you define on the TS3500 Tape Library apply to physical cartridges only. You should not define VOLSER ranges for logical volumes for a TS7700 Virtualization Engine. You must define logical volumes through the TS7700 Virtualization Engine management interface.

- *Modify physical volume range*

Use this panel to modify a range of unassigned physical volumes in a library attached to a TS7700 Virtualization Engine.

- *Confirm delete physical volume range*

Use this page to delete a range of unassigned physical volumes in a library attached to a TS7700 Virtualization Engine.

- *Eject unassigned physical volume*

Use this page to eject unassigned physical volumes from a library attached to a TS7700 Virtualization Engine.

For the TS7700 Virtualization Engine, no additional definitions are required at the hardware level other than setting up the proper VOLSER ranges at the TS3500 Tape Library library.

Notelist:

- If a physical volume's VOLSER occurs within a defined range, that volume, upon being inserted, can be inventoried according to its VOLSER definition. If the physical volume's VOLSER occurs outside a defined range, user intervention is required to assign the inserted physical volume to TS7700 Virtualization Engine resources.
- Although you could now enter cartridges into the TS3500 Tape Library, best practices recommend that you complete the required definitions at the host, as defined in the topic *Post-installation tasks* before you insert any physical cartridges.

Related information

“Post-installation tasks” on page 164

Define Fast Ready categories

This topic provides instructions to define Fast Ready categories.

The Fast Ready attribute allows you to take advantage of the scratch mount performance of the TS7700 Virtualization Engine when defined on categories used by the host for scratch volumes. When defined, it also prevents recalls for scratch mounts. The MOUNT FROM CATEGORY command, as used for scratch mounts, is not exclusively used for scratch mounts; therefore, the TS7700 Virtualization Engine cannot assume that any MOUNT FROM CATEGORY is for a scratch volume. The Fast Ready attribute provides a definition of a category to supply scratch mounts. The Fast Ready definition is achieved using the *Fast Ready categories* panel on the TS7700 Virtualization Engine Management Interface.

The actual category hexadecimal number depends on the software environment and on the definitions in the SYS1.PARMLIB member DEVSUPxx for library partitioning. Also, the DEVSUPxx member must be referenced in IEASYSxx to be activated.

Note: Any category up to and including the X'FEFF' may be overridden in DEVSUPxx, but be aware that categories may only be overridden if the TS7700 Virtualization Engine will not be accessed by the owning operating systems

When defining a Fast Ready category, you can also set up an expire time as well as further define the expire time as an expire hold time.

Note: Best practices recommend that you add a comment to DEVSUPnn to ensure that the Fast Ready categories are updated whenever the category values in DEVSUPnn are changed. They need to be in sync at all times.

Define logical volume expiration time

This topic provides instructions to define logical volume expiration time.

Use the *Fast Ready categories* panel on the TS7700 Virtualization Engine Management Interface to define the logical volume expiration time. If the Delete Expired Volume Data setting is not used, logical volumes occupy space on the physical volumes even after they have been returned to scratch. In that case, only when a logical volume is rewritten is the old data released to reduce the amount of active data on the physical volume. With the Delete Expired Volume Data setting, the data associated with volumes that have been returned to scratch are deleted after a time period and their old data released.

For example, assume that you have 20 000 logical volumes in scratch status at any point in time, that the average amount of data on a logical volume is 400 MB, and that the data compresses at a 2:1 ratio. The space occupied by the data on those scratch volumes is 4 000 000 MB or the equivalent of 14 (fourteen) 3592 JA cartridges. By using the Delete Expired Volume Data setting, you could reduce the number of cartridges required in this example by 14.

The parameter Expire Time specifies the amount of time in hours, days, or weeks. The data continues to be managed by the TS7700 Virtualization Engine after a logical volume is returned to scratch before the data associated with the logical volume is deleted. A minimum of 24 and a maximum of 32 767 hours (approximately 194 weeks) can be specified. Specifying a value of zero means that the data associated with the volume is to be managed as it was prior to the addition of this option. This means that it is never deleted. In essence, specifying a value (other than zero) provides a "grace period" from when the logical volume is

returned to scratch until its associated data is eligible for deletion. A separate Expire Time can be set for each category defined as fast-ready.

Chapter 3. Configuring

This section provides topics about configuring the TS7700 Virtualization Engine.

TS7700 Virtualization Engine configurations

The TS7700 Virtualization Engine is configured as a cluster and clusters can be combined in a TS7700 Grid.

TS7700 Cluster

The TS7700 Virtualization Engine cluster combines the Virtualization Engine with a disk subsystem cache.

The architecture allows additional disks or nodes to be added in the future to expand the capabilities of the system. A cluster provides FICON host attachment and 256 virtual tape device addresses. In the IBM Virtualization Engine TS7740 configuration the cluster includes the disk cache and that part of the tape library assigned to the TS7700 Virtualization Engine. In the IBM Virtualization Engine TS7720 configuration, emulated tape volumes exist only in disk-based cache. A TS7720 Cluster does not attach to a physical tape library.

Related information

“TS7700 Grid” on page 174

“TS7700 Virtualization Engine system component details” on page 21

“Tape library attachments, drives, and media” on page 36

“Tape drives” on page 38

“Tape media” on page 41

TS7720 Cluster

The TS7720 Cluster provides a disk-only TS7700 Virtualization Engine virtual tape subsystem.

The TS7720 Cluster is comprised of a TS7700 Virtualization Engine. Figure 35 on page 170 shows a typical TS7720 Cluster.

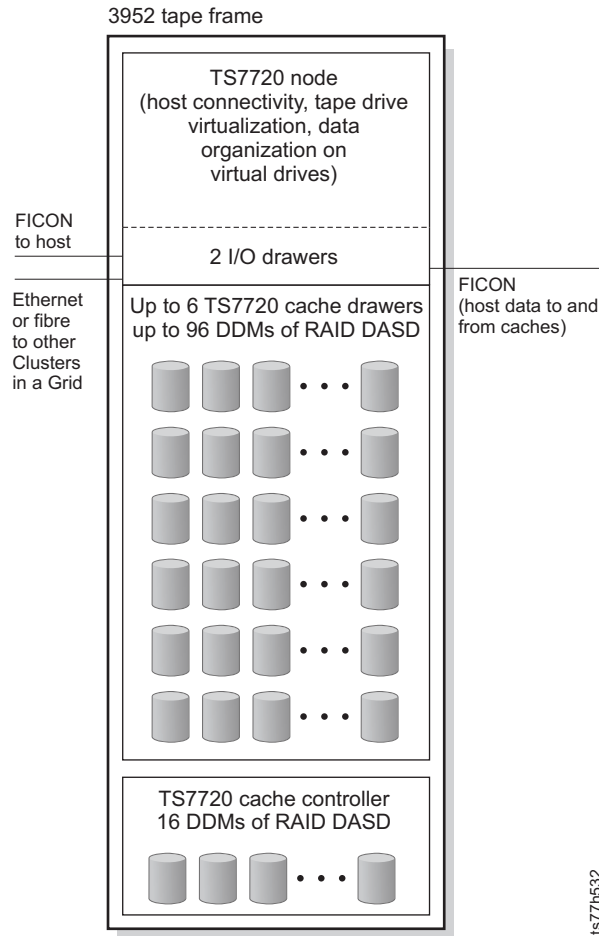


Figure 35. Typical TS7720 Cluster

A TS7720 Cluster typically consists of:

FICON connections to the host

The following configurations are supported:

- 2 FICON adapters
- 4 FICON adapters

Note: FICON adapters may be upgraded in number (two to four) and kind (shortwave to longwave) using “FC 3441, FICON short-wavelength attachment” on page 114, “FC 3442, FICON long-wavelength attachment” on page 114, and “FC 3443, FICON 10-km long-wavelength attachment” on page 115.

The TS7720 Virtualization Engine

Consisting of:

A 3952 Tape Frame

This is the frame that encloses the TS7720 Virtualization Engine.

A TS7720 Virtualization Engine can also be attached to an additional 3952 Tape Frame, identified as a TS7720 Storage Expansion Frame using “FC 7323, TS7720 Storage expansion frame” on page 124. Refer to the topic *TS7720 Storage Expansion Frame* in the **Related information** section for TS7720 Storage Expansion Frame configuration options.

A 3957-VEB

A TS7720 Cache subsystem

A TS7720 Cache subsystem consists of:

- A TS7720 Cache Controller (3956-CS8)
- Up to six TS7720 Cache Drawers (3956-XS7)

A base TS7720 Cache can be expanded by adding a TS7720 Storage Expansion Frame using “FC 7323, TS7720 Storage expansion frame” on page 124 and “FC 9323 Expansion frame attachment” on page 126. Refer to the topic *TS7720 Storage Expansion Frame* in the **Related information** section for TS7720 Storage Expansion Frame configuration options.

Note: An existing TS7720 Cache operating a code level of 8.7.0.xx or higher can be upgraded by MES to include a TS7720 Storage Expansion Frame. Refer to the topic *Upgrades specific to the TS7720 Virtualization Engine* in the **Related information** section for requirements.

Related information

“System requirements” on page 46

“TS7720 Storage Expansion Frame” on page 27

“Upgrades specific to the TS7720 Virtualization Engine” on page 83

TS7740 Cluster

The TS7740 Cluster combines the TS7700 Virtualization Engine with a tape library to form a virtual tape subsystem.

The TS7740 Cluster is comprised of a TS7700 Virtualization Engine attached to a 3494 Tape Library or a TS3500 Tape Library. Figure 36 on page 172 shows a typical TS7740 Cluster.

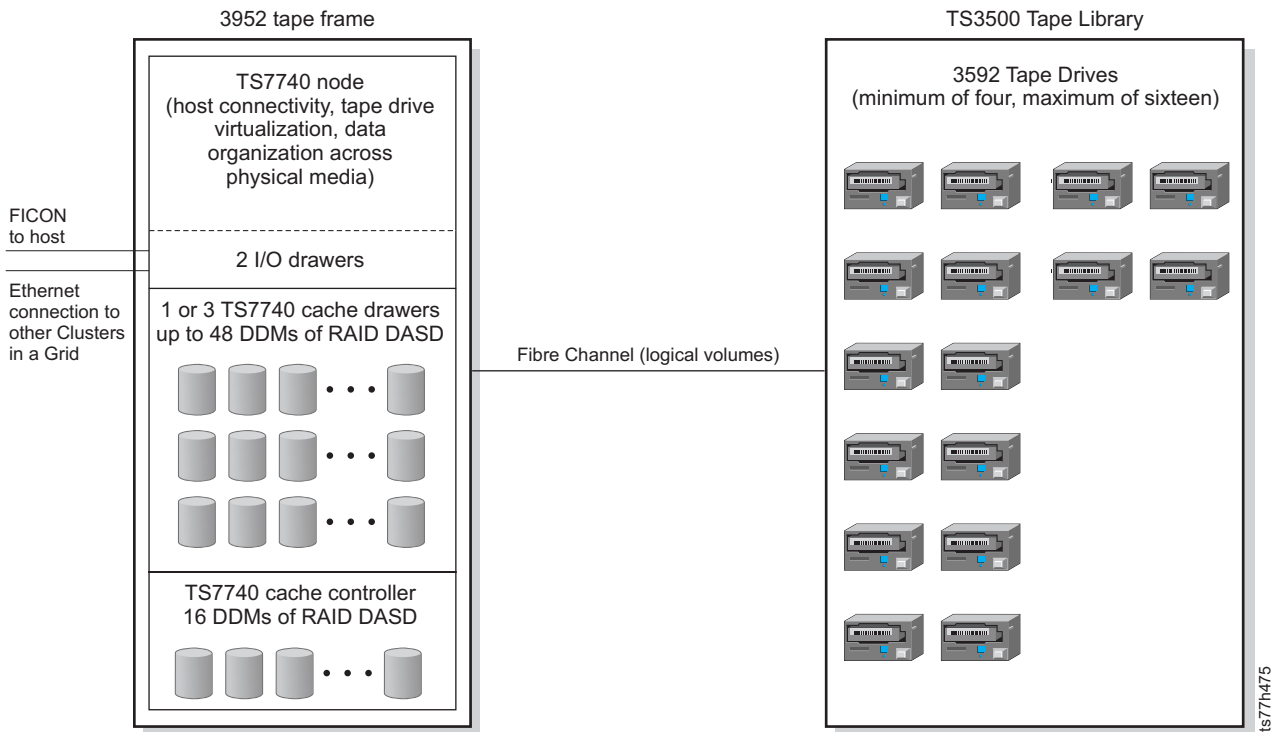


Figure 36. Typical TS7740 Cluster

A TS7740 Cluster typically consists of:

FICON connections to the host

The following configurations are supported:

- 2 FICON adapters
- 4 FICON adapters

Note: FICON adapters may be upgraded in number (two to four) and kind (shortwave to longwave) using “FC 3441, FICON short-wavelength attachment” on page 114, “FC 3442, FICON long-wavelength attachment” on page 114, and “FC 3443, FICON 10-km long-wavelength attachment” on page 115.

The TS7740 Virtualization Engine

Consisting of:

A 3952 Tape Frame

A 3957-V07

A TS7740 Cache subsystem

A TS7740 Cache subsystem consists of:

- One TS7740 Cache Controller with no attached TS7740 Cache Drawer (this is the single-drawer cache configuration).
- One TS7740 Cache Controller attached to one TS7740 Cache Drawer (this is the two-drawer cache configuration).
- One TS7740 Cache Controller attached to three TS7740 Cache Drawers (this is the four-drawer cache configuration).

Important: A field-installable upgrade (MES) is currently available for TS7740 cache configurations. An existing

one-drawer TS7740 cache configuration can be upgraded to a two-drawer TS7740 cache configuration. An existing two-drawer TS7740 cache configuration can be upgraded to a four-drawer TS7740 cache configuration. No MES is available to upgrade an existing one-drawer TS7740 cache configuration directly to a four-drawer TS7740 cache configuration. A one-drawer cache configuration must be upgraded to a two-drawer cache configuration before an upgrade to a four-drawer cache configuration can occur. Refer to “FC 5642, Field install 3956-CX7” on page 121 and “FC 9355, Field merge a TS7700 Cache Drawer in a 3952 F05” on page 128, for additional information.

A TS3500 Tape Library or 3494 Tape Library

The TS3500 Tape Library contains:

Tape drives

The TS7700 Virtualization Engine supports a minimum of four and a maximum of 16 tape drives (J1A, E05/EU5, or E06/EU6). E06/EU6 drives cannot be intermixed with J1A or E05/EU5 tape drives. If connected to a TS3500 Tape Library, 16 tape drives can be used, though two TS3500 Tape Library tape frames are required. The TS3500 Tape Library may use a single-frame or double-frame option, but each TS3500 Tape Library tape frame can contain only 12 tape drives.

If the TS7700 Virtualization Engine is connected to a 3494 Tape Library, 12 is the maximum number of tape drives that can be used. The 3494 Tape Library supports only a single-frame option; each 3494 Tape Library tape frame can contain only 12 drives. Figure 36 on page 172 shows a tape library with two frames enclosing 16 tape drives. It is not required that the tape drives be housed in only two frames; if desired, tape drives can be spread across many frames in the library.

Tape cartridges

The tape cartridges may contain data for multiple logical volumes and are sometimes referred to as physical stacked volumes.

Important: A TS7740 Virtualization Engine attached to a 3584 Tape Library can be used in a grid configuration. Each TS7740 Virtualization Engine in a grid can be attached to a separate physical library, or to the same physical library. TS7740 Virtualization Engines that connect to the same physical library must operate a code level of 8.4.0.xx or earlier and each must attach to its own 3953 Library Manager. However, sharing a physical library is not recommended and does not conform to best practices. A single library in a grid configuration limits overall performance since systems in the same grid are busy during the same batch windows. Furthermore, mount requests occur during these same peak demand times, limiting performance. A single library in a grid configuration also negates the advantage of independent and redundant subsystems for high availability. The redundancy available on the 3584 Tape Library (dual accessors, dual grippers, dual power, and the like) can help to mitigate this increased risk, but is still not considered the best practice.

Related information

“TS7700 Grid”

“TS7700 Virtualization Engine system component details” on page 21

“Tape library attachments, drives, and media” on page 36

“Tape drives” on page 38

“Tape media” on page 41

TS7700 Grid

A TS7700 Grid refers to two or more physically separate TS7700 Clusters connected to one another by means of a customer-supplied TCP/IP network. A TS7700 Grid can contain disk-only clusters that do not attach to a physical tape library, clusters that do attach to a physical tape library, or a combination of both.

The TCP/IP infrastructure connecting a TS7700 Grid is known as the *Grid Network*. The grid configuration is used to form a disaster recovery solution and provide remote logical volume replication. The term *grid* refers to the code and functionality that provides replication and management of logical volumes and their attributes in cluster configurations. A Grid can be used to form disaster recovery and high availability solutions. A disaster recovery solution is achieved when multiple clusters are geographically distant from one another. A high availability solution is achieved when multiple clusters are located in close proximity to one another.

The clusters in a TS7700 Grid can, but do not need to be, geographically dispersed. In a multiple-cluster grid configuration, two TS7700 Clusters are often located within 100 km of one another, while the remaining clusters can be located more than 1,000 km away. This provides both a highly available and redundant regional solution while also providing a remote disaster recovery solution outside of the region. All TS7700 Clusters may also be located in relatively distant proximity to one another; discuss this type of configuration with your IBM representative for any planning considerations. Any TS7700 Clusters located in relatively close proximity would typically use an immediate mode copy policy; TS7700 Clusters located in relatively distant proximity would typically use a deferred mode copy policy.

Refer to Figure 5 on page 12 for an illustration of a typical multi-cluster grid configuration.

Each TS7740 Cluster provides FICON host attachments and 256 virtual tape device addresses. The clusters in a Grid configuration are connected together through dual 1 Gb Ethernet links. The links use standard 1000 Base-T adapters for CAT-5E or CAT6 (CAT6 is highly recommended) balanced copper cabling or standard shortwave adapters for multimode fibre cable. Each grid Ethernet adapter contains two 1 Gb ports. You can use both ports on each adapter, for four total 1 Gb Ethernet grid links. These Ethernet links are used for the replication of data between clusters, passing control information, and access between a local cluster's virtual tape device and a logical volume's data in a remote cluster's TS7740 Cache . For a multiple-site grid Ethernet connection, you have a choice of the following:

1 Gb dual port copper Ethernet

This adapter is a full duplex, dual ported, Gb Ethernet adapter that can be configured to run each port at 10, 100, or 1000 Mbps data rates. The adapter conforms to the IEEE 802.3ab 1000 Base-T standard.

Note: Only the primary port can be used for the grid network unless FC 1034, Enable dual port grid connection is installed. Refer to the topic *Feature details* in the **Related information** section for feature code prerequisites and other requirements.

1Gb Grid dual port optical Ethernet

This is a dual port adapter that provides 1 Gbps throughput on a standard shortwave (850nm) 50/62.5 micron multimode optical cable. It conforms to the IEEE 802.3z standard and supports distances of 260m for 62.5µ multimode fiber (MMF) and 550m for 50.0µ MMF.

Note: Only the primary port can be used for the grid network unless FC 1034, Enable dual port grid connection is installed. Refer to the topic *Feature details* in the **Related information** section for feature code prerequisites and other requirements.

1 Gb fibre

This adapter provides 1000 Mbps throughput on a standard shortwave (850nm) 50/62.5 micron multimode optical cable and conforms to the IEEE 802.3z standard and supports distances of 260m for 62.5µ multimode fiber (MMF) and 550m for 50.0µ MMF.

1 Gb optical shortwave

This Ethernet SX adapter has a LC Duplex connector which attaches to 50-micron or 62.5 micron multimode fibre cable. This is a standard SW (850 nm) adapter that conforms to the IEEE 802.3z standards. It supports distances of 2 to 260 meters for 62.5 micron and 2 to 550 meters for 50.0 micron MMF.

Optical longwave

This adapter supports a maximum of 10 kilometers of 1310nm, 9µm, single-mode fiber optic cable. It conforms to the IEEE 802.3ae standard. This adapter requires 9µm single-mode fiber optic cables and uses a SC connector to connect to network infrastructure components. This adapter must be used in conjunction with a 3957-VEB or 3957-V07.

Note: Each 1Gb link requires a unique, customer assigned IP address. Ethernet activity is specific to each adapter and port pairing. As a result, clusters in a grid do not necessarily all require the same number of ports. Clusters with 10Gb, four 1 Gb, and two 1 Gb Ethernet connections can be part of the same grid configuration. Use of the second 1 Gb Ethernet port present in both grid Ethernet adapters is supported. This results in availability of four total 1 Gb ports for TS7700 Grid interconnections. This configuration is only supported by microcode levels of 8.20.0.xx and higher. It requires two dual-ported adapters and is activated using FC 1034, Enable dual port grid connection.

You can use Selective Device Access Control to tune the use of grid links. Refer to the topic *Selective device access control* in the **Related information** section for additional information.

Related information

“Data access and availability” on page 181

“Feature details” on page 108

“Selective device access control” on page 201

Hybrid TS7700 Grid configurations

A hybrid TS7700 Grid is one that contains both TS7700 Clusters that connect to physical tape drives in a physical tape library (TS7740 Clusters) and TS7700 Clusters that do not connect to physical tape drives in a physical tape library (TS7720 Clusters).

The hybrid grid configuration is used for archival and data retention purposes where data consistency shifts from disk-only clusters (those that do not connect to a physical library) to clusters that do connect to a physical library. Data contained within any TS7700 Cluster can be accessed by any peer cluster, regardless of either cluster's connection to a physical library.

A hybrid TS7700 Grid can be configured using between two and six TS7700 Clusters.

Five- or six- cluster hybrid

Five- and six-cluster hybrid grid configurations are supported by RPQ only. Possible configurations of five- and six-cluster grids include:

Two production sites each with two clusters, plus a one- or two-cluster disaster recovery site

Each production site contains one disk-only cluster combined with one cluster attached to a physical library. When part of a five-cluster grid, the disaster recovery site contains one cluster attached to a physical library. When part of a six-cluster grid, the disaster recovery site also contains a disk-only cluster.

Each production site writes and reads only to its local clusters and all data written within either production site is replicated to the adjacent cluster as well as all disaster recovery clusters.

One production site with three clusters, plus one disaster recovery site with three clusters

Each site contains two disk-only clusters and one cluster attached to a physical library. This configuration is available only with a six-cluster grid.

Data written to a production cluster is replicated to one adjacent cluster and to at least two disaster recovery clusters.

Four-cluster hybrid

There are two common configurations of a four-cluster grid:

Two disk-only production clusters, plus two remote clusters attached to physical libraries

Disk-only clusters are used for production data, while clusters attached to physical libraries are used for archival or disaster recovery purposes. Optimally, the clusters attached to physical libraries are at metro distances to separate long-term data from a single point of loss.

All clusters are configured for high availability. However, the production clusters are also configured for high cache hit rates. Long-term retention data migrates to the clusters attached to physical libraries. The copy export function can be used on these clusters to produce a second or third offsite copy of long-term retention data.

Identical production and remote configurations

One configuration is duplicated at multiple sites: one disk-only

cluster combined with one cluster attached to a physical library. This provides a high-availability solution for both production and archival data centers, while distancing the clusters attached to physical libraries for disaster recovery purposes. All clusters are configured for high cache hit rates.

Three-cluster hybrid

One disk-only cluster is used for production, as is one of the clusters attached to a physical library. The other cluster attached to a physical library is used for archival or disaster recovery purposes. This solution is a high availability production configuration that also provides the benefits of high cache hit rates for recent data.

Two-cluster hybrid

One disk-only cluster is used for production, while one cluster attached to a physical library is used for archival or disaster recovery purposes. Copy export can be used to produce a second offsite copy of the long-term data that resides only in the cluster attached to a physical library.

Table 57 summarizes the possible configurations of a hybrid TS7700 Grid.

Table 57. Hybrid grid configurations

Total clusters	Site A	Site B	Site C	Expectations
6	Production 1 disk-only cluster 1 library-attached cluster	Production 1 disk-only cluster 1 library-attached cluster	Backup 1 disk-only cluster 1 library-attached cluster	<ul style="list-style-type: none"> • High availability at two sites. • Remote access for volumes no longer in disk-only cache. • Optimal cache hits of newer content at production sites. • Copy export is optionally used to create offsite copies of long-term content.
6	Production and backup 2 disk-only clusters 1 library-attached cluster	Production and backup 2 disk-only clusters 1 library-attached cluster	No third site	<ul style="list-style-type: none"> • High availability at both sites. • Local access for volumes no longer in disk-only cache. • Copy export is optionally used to create offsite copies of long-term content.
5	Production 1 disk-only cluster 1 library-attached cluster	Production 1 disk-only cluster 1 library-attached cluster	Backup 1 library-attached cluster	<ul style="list-style-type: none"> • High availability at both sites. • Local access for volumes no longer in disk-only cache. • Optimal cache hits of newer content at production sites. • Copy export is optionally used to create offsite copies of long-term content.

Table 57. Hybrid grid configurations (continued)

Total clusters	Site A	Site B	Site C	Expectations
4	Production 2 disk-only clusters	Backup 2 library-attached clusters	No third site	<ul style="list-style-type: none"> High availability at both sites. Remote access for volumes no longer in disk-only cache. Optimal cache hits of newer content at the production site. Copy export is optionally used to create offsite copies of long-term content.
4	Production 1 disk-only cluster 1 library-attached cluster	Production or backup 1 disk-only cluster 1 library-attached cluster	No third site	<ul style="list-style-type: none"> High availability at both sites. Local access to volumes on tape. Second production site as backup. Optimal cache hits at both production and backup sites.
3	Production 1 disk-only cluster 1 library-attached cluster	Backup 1 library-attached cluster		<ul style="list-style-type: none"> High availability at the production site. Can require remote mount if local library-attached cluster is down and volume is not in cache. Optimal cache hits at the production site.
2	Production 1 disk-only cluster 1 library-attached cluster	No remote clusters		<ul style="list-style-type: none"> High availability for recently used volumes. Copy export is optionally used to create offsite copies of long-term content. Loss of cluster attached to physical library can prevent access to older volumes. For scheduled outages, a pre-removal of volumes from the disk-only cluster would be required to assure enough cache space is available.

Important: Copy policies must be set up correctly across the hybrid grid. Optimally, all volumes created on a disk-only cluster have a copy policy that creates a copy on one or more clusters attached to a physical library. Otherwise, the automatic removal cannot remove volumes from the disk-only cache, leading to the disk-only cache reaching its maximum capacity. If this happens, a manual intervention is required to reduce the volume use of the disk-only cluster.

TS7700 Clusters that attach to a physical library have a much higher total storage capacity than disk-only TS7700 Clusters. In a hybrid grid, a copy export from a cluster attached to a physical library can export all the contents of the library including any hybrid-migrated data residing only on the TS7700 Clusters attached to a physical library. Therefore, when a complete failure occurs to a copy export parent site, it is possible that the copy exported volumes are the only source for the hybrid-migrated data. A recovery in this scenario can occur by initiating a disaster recovery process into a new TS7700 Cluster attached to a physical library using the copy exported volumes. This allows the data to be merged back into the composite library and any pre-existing TS7700 Clusters remain present with valid content. This disaster recovery approach, as opposed to a copy export recovery approach, does not require the recovery point to be a stand alone TS7700 Cluster attached to a physical library.

Related information

“About cluster families”

“Copy export overview” on page 97

“TS7720 Cache thresholds and removal policies” on page 188

“Retain Copy Mode” on page 187

About cluster families

Cluster families group clusters that operate with a common purpose or under a common set of guidelines.

Note: The cluster family configuration is only supported when all clusters in the grid operate at code level 8.6.0.x or higher.

Clusters can be grouped in families to accomplish a particular task more efficiently or to imply a specific purpose within a grid. For example, one cluster family in a grid can be viewed as a production family. Another cluster family in the same grid can be viewed as an archive or disaster recovery family. In either case, clusters within a common family perform certain grid-related tasks more effectively than clusters that do not share a family.

All members of a family employ Cooperative Replication and tape volume cache (TVC) Selection for Mounts enhancements. During a mount scenario, these enhancements improve control and performance by favoring cluster family members when remote mounts are required. The favoring of cluster family members is especially beneficial in distinguishing a set of production clusters from clusters intended for disaster recovery or archival purposes. Consistency across the family is the primary goal for cluster family members, and they collaborate to achieve this goal. Upon reaching family-wide consistency, the cluster family members then share data to bring each individual member up to the family consistency level.

The maximum number of possible families is equal to the maximum number of clusters in the grid. However, for cluster family benefits to be observed a cluster family must possess at least two cluster members. A cluster can only belong to one family at any given time, but can change from one family to another. A cluster is not required to be a part of any family.

You can create, modify, or delete cluster families using the TS7700 Virtualization Engine Management Interface.

Cooperative Replication

Cooperative Replication improves the efficiency and versatility of the TS7700 Virtualization Engine's Copy Management function. Its enhancements to TVC selection enable the preferential selection of clusters within a cluster family when compared with clusters outside that family. As a result, clusters within the same cluster family can share the "Deferred" copy workload, optimizing throughput, and improving the overall time-to-family consistency.

Once a family becomes consistent with respect to volumes outside of the family, the members of the family begin to replicate among each other. This allows a family to become consistent at up to $1/n$ the time of volumes outside the family, where n is the number of clusters in the family. Since the clusters in a family are assumed to be at metro distances, the replication between them that later occurs is also accelerated.

Related information

“Connecting to the management interface” on page 219

Grid operational states

This topic describes how to locate and identify grid operational states that can indicate a cluster or network problem.

You can identify and trace grid warning states and network problems using the **Grid summary** panel on the TS7700 Virtualization Engine Management Interface. The **Grid summary** panel shows a visual summary of the TS7700 Grid, its clusters and families, and health status. This panel also displays warning states, such as a logical library out of scratch or copies disabled across the grid. If any operational state bits are not normal, the management interface degrades the health of the cluster shown on the grid summary panel and displays a warning message for the affected cluster.

Related information

“Connecting to the management interface” on page 219

This topic describes how to connect to the IBM Virtualization Engine TS7700 Management Interface.

Removing a cluster from a grid and cluster cleanup

One or more TS7700 Clusters can be removed from an existing TS7700 Grid erased of logical volumes and configuration information for reuse.

In some circumstances, it might be desirable to remove a TS7700 Cluster from a TS7700 Grid or restore it to a state similar to new. For instance, cluster removal can be used with cluster cleanup in a datacenter consolidation scenario. In this scenario, a TS7700 Cluster that used Grid replication to copy data to a primary datacenter could be detached and then cleaned up using “FC 4016, Remove Cluster from Grid” on page 115, and “FC 4017, Cluster cleanup” on page 116. Following removal and cleanup, the TS7700 Cluster can be relocated and reused.

Note: If the cluster removal process is initiated from a cluster operating a microcode level lower than 8.7.0.134 , all clusters in the grid must be at the same level of code before “FC 4016, Remove Cluster from Grid” on page 115 can be used. If the cluster removal process is initiated from a cluster operating a microcode level of 8.7.0.134 code or higher, then an intermix of code levels is permitted for use with “FC 4016, Remove Cluster from Grid” on page 115.

TS7700 Cluster removal

You can remove a TS7700 Cluster from a TS7700 Grid concurrently with operations on the remaining TS7700 Clusters as long as you do not inhibit inserts, ejects, or exports. Use “FC 4016, Remove Cluster from Grid” on page 115 to remove a TS7700 Cluster from a TS7700 Grid. You must determine ahead of the removal process how to address volumes having only a copy consistency point at the TS7700 Cluster being removed. Prior to the cluster's removal, these volumes must be ejected, moved to the scratch category, or copied to another cluster through Management Class mount and demount operations.

Note: Once the TS7700 Cluster has been removed, data still on that cluster (in cache or on tape) is unavailable. Development support must manually recover any data from a TS7700 Cluster removed using “FC 4016, Remove Cluster from Grid” on page 115.

TS7700 Cluster cleanup

You can clean up a stand-alone TS7700 Cluster or one that has been removed from a TS7700 Grid to achieve a state similar to new. Use “FC 4017, Cluster cleanup” on page 116 to return the TS7700 Cluster to a state similar to one received from manufacturing with the original feature codes still in place.

Note: To ensure that all volumes are present following removal of a TS7700 Cluster, you can decide to delay subsequent cleanup for a short period while the TS7700 Grid continues operation. Recovery of any missed data requires development support.

Related information

FC 4016, Remove Cluster from Grid

FC 4017, Cluster cleanup

Removing a TS7740 Cluster

A TS7740 Cluster can be removed from a TS7700 Grid.

FC 4016, Remove Cluster from Grid, delivers instructions for a one-time process to remove a TS7740 Cluster from a TS7700 Grid. You must order this feature before you can perform a cluster cleanup (FC 4017, Cluster cleanup) on any TS7740 Cluster configured to participate in a TS7700 Grid. If a TS7740 Cluster is removed from a TS7700 Grid, cleaned up, and then joined to a new TS7700 Grid, another instance of FC 4016 is required to remove the cluster from the new Grid.

Related information

“System requirements” on page 46

Removing a TS7720 Cluster

A TS7720 Cluster can be removed from a TS7700 Grid.

FC 4016, Remove Cluster from Grid, delivers instructions for a one-time process to remove a TS7720 Cluster from a TS7700 Grid. You must order this feature before you can perform a cluster cleanup (FC 4017, Cluster cleanup) on any TS7720 Cluster configured to participate in a TS7700 Grid. If a TS7720 Cluster is removed from a TS7700 Grid, cleaned up, and then joined to a new TS7700 Grid, another instance of FC 4016 is required to remove the cluster from the new Grid.

Related information

“System requirements” on page 46

Data access and availability

A TS7700 Grid configuration provides the following data access and availability characteristics:

Direct host attachment to TS7700 Virtualization Engine

Hosts are directly attached to a TS7700 Virtualization Engine, which affects how a mount request is issued.

A host mount request must be issued on a virtual device address defined for that cluster. The virtual device addresses for each cluster are independent. This is different than the prior generation's PtP VTS where the mount request was issued on a virtual device address defined for a virtual tape controller and the virtual tape controller then decided which VTS to use for data access.

Related information

“Planning for logical and physical volumes” on page 69

“Workload considerations” on page 44

Logical volume data

The following features describe data stored on logical volumes.

Access and location of logical volume data

Best performance is achieved by accessing logical volumes data resident in the local cache.

Access of logical volume data typically adheres to one of the following scenarios:

- If a recall is required to place the logical volume in the local cache, it is done as part of the mount operation.
- If a copy of the logical volume is not available at a local TS7700 Cluster, and a copy is available at a remote TS7700 Cluster in the grid, then the volume is accessed through the remote TS7700 Virtualization Engine's cache. A logical volume is not available on a given cluster if that cluster does not have a copy or if the copy it does have is inaccessible due to an error.
- If the local copy requires a recall, and a remote copy is already resident in cache, a remote access can occur if the remote access penalty is measured to be lower than the time to recall the volume locally.
- If a recall is required to place the logical volume in the **remote** cache, it is done as part of the mount operation. If access is through a remote cache, the available data rate is dependent on the available bandwidth provided for the inter-cluster links and the distance between the TS7700 Clusters.

Grid network load balancing

For a given TS7700 Grid link, the dynamic load balancing function calculates and stores the following information:

- Instantaneous throughput
- Number of bytes queued to transfer
- Total number of jobs queued on both links
- Whether deferred copy throttling is enabled on the remote node
- Whether a new job will be throttled (is deferred or immediate)

As a new task starts, a link selection algorithm uses the stored information to identify the link that will most quickly complete the data transfer. The dynamic load balancing function also uses the instantaneous throughput information to identify degraded link performance.

Related information

“TS7700 Virtualization Engine configurations” on page 169

Accessibility of logical volumes through virtual device addresses

All logical volumes are accessible through any of the virtual device addresses on a TS7700 Virtualization Engine in a grid configuration.

The TS7700 Virtualization Engine determines where the accessible copies of data are located and selects a TS7700 cache through which to access the data. The selected TS7700 cache is not required to be local to the TS7700 Virtualization Engine the mount request was received on, but preference is for access through the local cache to provide the best data access performance. If a remote cache is selected, the host's read and write access to the logical volume travels over the

1-Gb grid WAN links. In this way, access to logical volumes is similar to that of the prior generation when PtP routed I/O through the virtual tape controller to the VTS that contained a cached copy of the data.

Logical volume copy availability

Whether a copy is available at another TS7700 Cluster depends on the copy consistency point that had been assigned to the logical volume when it was written.

You choose whether a TS7700 Cluster is to have a copy of a logical volume's data and when the copy will be performed. You can select from the following data copy policies:

- Copy data as part of the rewind unload processing (RUN) for a volume

Important: Since immediate mode copies take place in their entirety after a volume is closed, the ability to replicate 6000 MB volumes increases the copy and Rewind-Unload (RUN) device end holding time by 50% over 4000 MB volumes. The immediate mode replication policy is not optimal for use with 6000 MB volumes.

- Defer copy after the RUN for the volume
- Do not copy

The copy policies are the same as provided by the prior generation's PtP VTS. If the TS7700 Cluster used as the initial source for a logical volume fails and another TS7700 Cluster has not completed a copy, then that logical volume is not available during the outage and the mount request for the volume within the grid fails.

Logical WORM

Logical WORM (LWORM) is a software-emulated, virtual equivalent of the Write-Once, Read-Many (WORM) capability available on physical tape media.

The LWORM attribute emulates physical WORM to leverage host software support of WORM physical media. With LWORM, an attached host recognizes the TS7700 Virtualization Engine as an LWORM-compliant library, able to contain WORM-compliant logical drives.

Note: The LWORM attribute is only supported when all clusters in the grid operate at code level 8.6.0.x or higher.

The LWORM attribute provides the following functions:

- Assigns a data class construct property to volumes assigned as LWORM-compliant, either upon the first mount or during reuse from scratch
- Generates a temporary World Wide Identifier (WWID) during WORM type assignment that is sent to the host, then bound (persistently saved) to the volume
- Generates and maintains a persistent write-mount count for each LWORM volume, synchronized to the host software
- Permits appends to LWORM volumes using only physical WORM append guidelines
- Permits host software to access LWORM attributes for a given, mounted volume

Logical WORM attributes cannot be appended to previously written volumes. In order for the volume to be LWORM-compliant, it must be assigned so before data is written to it, either upon the first mount or during reuse from scratch. Once all clusters within a TS7700 Virtualization Engine are LWORM-compliant, the host

Read Device Characteristics commands begin to set a new flag stating the device or composite-library is LWORM-compliant.

Data Class LWORM assignment (binding)

Logical volumes are configured as LWORM volumes in the Data Class record, modifiable on the Data Class panel of the TS7700 Virtualization Engine Management Interface. Binding refers to the process of persistently saving a type or attribute property of a volume. Prior to the binding of the property, any derived or assigned properties can be utilized but they are not permanent until the binding event occurs. Once the binding succeeds, the type and or attributes are said to be “bound” to the volume.

LWORM can be set for a new or existing Data Class, however the WWID for the volume can only be bound or cleared upon one of the following:

- The first use of the volume after insert
- The first reuse of the volume after scratch

The first use or reuse of an LWORM volume is only valid when the first write also occurs at the load point beginning of tape (BOT). Prior to the first write at BOT, the volume is only a candidate for use or reuse and any previously bound or NULL information remains unchanged.

Mount with expected WORM binding or clearing

During a mount, the TS7700 Virtualization Engine creates a new WWID for the volume if both of the following are true:

1. The pending Data Class assignment states the volume should be treated as an LWORM
2. The volume has never accepted a write operation (is newly inserted) or the mount sequence is fast ready

If the pending Data Class assignment states the volume should not be treated as a logical worm and the other variables are true, then a temporary NULL WWID value is assumed.

Once a WWID is bound to a volume, all future non-fast ready mounts treat the volume as an LWORM volume independent of any currently configured Data Class settings. Once a WWID is already bound, changes to the Data Class name or attributes for the volume do not affect the binding of the LWORM volume type. A bound LWORM volume is composite in scope, which means that once it is bound with a WWID, all clusters within a grid honor all LWORM rules associated with that volume. Binding (to a new WWID or clearing of an existing WWID) can only occur at first use or reuse of a volume.

Important: A non-LWORM volume with existing data cannot be bound to a WWID by configuring a Data Class then performing a mount or demount sequence unless the mount is a fast-ready mount and a write operation occurs at BOT. Any previously bound WWID can be cleared (NULL WWID) through the binding process only if a fast-ready mount operation has a pending non-LWORM Data Class setting and a first write occurs at BOT. This is the means of which an LWORM volume can legally be reused as a standard read and write volume.

WWID and write-mount count DFSMS synchronization

The write-mount count is a host software synchronized value that mimics tape media WORM behavior. Each time a volume is assigned a new WWID, a write-mount count (initially set to zero) must be associated with and bound to the volume during the first write from BOT. Each time a volume is mounted thereafter and at least one write operation of any kind is issued during that mount, the write-mount count for the volume is increased by one. The write-mount count can be used to count the total number of times a volume was mounted with modifications. When the write-mount count is bound for the first time it has a value of 1, which represents the initial value of 0 increased by one due to the first write from BOT.

To keep the host and the TS7700 Virtualization Engine data facility system managed storage (DFSMS) synchronized, WWID and write-mount count are handled as follows:

Table 58. WWID and write-mount count scenarios

If	Then	Result
The host has previously expired and reused a volume and the user designates the volume can be reused.	The Removal Media Manager (RMM) resets the explicit WORM identifier, the WWID, and write-mount count within the host catalogue.	The host is informed that the current reset assignment represents a standard read and write volume without any WORM obligations. Host software can mark the volume for scratch and it can be returned to scratch during the next scratch processing phase.
During host software mount processing, a mount with expected WORM binding or clearing occurs.	A WWID is temporarily generated and eventually bound or cleared at first write from BOT.	If a first write from BOT does not occur, this temporary WWID is discarded leaving any previously bound WWID value intact.
A new WWID is temporarily assigned.	The TS7700 Virtualization Engine resets the write-mount count for the volume to 0 (within memory).	<p>During the first write from BOT, this write-mount count is increased to a value of 1 and bound when the temporary WWID is bound.</p> <p>If a first write from BOT does not occur, this write-mount count is discarded, leaving any previously bound write-mount count value intact.</p> <p>If a NULL-WWID is to be bound (for example, standard read and write volume), the write-mount count is not increased with each first write operation.</p>

Logical WORM volume usage restrictions

Logical WORM volumes must have Non-Rewriteable concepts implied by the LWORM type of the volume. Once a WWID is bound to a volume, only WORM-supported appends are allowed. No retention concepts such as prevention of eject, delete, delete-expire, nor assignment to fast-ready categories are restricted by the TS7700 Virtualization Engine.

However, any attempt to overwrite previously written data on an LWORM bound volume (independent of write-mount count) fails if it does not meet the Append Only Rules, as follows:

1. Appending restrictions are the same as those for physical WORM.
2. If a volume has previously accepted a completed EOVS construct sequence followed by one or two tape marks, the volume can no longer be written to.
3. Writing is not allowed at any location prior to the start of a construct sequence, where both of the following are true:
 - The sequences are those explicitly enumerated below
 - At least one non-construct record has been written to the tape (rule 6 is an exception)
4. Writing is not allowed over or before any construct sequence which is followed by another construct sequence or data logical block which have been explicitly or implicitly synchronized. The synchronization event should, at a minimum, progress the legal append point to the block following the last completed construct sequence. Explicit synchronization results from the acceptance of one of the following commands:
 - SYNC
 - WTM
 - RUN

Implicit synchronization includes:

- a. Synchronize Buffer
 - b. Forward Space Block, Forward Space File, Backward Space Block, Backward Space File, Rewind, Rewind Unload, Write Tape Mark, Erase Gap, Data Security Erase or Locate Block
 - c. Read Forward, Read Previous or Read Backward and there is buffered write data
 - d. A Write command is issued in a command chain following either a Mode Set command which specifies tape write immediate mode or a Set Tape Write Immediate command
 - e. The logical end of volume point is reached or exceeded
5. Overwriting of any data logical block that has been explicitly or implicitly synchronized is not allowed. The synchronization event, at a minimum, advances the legal append point to the block following the last completed non-construct data logical block.
 6. Full overwrite of the entire tape and any constructs is permitted so long as no data logical blocks (non-constructs) have been written.
 7. All or partial overwrite of the last construct sequence is permitted when the construct sequence is either incomplete, or is not followed by additional data or tape marks.
 8. Writing is not allowed at points other than following the last complete volume record of any type when a volume is loaded and its ending disposition cannot

be definitively determined. This can occur after an outage or after a volume corruption where the last known persistent append point is either unknown or no longer valid.

Related information

“Copy export overview” on page 97

Retain Copy Mode

Retain Copy Mode prevents the copy modes of a logical volume from being refreshed by an accessing host device if the accessing cluster is not the same cluster that created the volume.

Use the *Management Classes* panel on the TS7740 Virtualization Engine Management Interface to enable or disable the Retain Copy Mode. To verify that the Retain Copy Mode is enabled and working, check that the Copy Mode displayed on the *Logical Volume Details* page of the management interface remains unchanged following any access of the non-fast-ready logical volumes associated with the Management Class in question.

In some grid configurations, logical volume copies are either not required or intentionally avoided on all clusters. This may be to reduce the replication counts of a volume, or to partition the overall capacity of a grid configuration through selective replication. When these volumes are read or modified through a device on a cluster that did not create the content, the copy modes for the logical volume can be refreshed, or updated with values from the accessing cluster. The resulting copy modes can be a combination of old and new copy modes, leading to the creation of additional copies not originally requested. When Retain Copy Mode is enabled through the management interface, previously assigned copy modes are retained and subsequent read or modify access does not refresh, update, or merge copy modes. This allows the original number of copies to remain in place.

Note: The Retain Copy Mode option is available only on non-fast-ready logical volume mounts.

When enabled for a particular Management Class, Retain Copy Mode ensures that the existing copy mode setting is not changed when any non-fast-ready logical volumes associated with that Management Class are accessed. Retain Copy Mode does not eliminate existing extra copies, but once enabled prevents extra copies from being made. If copy modes are updated for a given Management Class where Retain Copy Mode is enabled, the new copy modes are only applied to fast-ready mounts; non-fast-ready mounts retain the earlier copy mode settings.

Table 59. Effects of Retain Copy Mode in mount scenarios

Scenario	Retain Copy Mode setting enabled?	Result
Fast-ready mount is issued	Yes	Retain Copy Mode setting ignored
Non-fast-ready mount is issued	Yes	Grid uses volume's existing copy modes
Non-fast-ready mount is issued	No	Grid uses copy modes defined by cluster emulating the device used for the mount
New volume or copy mode not established	Yes	Grid uses copy modes associated with assigned Management Class

Table 59. Effects of Retain Copy Mode in mount scenarios (continued)

Scenario	Retain Copy Mode setting enabled?	Result
Retain Copy Mode setting is modified on associated Management Classes	Yes	Management Classes are updated; subsequent copy actions updated only on fast-ready mounts associated with each Management Class

Related information

“Copy export overview” on page 97

Ownership-dependent access to a logical volume

To access a logical volume through a TS7700 Virtualization Engine, that TS7700 Virtualization Engine must have ownership of the volume.

At any point in time a logical volume is ‘owned’ by a TS7700 Cluster. The owning cluster has control over access to the volume and changes to the attributes associated with the volume (such as category or storage constructs). Cluster ownership of a logical volume can change dynamically based on which cluster in the grid configuration is requesting a mount of the volume. If a local TS7700 Cluster receives a mount request for a volume it does not own , it must first obtain ownership from the owning cluster. If the a TS7700 Clusters are in a grid configuration and at least one of the 1-Gb Ethernet links between them are operational, any required change of ownership is automatic. This change of ownership adds a small amount of time to the mount operation.

TS7720 Cache thresholds and removal policies

This topic describes the boundaries (thresholds) of free cache space in a disk-only TS7720 Virtualization Engine and the policies that can be used to manage available (active) cache capacity in a grid configuration.

Cache thresholds for a TS7720 Cluster

A disk-only TS7720 Virtualization Engine does not attach to a physical backend library; all virtual volumes are stored in the cache. There are three thresholds that define the active cache capacity in a TS7720 Virtualization Engine and determine the state of the cache as it relates to remaining free space. In ascending order of occurrence, they are:

Automatic removal

This state occurs when the cache is 2 TB below the out-of-cache-resources threshold. In the automatic removal state, the TS7720 Virtualization Engine automatically removes volumes from the disk-only cache to prevent the cache from reaching its maximum capacity. This state is identical to the limited-free-cache-space-warning state unless the Temporary Removal Threshold is enabled.

Note: You can disable automatic removal within any given TS7720 Cluster using the following library request command:

```
LIBRARY REQUEST,CACHE,REMOVE,{ENABLE|DISABLE}
```

So that a disaster recovery test can access all production host-written volumes, automatic removal is temporarily disabled while disaster recovery write protect is enabled on a disk-only cluster. When the write protect state is lifted, automatic removal returns to normal operation.

Limited free cache space warning

This state occurs when there is less than 3 TB of free space left in the cache. Once the cache passes this threshold and enters the limited-free-cache-space-warning state, write operations can use only an additional 2 TB before the out-of-cache-resources state is encountered. When a TS7720 Cluster enters the limited-free-cache-space-warning state it remains in this state until the amount of free space in the cache exceeds 3.5 TB. Messages that can be displayed on the management interface during the limited-free-cache-space-warning state include:

- HYDME0996W
- HYDME1200W

Refer to the **Related information** section for additional information about each of these messages.

Note: Host writes to the TS7720 Cluster and inbound copies continue during this state.

Out of cache resources

This state occurs when there is less than 1 TB of free space left in the cache. Once the cache passes this threshold and enters the out-of-cache-resources state, it remains in this state until the amount of free space in the cache exceeds 3.5 TB. When a TS7720 Cluster is in the out-of-cache-resources state, volumes on that cluster become read-only and one or more out-of-cache-resources messages are displayed on the management interface. These messages can include:

- HYDME0997W
- HYDME1133W
- HYDME1201W

Refer to the **Related information** section for additional information about each of these messages.

Note: New host allocations do not choose a TS7720 Cluster in this state as a valid tape volume cache candidate. New host allocations issued to a TS7720 Cluster in this state choose a remote tape volume cache instead. If all valid clusters are in this state or unable to accept mounts, the host allocations fail. Read mounts can choose the TS7720 Cluster in this state, but modify and write operations fail. Copies inbound to this TS7720 Cluster are queued as deferred until the TS7720 Cluster exits this state

Table 60 displays the start and stop thresholds for each of the active cache capacity states defined.

Table 60. Active cache capacity state thresholds

State	Enter state (free space available)	Exit state (free space available)	Host message displayed
Automatic removal	<3 TB	>3.5 TB	CBR3750I when automatic removal begins
Limited free cache space warning	<3 TB	>3.5 TB	CBR3792E upon entering state CBR3793I upon exiting state

Table 60. Active cache capacity state thresholds (continued)

State	Enter state (free space available)	Exit state (free space available)	Host message displayed
Out of cache resources	<1 TB	>3.5 TB	CBR3794A upon entering state CBR3795I upon exiting state
Temporary removal†	<(X + 1 TB)‡	>(X + 1.5 TB)‡	Console message
†When enabled ‡Where X is the value set by the <i>Tape Volume Cache</i> panel on the given cluster.			

Volume removal policies in a grid configuration

Removal policies determine when logical volumes are removed from the cache of a TS7720 Cluster in a grid configuration. These policies provide more control over the removal of content from a TS7720 Cache as the active data reaches full capacity.

To guarantee that data will always reside in a TS7720 Virtualization Engine or will reside for at least a minimal amount of time, a pinning time must be associated with each removal policy. This pin time in hours will allow volumes to remain in a TS7720 Virtualization Engine tape volume cache for at least x hours before it becomes a candidate for removal, where x is between 0 and 65,536. A pinning time of zero assumes no minimal pinning requirement. In addition to pin time, three policies are available for each volume within a TS7720 Virtualization Engine. These policies are as follows:

Pinned

The copy of the volume is never removed from this TS7720 Cluster. The pinning duration is not applicable and is implied as infinite. Once a pinned volume is moved to scratch, it becomes a priority candidate for removal similarly to the next two policies. This policy must be used cautiously to prevent TS7720 Cache overruns.

Prefer Remove - When Space is Needed Group 0 (LRU)

The copy of a private volume is removed as long as an appropriate number of copies exists on peer clusters, the pinning duration (in x hours) has elapsed since last access, and the available free space on the cluster has fallen below the removal threshold. The order of which volumes are removed under this policy is based on their least recently used (LRU) access times. Volumes in Group 0 are removed prior to the removal of volumes in Group 1 except for any volumes in Fast Ready categories which are always removed first. Archive and backup data would be a good candidate for this removal group since it won't likely be accessed once written.

Prefer Keep - When Space is Needed Group 1 (LRU)

The copy of a private volume is removed as long as an appropriate number of copies exists on peer clusters, the pinning duration (in x hours) has elapsed since last access, the available free space on the cluster has fallen below a threshold, and LRU group 0 has been exhausted. The order of which volumes are removed under this policy is based on their least recently used (LRU) access times. Volumes in Group 0 are removed prior to the removal of volumes in Group 1 except for any volumes in Fast Ready categories which are always removed first.

Prefer Remove and **Prefer Keep** are similar to cache preference groups PG0 and PG1 with the exception that removal treats both groups as LRU versus using the volume size.

In addition to these policies, volumes assigned to a Fast Ready category that have not been previously delete-expired are also removed from cache when the free space on a cluster has fallen below a threshold. Fast Ready category volumes, regardless of what their removal policies are, are always removed before any other removal candidates in volume size descending order. Pin time is also ignored for Fast Ready volumes. Only when the removal of Fast Ready volumes does not satisfy the removal requirements will Group 0 and Group 1 candidates be analyzed for removal. The requirement for a Fast Ready removal is that an appropriate number of volume copies exist elsewhere. If one or more peer copies can not be validated, the Fast Ready volume is not removed.

Only when all TS7700 Virtualization Engines within a grid are at level 1.7 or later will these new policies be made visible within the management interface. All records creations prior to this time should maintain the default Removal Group 1 policy and be assigned a zero pin time duration.

Note: As of code level 8.7.0.xx, there is no automatic method to re-introduce a consistent instance of a previously removed volume into a TS7720 Cache simply by accessing the volume. Only when the copy override **Force Local Copy** or the volume is modified will a consistent version of a previously removed volume be re-introduced into a TS7720 Cache as a result of a mount operation.

The following fields on the TS7700 Virtualization Engine Management Interface *Tape Volume Cache* panel are used to configure the removal policy:

Removal Threshold

The Removal Threshold is used to prevent a cache overrun condition in a TS7720 Cluster configured as part of a grid. It is a fixed, 2 TB value that, when taken with the amount of used cache, defines the upper limit of a TS7720 Cache size. Above this threshold, logical volumes begin to be removed from a TS7720 Cache.

Logical volumes in a TS7720 Cache can be copied to one or more peer TS7700 Clusters. When the amount of used cache in a TS7720 Cache reaches a level that is 3 TB (fixed 2 TB plus 1 TB) below full capacity, logical volumes begin to be removed. Logical volumes are removed from a TS7720 Cache in this order:

1. Volumes in fast ready categories
2. Private volumes least recently used, using the enhanced removal policy definitions

Once removal begins, the TS7720 Virtualization Engine continues to remove logical volumes until the Stop Threshold is met. The Stop Threshold is a value that is the Removal Threshold minus 500 GB.

A particular logical volume cannot be removed from a TS7720 Cache until the TS7720 Virtualization Engine verifies that a consistent copy exists on a peer cluster. If a peer cluster is not available, or a volume copy has not yet completed, the logical volume is not a candidate for removal until the appropriate number of copies can be verified at a later time.

Note: This field is only visible if the selected cluster is a TS7720 Virtualization Engine in a grid configuration.

Temporary Removal Threshold

The Temporary Removal Threshold lowers the default Removal Threshold to a value lower than the Stop Threshold in anticipation of a Service mode event.

Logical volumes may need to be removed before one or more clusters enter Service mode. When a cluster in the grid enters Service mode, remaining clusters can lose their ability to make or validate volume copies, preventing the removal of an adequate number of logical volumes. This scenario can quickly lead to the TS7720 Cache reaching its maximum capacity. The lower threshold creates additional free cache space, which allows the TS7720 Virtualization Engine to accept any host requests or copies during the service outage without reaching its maximum cache capacity.

The Temporary Removal Threshold value must be equal to or greater than the expected amount of compressed host workload written, copied, or both to the TS7720 Virtualization Engine during the service outage. The default Temporary Removal Threshold is 4 TB providing 5 TB (4 TB plus 1 TB) of free space exists. You can lower the threshold to any value between 2 TB and full capacity minus 2 TB.

The Temporary Removal Threshold is initiated through the temporary removal process on the *Service Mode* page. To initiate this process, you must enable it on the cluster that is expected to enter the Service mode.

Monitor threshold lowering operation

You can monitor or cancel an in-progress threshold lowering operation on the *Operation History* page for the accessing cluster. During a removal operation, the **Current step details** table on the *Operation History* panel displays a summary of the temporary removal goal of each cluster attempting removal. Information shown includes:

Cluster

The name of each cluster in the grid.

Threshold

The temporary removal threshold for each cluster listed.

Remaining

The amount of data on the cluster that is above the threshold and needs to be removed, or how far above the threshold the cluster's data is.

Exceeding

The amount of free space that exists beyond the configured temporary threshold, or how far below the threshold the cluster's data is.

Exhausted

Whether the removal operation has removed all candidate volumes, but has not yet met the threshold.

A threshold lowering operation remains in progress until it is canceled or the cluster scheduled for service enters Service mode or goes offline.

All TS7720 Clusters in the grid that remain available automatically lower their Removal Thresholds to the Temporary Removal Threshold value defined within each of their *Tape Volume Cache* pages. Each TS7720 Cluster may use a different Temporary Removal Threshold. The default Temporary Removal Threshold value is 4 TB or an additional 2 TB more data than the default removal threshold of 2 TB. Each TS7720 Cluster will use its defined value until any cluster in the grid enters Service mode or the temporary removal process is canceled. The cluster initiating the temporary removal process will not lower its own removal threshold during this process.

Note: To abandon the operation to put the cluster into Service mode, click the **Cancel** button on the *Operation history* panel.

To temporarily adjust the threshold for a particular TS7720 Cluster, enter the new threshold value from that cluster and click the **Submit Changes** button.

Note: This field is only visible if the selected cluster is a TS7720 Virtualization Engine in a grid configuration.

Related information

“Hybrid TS7700 Grid configurations” on page 176

HYDME0996W

HYDME0997W

HYDME1133W

HYDME1200W

HYDME1201W

“Logical volume data” on page 182

“Merging” on page 76

TS7740 Cache migration threshold

This topic describes the preference groups that manage logical volume migration from cache in a TS7740 Virtualization Engine, and the threshold that determines when migration begins.

Logical volumes in a TS7740 Virtualization Engine are managed by preference group (PG). These groups determine how soon volumes are migrated from cache following their copy to backend physical tape and are classified either as PG0 or PG1. The migration threshold only applies to PG1, which is the last group of volumes migrated from disk cache.

Preference Group 0 (PG0)

When space is needed, volumes are migrated from cache according to size. Largest volumes are migrated first.

This group is assigned to volumes that are unlikely to be accessed after being created. There is no need to keep them in cache any longer than is necessary to copy them to physical tape. When a volume is assigned as PG0, the TS7740 Virtualization Engine gives it preference to be copied to physical tape. When space is needed in the tape volume cache (TVC), the TS7740 Virtualization Engine first selects a PG0 volume that has been copied to a physical volume and then deletes it from cache, leaving a copy only on physical tape. PG0 volumes are selected by largest size first, independent of how long they have been resident in cache. If no PG0 volumes remain that are resident in cache and have also been copied to physical tape, the TS7740 Virtualization Engine begins to select preference group 1 (PG1) volumes for migration.

The TS7740 Virtualization Engine also migrates PG0 volumes from cache if the subsystem is relatively idle. There is a small amount of internal processing impact to migrating a volume from cache, so there is some benefit in migrating them when extra processing capacity is available. In the case where the TS7740 Virtualization Engine migrates PG0 volumes during idle times, it selects them by smallest size first.

Preference Group 1 (PG1)

When space is needed, volumes are migrated from cache according to last recently used (LRU) access time.

This group is assigned to volumes that are likely to be accessed after being created. One example of volumes in this category are those that contain master files created as part of the nightly batch run. Because the master files are likely to be used as input for the next night's batch run, it is beneficial for these volumes to stay in the TVC for as long as possible. When a volume is assigned as PG1, the TS7740 Virtualization Engine adds it to the queue of volumes to be copied to physical tape soon after the volume is demounted. It is copied to tape with a lower priority than PG0 volumes that have not yet been copied to tape. When space is needed in cache, the TS7740 Virtualization Engine first determines whether any PG0 volumes can be migrated. If not, the TS7740 Virtualization Engine selects PG1 volumes to be migrated based on an LRU algorithm. The LRU algorithm causes volumes that have already been copied to physical tape and that have been resident in cache the longest without access to be migrated first. The selected volumes are deleted from disk cache, leaving a copy of the volume only on physical tape.

The migration threshold for PG1 is 95% of full capacity or full capacity minus 300 GB, whichever value permits more active content to remain in cache.

When a preference group is assigned to a volume, that assignment is persistent until the volume is reused for scratch or remounted and a new preference group is assigned. Thus, a volume that is assigned as PG0 maintains that preference group when it is subsequently recalled into cache. You can use the *Storage Class* panel of the management interface to set a volume preference group as PG0 or PG1.

Note: When a second physical tape copy is requested within a volume's management class, copies to both physical tape pools must complete before the volume is a candidate for migration.

Related information

“Logical volume data” on page 182

Ownership takeover

If a TS7700 Cluster fails, ownership transfer of the volumes that it owned is not automatic. In order for another cluster to access and manage those volumes, the failed TS7700 Cluster is placed in an ownership takeover mode.

The ownership takeover modes are set through the TS7700 Virtualization Engine's System Management Interface Tool panel. Three modes are provided:

Read Ownership Takeover

When Read Ownership Takeover (ROT) is enabled for a failed cluster, volume ownership is allowed to be taken from a failed TS7700 Cluster by any other available TS7700 Cluster. Only read access to the volume is allowed through the remaining TS7700 Clusters in the event the volume is

taken over. Once ownership for a volume has been taken in this mode, any operation attempting to modify data on that volume or change its attributes fails.

Write Ownership Takeover

When Write Ownership Takeover (WOT) is enabled for a failed TS7700 Cluster, volume ownership is allowed to be taken from a failed TS7700 Cluster. Full access is allowed through the remaining available TS7700 Clusters in the Grid.

Service Preparation/Service Mode

When a TS7700 Cluster is placed into service preparation and successfully enters the service mode, ownership of its volumes is allowed to be taken by the remaining available TS7700 Clusters in the Grid. Full access is allowed.

The Autonomic Ownership Takeover Manager:

The Autonomic Ownership Takeover Manager (AOTM) is a method by which either Read-Only Takeover (ROT) or Write-Only Takeover (WOT) can be automatically enabled against a failed TS7700 Cluster through internal negotiation methods. AOTM is optionally configurable.

When communication between two or more TS7700 Virtualization Engine clusters is disrupted, the clusters (local and remote) are no longer able to negotiate ownership of logical volumes. In this scenario, ownership takeover, or human intervention, is sometimes utilized to establish temporary access to data resources. Ownership takeover occurs when an operator, working with the knowledge that one cluster is in a failed state, physically intervenes to obtain permission to access that cluster's data. When network problems cause a communication failure, ownership takeover is not the correct solution to re-establish access.

One solution is an automated process (AOTM) that permits a local cluster to access data from a remote cluster if normal communication is interrupted. Communication between clusters can be interrupted by a failure of the Grid Network, or by failure of a cluster. Since data may be lost or compromised if a local cluster is allowed to access data from a working remote cluster, AOTM only automatically grants a local cluster permission access to a remote cluster when normal communication between the clusters is disrupted and the local cluster can verify that the remote cluster is offline or otherwise not operating.

Notelist:

1. Ownership takeover, including ROT, WOT, and AOTM, should only be enabled when the TS7700 Cluster in question has actually failed. If communication is only interrupted via a network failure, a takeover mode should not be enabled. AOTM attempts to distinguish between a cluster failure and a network failure.
2. The minimum required TS7700 Virtualization Engine microcode level to enable AOTM is 8.0.1.xx.
Use "FC 0521, Functional enhancement field" on page 110, to receive the most current level of TS7700 Virtualization Engine code.

Before AOTM intervenes to allow a working cluster access to data from a remote cluster, it must determine whether the remote cluster is inaccessible due to failure of the cluster itself or failure of the Grid network. AOTM does this by sending a status message across a network connecting the Master Consoles associated with

the clusters. This network is referred to as the Master Console Grid Network and illustrated by the following figures.

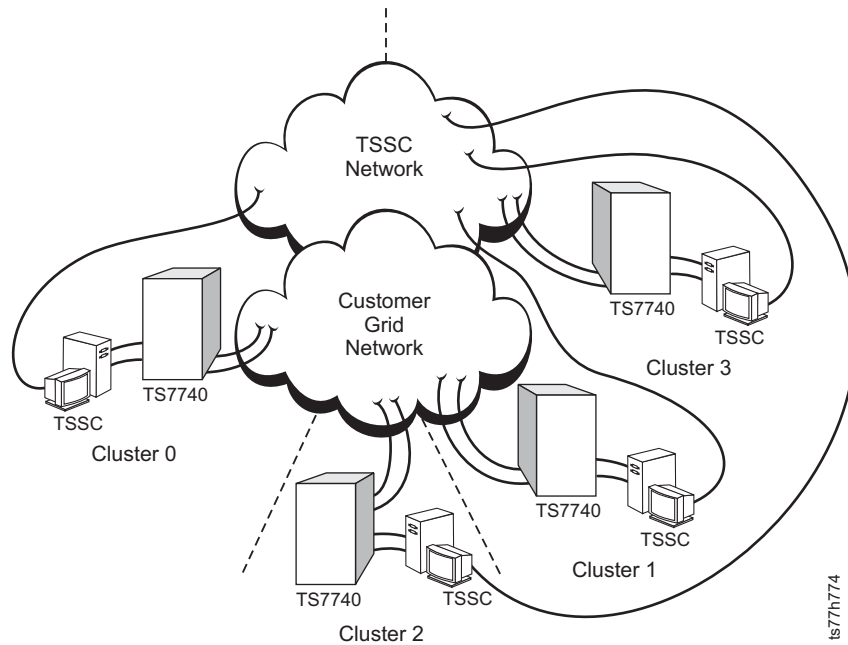


Figure 37. Autonomic Ownership Takeover Manager configuration for four clusters

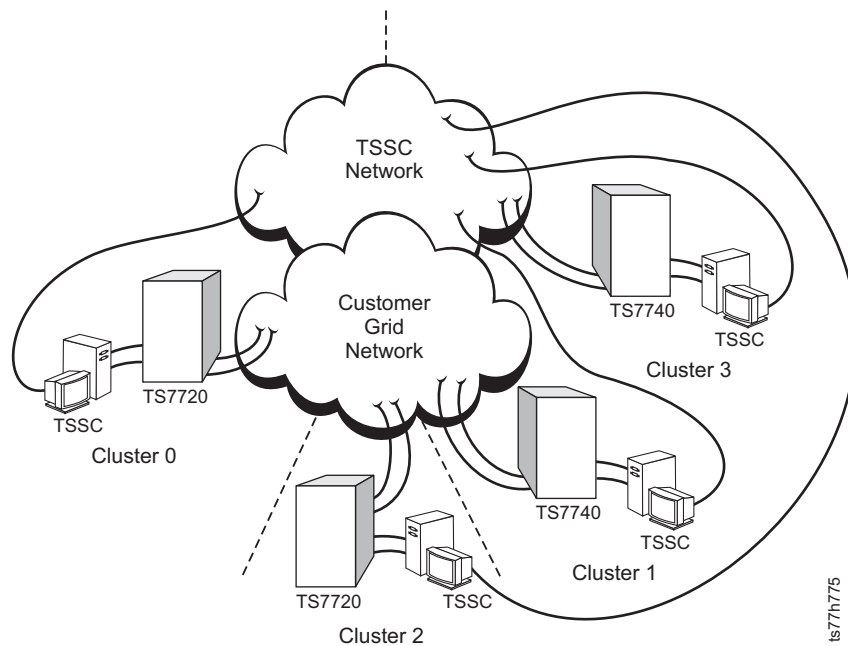


Figure 38. Autonomic Ownership Takeover Manager configuration for four clusters in a hybrid grid

If a working cluster in a TS7700 Grid is unable to process transactions with a remote cluster because communication with the remote cluster has been lost, the local cluster starts an AOTM grace period timer. Once the grace period configured by you has expired, the AOTM cluster outage detection process is initiated. The local cluster communicates with the local Master Console, which then forwards a request to a remote Master Console. The remote Master Console then attempts to communicate with the remote cluster. Only when the remote Master Console

request returns and agrees that the remote cluster has failed is the configured takeover mode enabled. Once enabled, access to data owned by the failed cluster is allowed using the enabled takeover mode.

Conditions required for takeover

When AOTM is enabled on multiple systems in a TS7700 Grid environment, takeover occurs when one TS7700 Cluster fails as long as all TSSC system consoles attached to the TS7700 Clusters remain in communication with one another.

Note: To complete the communication path between TS7700 Clusters, each TSSC system console must have a designated IP address.

Figure 39 illustrates AOTM as configured on a three-cluster Grid. In an optimal situation, WAN1 and WAN2 would reside on different physical networks. Any outage within WAN1 may appear as a TS7700 Cluster outage. This failure can be validated through WAN2 with the help of the TSSCs. If the secondary TSSC path shows the TS7700 Cluster to be available, then the failure may be isolated to the network. If both TSSCs show the TS7700 Cluster as unavailable then it is safe to assume the TS7700 Cluster is in a failed state.

Note: Each TS7700 Cluster requires a **regionally local** TSSC. However, clusters in a TS7700 Grid can share a TSSC and AOTM is supported with a single, shared TSSC when the clusters are in close proximity.

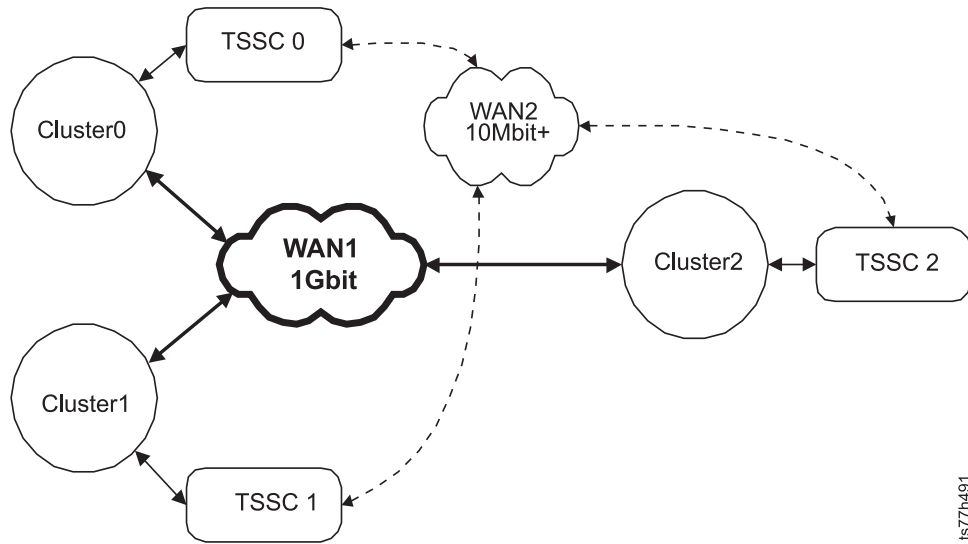


Figure 39. Autonomic Ownership Takeover Manager configuration in a three-cluster Grid

Table 61 displays the conditions under which AOTM takes over a failed cluster.

Table 61. Conditions under which AOTM takes over a failed cluster

Remote cluster appearance	Remote cluster actual state	Does present third peer recognize cluster as down?	Status of Grid links	Status of links between local TSSC and local cluster	Status of links between remote TSSC and remote cluster	Status of links between TSSCs	Notes
Down	Down	Yes	Not applicable	Connected	Connected	Connected	

Table 61. Conditions under which AOTM takes over a failed cluster (continued)

Remote cluster appearance	Remote cluster actual state	Does present third peer recognize cluster as down?	Status of Grid links	Status of links between local TSSC and local cluster	Status of links between remote TSSC and remote cluster	Status of links between TSSCs	Notes
Down	Down	Yes	Not applicable	Connected	Down	Connected	
Down	Online	Not present	Down	Connected	Down	Connected	Cluster is assumed down since last network path is down.
Down	Offline	Yes	Not applicable	Connected	Not applicable	Connected	

Table 62 displays the conditions under which AOTM does **NOT** takeover a failed cluster.

Table 62. Conditions under which AOTM does not takeover a failed cluster

Remote cluster appearance	Remote cluster actual state	Does present third peer recognize cluster as down?	Status of Grid links	Status of links between local TSSC and local cluster	Status of links between remote TSSC and remote cluster	Status of links between TSSCs	Notes
Down	Down	Yes/not present	Not applicable	Connected	Not applicable	Down	
Down	Down	Yes/not present	Not applicable	Down	Not applicable	Not applicable	
Down	Online	No	Down	Not applicable	Not applicable	Not applicable	Third cluster prevents takeover
Down	Online	Not present	Down	Connected	Connected	Connected	
Down	Offline	Yes	Not applicable	Down	Not applicable	Down	Takeover not enabled if TSSC is not present or accessible
Down	Offline	Yes	Not applicable	Connected	Not applicable	Down	Takeover not enabled if TSSC is not present or accessible

Differences between forms of takeover

AOTM is not the only form of ownership takeover that may be employed in the event of a system failure. The following descriptions of *Service Ownership Takeover*

(SOT), *Read Only Takeover/Write Only Takeover* (ROT / WOT), and AOTM are provided to avoid confusion when discussing options for ownership takeover.

SOT SOT is activated during normal operating conditions prior to bringing a system offline for upgrade, maintenance, or relocation purposes. A TS7700 Cluster in the SOT state surrenders ownership of all its data and other TS7700 Clusters in the Grid may access and mount its logical volumes.

ROT / WOT

ROT / WOT is employed when a TS7700 Cluster is in the failed state and cannot be placed in SOT, or Service mode. In this state, the logical volumes belonging to the failed TS7700 Cluster cannot be accessed or modified. You must use the TS7700 Virtualization Engine Management Interface from an active TS7700 Cluster in the Grid to establish ROT / WOT for the failed TS7700 Cluster.

AOTM represents an automation of ROT / WOT. AOTM makes it unnecessary for a user to physically intervene through the TS7700 Virtualization Engine Management Interface to access data on a failed TS7700 Cluster. AOTM limits the amount of time that logical volumes from a failed TS7700 Cluster are inaccessible and reduces opportunities for human error while establishing ROT / WOT.

Physical volume data

The following features describe data stored on physical volumes.

Automated read-only recovery

Automated read-only (RO) recovery is the process by which hierarchical storage management (HSM) recalls all active data from a particular physical volume that has exceeded its error thresholds, encountered a permanent error, or is damaged.

Some HSM functions such as reclaim or secure data erase will designate a physical volume as RO for recovery. HSM requires that a certain number of drives be available for a period of time before RO is allowed to proceed. At least one drive must be free for five minutes, or two drives must be free for any period of time. If either of these criteria is not met, HSM will defer the RO recovery of that physical volume to the next hourly cycle.

In a TS7700 Grid configuration, if a logical volume cannot be recovered from the RO volume and a valid copy exists on another TS7700 Cluster, the remote logical volume will be copied to the cluster performing the recovery and afterwards migrated to another physical volume. In this way, the previously unrecoverable copy is recovered. If the logical volume cannot be recovered, an intervention is reported.

Allocation assistance

Tape library performance can be increased by using allocation assistance to identify the subset of available clusters best suited for a given allocation (mount) request.

Device allocation assistance

Device allocation assistance (DAA) is a function that allows the host to query the TS7700 Virtualization Engine to determine which clusters should be preferred for a private (specific) mount request. When enabled, DAA returns to the host a ranked list of clusters (the preferred cluster is listed first) that determines for a specific VOLSER which cluster is best to use for device allocation.

DAA is available when all clusters in the grid have a microcode level of 8.5.0.xx or higher; it is enabled by default. If all clusters in the grid have a microcode level of 8.20.0.xx, DAA can be disabled using the following LIBRARY REQUEST command:
LIBRARY REQUEST, *library-name*, SETTING, DEVALLOC, PRIVATE, [ENABLE|DISABLE]
where *library-name* = composite-library-name

The selection algorithm orders the clusters first by those having the volume already in cache, then by those having a valid copy on tape, and then by those without a valid copy. If the mount is directed to a cluster without a valid copy, then a remote mount is the result. Thus, in special cases, even if DAA is enabled remote mounts and recalls can still occur.

Scratch allocation assistance

Scratch allocation assistance (SAA) is an extension of the DAA function for scratch mount requests. SAA filters the list of clusters in a grid to return to the host a smaller list of candidate clusters specifically designated as scratch mount candidates. By identifying a subset of clusters in the grid as sole candidates for scratch mounts, SAA optimizes scratch mounts to a TS7700 Grid.

A cluster is designated as a candidate for scratch mounts using the Scratch Mount Candidate option on the management class construct, accessible from the TS7700 Management Interface (refer to the *Management Classes* topic in the **Related information** section for additional information about the management class construct). Only those clusters specified through the assigned management class are considered for the scratch mount request. When queried by the host preparing to issue a scratch mount, the TS7700 Virtualization Engine considers the candidate list associated with the management class, along with cluster availability. The TS7700 Virtualization Engine then returns to the host a filtered, but unordered, list of candidate clusters suitable for the scratch mount operation. The z/OS allocation process then randomly chooses a device from among those candidate clusters to receive the scratch mount. In the event all candidate clusters are unavailable or in service, all clusters within the grid become candidates. In addition, if the filtered list returns clusters that have no devices configured within z/OS, all clusters in the grid become candidates.

In a hybrid configuration, the SAA function can be used to direct certain scratch allocations (workloads), to one or more TS7720 Virtualization Engines for fast access, while other workloads can be directed to TS7740 Virtualization Engines for archival purposes.

Before SAA is visible or operational, all of the following must be true:

1. All clusters in the grid have a microcode level of 8.20.0.xx and the necessary z/OS host software support is installed. Refer to Authorized Program Analysis Report (APAR) OA32957, at the Techdocs Library link in the **Related information** section for additional information.
2. The z/OS environment uses Job Entry Subsystem (JES) 2.

Note: JES3 does not support DAA or SAA. If the composite library is being shared between JES2 and JES3, do not enable SAA through the Scratch Mount Candidate option on the management classes assigned to JES3 jobs. This could cause job abends to occur in JES3.

3. SAA is enabled with the host Library Request command using the following LIBRARY REQUEST command:

LIBRARY REQUEST, *library-name*, SETTING, DEVALLOC, SCRATCH, [ENABLE|DISABLE]
where *library-name* = composite-library-name

Disabled is the default setting.

4. An adequate number of devices connected to the scratch mount candidate clusters are online at the host.

Note: If the clusters are online, but too few or no devices are online at the host, jobs using SAA can go into allocation recovery. In allocation recovery, the existing MVS allocation options for device allocation recovery (WTOR|WAITHOLD|WAITNOH|CANCEL) are used. If all or many devices associated with the candidate clusters need to be taken offline, as when servicing a cluster, then SAA should first be disabled using the host Library Request command. Thus, other clusters in the grid can be used for SAA during the outage. Alternatively, you can extend the list of candidate clusters to include clusters that have devices remaining online at the host during the outage. Use the management class construct to extend the list of candidate clusters.

Related information

“Retain Copy Mode” on page 187

 <http://www-03.ibm.com/support/techdocs/atmastr.nsf/Web/Techdocs>

Selective device access control

This topic provides information about use of selective device access control in a TS7700 Grid configuration.

Selective device access control (SDAC) allows exclusive access to one or more VOLSER ranges by only certain logical control units or subsystem IDs within a composite library for the purpose of host-initiated mounts, ejects, and changes to attributes or categories.

You can use SDAC to configure hard partitions at the LIBPORT-ID level for independent host logical partitions or system complexes. Hard partitioning prevents a host logical partition or system complex with an independent tape management configuration from inadvertently modifying or removing data owned by another host. It also prevents applications and users on one system from accessing active data on volumes owned by another system.

SDAC is enabled using FC 5271, Selective device access control. Refer to the topic *Feature details* in the **Related information** section for additional information about this feature. Each instance of this feature enables definition of eight SDAC groups, excluding the default group. This feature license key must be installed on all clusters in the grid before SDAC is enabled. You can specify one or more LIBPORT-IDs per SDAC group. Each access group is given a name and assigned mutually exclusive VOLSER ranges. Use the *Library port access groups* panel on the TS7700 Virtualization Engine Management Interface to create and configure library port access groups for use with SDAC. Access control is imposed as soon as a VOLSER range is defined. As a result, selective device protection applies retroactively to pre-existing data.

Related information

“Feature details” on page 108

Circumstances of a job failure

A job failure may result from failure of the TS7700 Virtualization Engine or of a link between TS7700 Clusters.

Failure of a TS7700 Virtualization Engine

A failure of a TS7700 Virtualization Engine causes any job using that virtual device addresses to fail. The job also fails if the failed cluster is the one sourcing the data "remote TVC". In order to re-run the jobs, host connectivity to the virtual device addresses in another TS7700 Virtualization Engine must be enabled and an appropriate ownership takeover mode selected. As long as the other TS7700 Virtualization Engine has a valid copy of a logical volume, the jobs can be retried.

Failure of one or more 1-Gb Ethernet links between TS7700 Clusters

If a logical volume is being accessed in a remote cache through a 1-Gb Ethernet link and that link fails, the job accessing that volume also fails. If the failed job is attempted again, the TS7700 Virtualization Engine uses the remaining 1-Gb Ethernet link. If both links fail, no access to any data in a remote cache is possible.

Configuring for disaster recovery

This topic provides planning information for a TS7700 Grid configuration to be used specifically for disaster recovery purposes.

The assumption is that some natural or human-caused event has made the local site's TS7700 Cluster unavailable. The TS7700 Clusters reside in different locations, separated by a distance dictated by your company's requirements for disaster recovery.

Note: Refer to "TS7700 Grid" on page 174 for guidelines pertaining to geographic location of TS7700 Clusters in a TS7700 Grid configuration.

Only the TS7700 Grid interconnection and the TSSC network connect the local site to the disaster recovery site. No host connectivity exists between local hosts and the FICON channels on the disaster recovery site's TS7700 Virtualization Engine. As part of planning a TS7700 Grid configuration to address this solution, you must consider the following:

- Plan for the necessary WAN infrastructure and bandwidth to meet the copy requirements that you need. You generally require more bandwidth if you are primarily using a copy consistency point of RUN since any delays in copy time caused by bandwidth limitations result in an elongation of job run times. If you have limited bandwidth available between sites, use the deferred copy consistency point or only copy the data that is critical to the recovery of your key operations.
- Plan for backup host connectivity at your disaster recovery site with sufficient resources to perform your critical workloads.
- Design and code the Data Facility System Managed Storage (DFSMS) Automatic Class Selection routines to control what data gets copied and by which copy consistency point.
- Prepare procedures that your operators would execute in the event the local site became unusable. The procedures would include such tasks as bringing up the disaster recovery host, varying the virtual drives online, as well as enabling one of the ownership takeover modes against the failed primary TS7700 Cluster.

Selective write protect for disaster recovery testing. You can test disaster recovery preparedness by emulating disaster recovery events and performing test operations at a TS7700 Grid disaster recovery site. The selective write protect function is a set of options configured through the *Write Protect Mode* panel on the TS7700 Virtualization Engine Management Interface. You can use this function to create categories that are excluded from write protection on a cluster, when a recovery host connected to a non-production cluster must access and validate production data without any risk of modifying it.

When Write Protect Mode is enabled on a cluster, host commands fail if they are issued to logical devices in that cluster and attempt to modify a volume's data or attributes. Meanwhile, host commands issued to logical devices in peer clusters are allowed to continue with full read and write access to all volumes in the library. A cluster can be placed into Write Protect Mode only if the cluster is online. Once set, the mode is retained through intentional and unintentional outages and can only be disabled through the same management interface panel used to enable the function. When a cluster within a grid configuration has Write Protect Mode enabled, standard grid functions such as logical volume replication and logical volume ownership transfer are unaffected.

Configuring for high availability

This topic provides information needed to plan for a TS7700 Grid configuration to be used specifically for high availability.

The assumption is that continued access to data is critical and no single point of failure, repair, or upgrade can be allowed to impact the availability of data. In a high availability configuration, two or more TS7700 Clusters are located in close proximity to one another at the same site. The TS7700 Clusters are connected through a LAN. If one of the TS7700 Clusters becomes unavailable because it has failed, is undergoing service, or is being updated, data can be accessed through another TS7700 Cluster until the original TS7700 Cluster is again available. As part of planning a TS7700 Grid configuration to address this solution, you must consider the following:

- Plan for the virtual device addresses in the clusters to be configured to the local hosts. In this way, a total of 1024 virtual tape devices (256 from each TS7700 Cluster) are available for use.
- Set up a copy consistency point of RUN for all data to be made highly available. With this copy consistency point, as each logical volume is closed it is copied to another TS7700 Cluster.
- Design and code the data facility system managed storage (DFSMS) Automatic Class Selection routines to set the necessary copy consistency point.
- Design and code the DFSMS Automatic Class Selection routines to control what data gets copied and by which copy consistency point.
- Prepare procedures that your operators would execute in the event one of the TS7700 Clusters becomes unavailable. The primary task is to enable an ownership takeover mode against a failed TS7700 Cluster in order to maintain continued access to data owned by the failed TS7700 Cluster.

Configuring for both disaster recovery and high availability

This topic provides information needed to plan for a TS7700 Grid configuration to be used for disaster recovery and high availability.

It is possible to configure a TS7700 Grid to provide for both disaster recovery and high availability solutions. The assumption is that two or more TS7700 Clusters reside in different locations, separated by a distance dictated by your company's requirements for disaster recovery. In a three-cluster or four-cluster grid configuration, disaster recovery and high availability can also be achieved simultaneously by ensuring:

- Two local, high availability clusters possess RUN volume copies and have shared access to the host
- The third and fourth remote clusters possess deferred volume copies for disaster recovery

Note: Refer to “TS7700 Grid” on page 174 for guidelines pertaining to geographic location of TS7700 Clusters in a TS7700 Grid configuration.

In addition to the considerations for configuring for disaster recovery, you must plan for:

- Access from your local site's hosts to the FICON channels on the TS7700 Cluster located at the disaster recovery site(s). This may involve connections using dense wavelength-division multiplexing (DWDM) or channel extension equipment, depending on the distance separating the sites. If the local TS7700 Cluster becomes unavailable, you would use this remote access to continue your operations using a remote TS7700 Cluster.
- Differences in read or write performance as compared to the virtual devices on the local TS7700 Cluster. These can occur because the virtual devices on a remote TS7700 Cluster are connected to the host through channel extensions. If performance differences are a concern, when the local TS7700 Virtualization Engine is unavailable consider using only the virtual device addresses in a remote TS7700 Cluster. If performance differences are an important consideration, provide procedures both for ownership takeover and for an operator to vary the virtual devices in a remote TS7700 Virtualization Engine from online to offline.
- Creation of separate copy consistency policies for disaster recovery data and data that requires high availability.

Chapter 4. Security

The topics in this section provide information about security protocols for the TS7700 Virtualization Engine.

System Storage Productivity Center and Tivoli Storage Productivity Center

The option for Role-Based Access Controls (RBAC) is available on the TS7700 Virtualization Engine or TS3500 Tape Library using the System Storage Productivity Center (SSPC), a server operating with the Tivoli Storage Productivity Center (TPC) software.

Remote authentication is supported on a TS7700 Virtualization Engine or TS3500 Tape Library using the Tivoli Secure Authentication Service (SAS) client and server, and the WebSphere® Federated Repositories. The TS7700 Virtualization Engine or TS3500 Tape Library must connect to an SSPC appliance or a server using TPC. The SAS client is integrated into the TS7700 Virtualization Engine microcode or the TS3500 Tape Library firmware, while the SAS server and the WebSphere Federated Repositories are integrated into TPC 4.1 and higher. TPC is available as a software-only package or as an integrated solution on the SSPC appliance.

When SAS is enabled, the TS3500 Tape Library passes user authentication requests to the SAS server on the SSPC or TPC, where they are forwarded to the customer's Lightweight Directory Access Protocol (LDAP) or Microsoft Active Directory (AD) server. The LDAP or AD server then authenticates the user's ID and password; if they are valid then one or more user groups are assigned. The TS7700 Virtualization Engine or TS3500 Tape Library then assigns the user a role based on the LDAP or AD group.

This central repository allows you to accomplish the following security tasks from a single interface, without logging in to multiple machines:

- Add or remove a user
- Reset or change a password
- Assign, change, or delete the role of a user

A central repository can also simplify the process of responding to new security requirements. For instance, rules for passwords can be changed in one location without reconfiguring multiple, affected machines. By comparison, when local authentication is employed, each individual machine maintains an internal database of user IDs, with corresponding passwords and roles.

LDAP dependency

The WebSphere Federated Repositories component of the SSPC or TPC receives authentication requests from attached devices such as the TS7700 Virtualization Engine through the SAS. The SAS passes user ID and password information to the LDAP or AD server. The LDAP or AD server returns authentication status to the SSPC or TPC, which forwards the authentication status through the SAS to the requesting device. The LDAP or AD server attached to the SSPC or TPC manages the following information:

User ID

A string to identify a specific user

User password

A password for each user ID

Groups

Strings to identify one or more groups of users. The TS7700 Virtualization Engine can assign groups of users a particular role.

Each user is defined as a member of one or more groups, meaning the user assumes the roles defined by those groups.

Mapping groups to roles


When a user is successfully authenticated using the SAS client, the resulting user information includes a list of groups the user belongs to. You can use the TS7700 Virtualization Engine Management Interface to define how groups are mapped to roles.

For more information about TPC, visit the web at <http://www-03.ibm.com/systems/storage/software/center/index.html>. Refer to the PUBLIB link in the **Related information** section for additional information about TPC security features, including the external topic *Using Microsoft Active Directory for authentication*.

Related information

“Connecting to the management interface” on page 219

“Establish a connection to the Storage Authentication Server”

 http://publib.boulder.ibm.com/infocenter/wasinfo/v7r0/index.jsp?topic=/com.ibm.websphere.base.doc/info/aes/ae/cwim_fedrepos.html

Establish a connection to the Storage Authentication Server

This topic provides instructions for establishing a connection to the Storage Authentication Server for the System Storage Productivity Center.

To establish a connection to the Storage Authentication Server you must use an integrated portal and the TS7700 Virtualization Engine Management Interface.

1. Set up a System Storage Productivity Center by configuring the TotalStorage Productivity Center to communicate with an external Lightweight Directory Access Protocol (LDAP) repository.

Note: Refer to the topic *Changing the user authentication method*, available from the PUBLIB link in the **Related information** section for configuring instructions.

2. Use the *Add Storage Authentication Service policy* panel of the TS7700 Virtualization Engine Management Interface to create a new storage authentication service policy. On this panel:
 - a. Enter a unique policy name
 - b. Enter an address for the TotalStorage Productivity Center
 - c. Retrieve the certificate
 - d. Enter an administrative user name and password for the TotalStorage Productivity Center
 - e. Click **OK**

3. Use the *Modify Storage Authentication Service policy* panel of the TS7700 Virtualization Engine Management Interface to modify the new storage authentication service policy.

Add users and groups from the LDAP server that you want to give permission to access the management interface.

4. Use the *Assign authentication policy* panel of the TS7700 Virtualization Engine Management Interface to assign the new authentication policy to one or more clusters.

Enter the user name and password for the user(s) assigned to the administrator role by the new policy.

Related information

“Connecting to the management interface” on page 219

http://publib.boulder.ibm.com/infocenter/tivihelp/v4r1/topic/com.ibm.tpc_V41.doc/fqz0_c_change_user_auth_method.html

Audit logging

Audit logging tracks user actions that have the potential to negatively affect TS7700 Virtualization Engine operations if performed incorrectly or maliciously.

User actions that have the potential to negatively affect operations include such things as:

- Log on and log out events
- Configuration changes
- Varying the machine on or off
- User-initiated media export
- Code updates

Audit logging events are captured by Simple Network Management Protocol (SNMP) traps that capture the following information associated with the event:

- Identification of the machine affected, by IP address
- User ID
- Description of the event
- Any applicable parameter data

These SNMP traps occur in real time (log events are sent as they occur) and the logs are maintained on a remote server in a secure area. You can use the TS7700 Virtualization Engine Management Interface to configure and test SNMP traps on a TS7700 Cluster.

You can use any SNMP monitoring application to receive log events. The same application can also be used to filter the logged events, allowing for a single monitoring and filtering application for all clusters in the grid. The use of an SNMP Management Information Block (MIB) file permits you to replace a full text log description with a message identifier, preserving valuable storage space. The Tivoli Security Information Event Manager is an SNMP monitoring application that can be used to achieve these benefits.

Follow these instructions to locate and download a SNMP MIB file:

1. Open the following link in your web browser: <http://www-933.ibm.com/support/fixcentral/>.
2. Select **Storage Systems** from the **Product Group** menu.

3. Select **Tape Systems** from the **Product Family** menu.
4. Select **Tape Virtualization** from the **Product Type** menu.
5. Select **System Storage TS7740/TS7720 Virtualization Engine (3957-V06/VEA)** from the **Product** menu.
6. Select **All** from the **Platform** menu.
7. Click **Continue**.
8. On the **Select Fixes** page, check the box next to the desired SNMP MIB file.
9. Click **Continue**.
10. On the **Download Options** page, select **Download using Download Director**.
11. Select the checkbox next to **Include prerequisites and co-requisite fixes**.
12. Click **Continue**.
13. On the **Download files using Download Director** page, ensure that the checkbox next to the SNMP MIB file version you want is checked and click **Download now**. The Download Director applet opens. The downloaded file is saved at C:\DownloadDirector\.

Related information

“Connecting to the management interface” on page 219

SNMP MIB definitions

This topic defines the trap type values that can be present on an SNMP Management Information Block (MIB) log file.

Refer to Table 63 to identify a specific trap type present on the MIB log.

Table 63. SNMP MIB definitions

Trap type	Description
hydAccountManagement	This trap is sent when a new task is created in the task_tracking database. It logs account management on the TS7700 Virtualization Engine.
hydActivateCodeImage	This trap is sent when a SMIT command is executed. It logs activation of TS7700 Virtualization Engine code images on the TS7700 Virtualization Engine.
hydActivateTapeMicrocode	This trap is sent when a SMIT command is executed. It logs activation of tape drive microcode on the TS7700 Virtualization Engine.
hydActivateTapeMicrocode2	This trap is sent when a SMIT command is executed. It logs activation of tape drive microcode on the TS7700 Virtualization Engine (Duplicate SMIT type entry).
hydAddAccessGroupVolumeRanges	This trap is sent when a new task is created in the task_tracking database. It logs when access group volume ranges are added to the TS7700 Virtualization Engine.
hydAddLibraryPortAccessGroup	This trap is sent when a new task is created in the task_tracking database. It logs when a library port access group is added or modified on the TS7700 Virtualization Engine.
hydAddModifyOrDeleteUser	This trap is sent when a new task is created in the task_tracking database. It logs when a user account is added, modified or deleted on the TS7700 Virtualization Engine.
hydAddOrModifyCategory	This trap is sent when a new task is created in the task_tracking database. It logs when a category is added or modified on the TS7700 Virtualization Engine.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydAddOrModifyConstruct	This trap is sent when a new task is created in the task_tracking database. It logs when a construct is added or modified on the TS7700 Virtualization Engine.
hydAutomaticOwnership	This trap is sent when a SMIT command is executed. It logs configuring automatic ownership takeover manager to a remote cluster on the TS7700 Virtualization Engine.
hydBringNodeOffline	This trap is sent when a new task is created in the task_tracking database. It logs that a node was brought offline on the TS7700 Virtualization Engine.
hydBringOnline	This trap is sent when a new task is created in the task_tracking database. It logs that the TS7700 Virtualization Engine was brought online.
hydCacheFailure	This trap is sent when a physical drive failure is detected on the TS7700 Virtualization Engine.
hydCacheRebuild	This trap is sent when a physical drive is being rebuilt on the TS7700 Virtualization Engine.
hydCacheReplaceSuccess	This trap is sent when a physical drive has been successfully replaced on the TS7700 Virtualization Engine.
hydCallHomeFilters	This trap is sent when a SMIT command is executed. It logs the changing or displaying of call home filters on the TS7700 Virtualization Engine.
hydCallHomeRemoteServices	This trap is sent when a SMIT command is executed. It logs the changing or displaying of call home or remote services on the TS7700 Virtualization Engine.
hydCancelCopyExport	This trap is sent when a new task is created in the task_tracking database. It logs when a copy export is cancelled on the TS7700 Virtualization Engine.
hydCancelMove	This trap is sent when a new task is created in the task_tracking database. It logs when a move or eject of physical volumes is canceled on the TS7700 Virtualization Engine.
hydCancelOperation	This trap is sent when a new task is created in the task_tracking database. It logs when an operation is cancelled on the TS7700 Virtualization Engine.
hydCancelService	This trap is sent when a SMIT command is executed. It logs when service/service prep is cancelled on the TS7700 Virtualization Engine.
hydCancelServicePrep	This trap is sent when a new task is created in the task_tracking database. It logs when a service prep is cancelled from the interface on the TS7700 Virtualization Engine.
hydChangeStackedVolumeToRO	This trap is sent when a SMIT command is executed. It logs when the stacked volume is changed to read only on the TS7700 Virtualization Engine.
hydChangeTapeDriveSettings	This trap is sent when a SMIT command is executed. It logs when the tape drive settings are changed on the TS7700 Virtualization Engine.
hydChangeVPD	This trap is sent when a SMIT command is executed. It logs changes to Vital Product Data (VPD) on the TS7700 Virtualization Engine.
hydClusterFamilies	This trap is sent when a new task is created in the task_tracking database. It logs when cluster families change on the TS7700 Virtualization Engine.
hydClusterHealthScan	This trap is sent when a new task is created in the task_tracking database. It logs a cluster health scan on the TS7700 Virtualization Engine.
hydClusterNetworkSettings	This trap is sent when a new task is created in the task_tracking database. It logs cluster network settings on the TS7700 Virtualization Engine.
hydCommandText	The message with a more detailed description of the task, this can be empty if it is not sent in the trap. Access the TS7700 Virtualization Engine Management Interface to view the command text.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydCommandTextId	The message ID mapped to a string with a more detailed description of the task. The full string is shown in the TS7700 Virtualization Engine Management Interface. The text may be sent in the hydCommandText value.
hydCommandTextInserts	The specific inserts for the message with details info about the task. Used to insert context-sensitive values into the static message mapped to hydCommandTextId.
hydCompleteNonConcurrentLoad	This trap is sent when a SMIT command is executed. It logs completing a non-concurrent 3956 microcode load on the TS7700 Virtualization Engine.
hydConfigTSSCIP	This trap is sent when a SMIT command is executed. It logs the IBM TSSC TCP/IP configuration on the TS7700 Virtualization Engine.
hydConfigureFICON	This trap is sent when a SMIT command is executed. It logs configuration of FICON 1Gbit/2Gbit/4Gbit settings on the TS7700 Virtualization Engine.
hydConfigureGridDegradation	This trap is sent when a SMIT command is executed. It logs configuration of grid degradation detection settings on the TS7700 Virtualization Engine.
hydConfigureLocalCluster	This trap is sent when a SMIT command is executed. It logs configuration of the local cluster with remote cluster network IPs on the TS7700 Virtualization Engine.
hydConfigureLocalGrid	This trap is sent when a SMIT command is executed. It logs configuration of the local GRID network IPs on the TS7700 Virtualization Engine.
hydConfigureNetworkPort	This trap is sent when a SMIT command is executed. It logs configuration of network ports for remote connection on the TS7700 Virtualization Engine.
hydCopyExport	This trap is sent when a new task is created in the task_tracking database. It logs a copy export on the TS7700 Virtualization Engine.
hydCopyExportSettings	This trap is sent when a new task is created in the task_tracking database. It logs a copy of export settings on the TS7700 Virtualization Engine.
hydCopyPolicy	This trap is sent when a new task is created in the task_tracking database. It logs the copy policy on the TS7700 Virtualization Engine.
hydCurrentStep	The current step that is being executed for the task. Used in conjunction with hydTotalSteps to determine how far the task has progressed. Since the notification is sent when the task is first created, the user will not see a progression of the task. The management interface for the TS7700 Virtualization Engine provides updated status on the progression of a task.
hydCustomerConfig	This trap is sent when a SMIT command is executed. It logs customer configuration settings on the TS7700 Virtualization Engine.
hydDeleteAccessGroupVolumeRanges	This trap is sent when a new task is created in the task_tracking database. It logs when access group volume ranges are deleted from the interface on the TS7700 Virtualization Engine.
hydDataManagement	This trap is sent when a SMIT command is executed. It logs data management settings on the TS7700 Virtualization Engine.
hydDeleteCategory	This trap is sent when a new task is created in the task_tracking database. It logs deletion of a category on the TS7700 Virtualization Engine.
hydDeleteConstruct	This trap is sent when a new task is created in the task_tracking database. It logs deletion of a construct on the TS7700 Virtualization Engine.
hydDeleteLibraryPortAccessGroup	This trap is sent when a new task is created in the task_tracking database. It logs deletion of a library port access group on the TS7700 Virtualization Engine.
hydDeleteRange	This trap is sent when a new task is created in the task_tracking database. It logs deletion of a range on the TS7700 Virtualization Engine.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydDisableTapeDrivePath	This trap is sent when a SMIT command is executed. It logs when a tape drive path is disabled on the TS7700 Virtualization Engine.
hydDisasterRecovery	This trap is sent when a new task is created in the task_tracking database. It logs recovery from disaster on the TS7700 Virtualization Engine.
hydEjectPhysicalVolumes	This trap is sent when a new task is created in the task_tracking database. It logs when unassigned physical volumes are ejected on the TS7700 Virtualization Engine.
hydEnableTapeDrivePath	This trap is sent when a SMIT command is executed. It logs when a tape drive path is enabled on the TS7700 Virtualization Engine.
hydExport	This trap is sent when a new task is created in the task_tracking database. It logs an export on the TS7700 Virtualization Engine.
hydForce3957Offline	This trap is sent when a SMIT command is executed. It logs when a 3957-V06/VEA is forced offline on the TS7700 Virtualization Engine.
hydGeneric	This trap is sent when a new task is created in the task_tracking database. It logs a generic task on the TS7700 Virtualization Engine.
hydGridProperties	This trap is sent when a new task is created in the task_tracking database. It logs changes to grid properties on the TS7700 Virtualization Engine.
hydImport	This trap is sent when a new task is created in the task_tracking database. It logs an import on the TS7700 Virtualization Engine.
hydInfoCenterSettings	This trap is sent when a new task is created in the task_tracking database. It logs changes to InfoCenter settings on the TS7700 Virtualization Engine.
hydInitiateForcedServicePrep	This trap is sent when a SMIT command is executed. It logs initiation of a forced service prep on the TS7700 Virtualization Engine.
hydInitiateMicrocodeActivation	This trap is sent when a SMIT command is executed. It logs TS7700 Virtualization Engine microcode activation on the TS7700 Virtualization Engine.
hydInitiateServicePrep	This trap is sent when a SMIT command is executed. It logs initiation of service prep on the TS7700 Virtualization Engine.
hydIntCancelService	This trap is sent when a new task is created in the task_tracking database. It logs a cancellation of service from the interface on the TS7700 Virtualization Engine.
hydJoinLocalSystem	This trap is sent when a SMIT command is executed. It logs joining a local system with a remote cluster on the TS7700 Virtualization Engine.
hydLogicalVolumeDelete	This trap is sent when a new task is created in the task_tracking database. It logs deletion of logical volumes on the TS7700 Virtualization Engine.
hydLogicalVolumeInsert	This trap is sent when a new task is created in the task_tracking database. It logs insertion of logical volumes on the TS7700 Virtualization Engine.
hydLoginLogout	This trap is sent when a new task is created in the task_tracking database. It logs user log in and log out events on the TS7700 Virtualization Engine.
hydLowerRemovalThreshold	This trap is sent when a new task is created in the task_tracking database. It logs temporary lower removal threshold on the TS7700 Virtualization Engine.
hydMicrocodeUpdate	This trap is sent when a new task is created in the task_tracking database. It logs an update of the microcode on the TS7700 Virtualization Engine.
hydMigrateAllIvols	This trap is sent when a SMIT command is executed. It logs when all the logical volumes in cache are migrated to tape and clears the cache (-m) on the TS7700 Virtualization Engine.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydModifyClusterPairProperties	This trap is sent when a new task is created in the task_tracking database. It logs a change to cluster pair properties on the TS7700 Virtualization Engine.
hydModifyClusterProperties	This trap is sent when a new task is created in the task_tracking database. It logs a change to cluster properties on the TS7700 Virtualization Engine.
hydModifyDateAndTimeSettings	This trap is sent when a new task is created in the task_tracking database. It logs a change to the date and time on the TS7700 Virtualization Engine0.
hydModifyFeatureLicensing	This trap is sent when a new task is created in the task_tracking database. It logs a change to feature licensing on the TS7700 Virtualization Engine.
hydModifyKeyManager	This trap is sent when a new task is created in the task_tracking database. It logs a change to the key manager on the TS7700 Virtualization Engine.
hydModifyLogicalVolumes	This trap is sent when a new task is created in the task_tracking database. It logs a change to logical volumes on the TS7700 Virtualization Engine.
hydModifyNodeNickname	This trap is sent when a new task is created in the task_tracking database. It logs a change to a node nickname on the TS7700 Virtualization Engine.
hydModifyPool	This trap is sent when a new task is created in the task_tracking database. It logs a change to a pool on the TS7700 Virtualization Engine.
hydModifyPoolEncryption	This trap is sent when a new task is created in the task_tracking database. It logs a change to pool encryption on the TS7700 Virtualization Engine.
hydModifyRange	This trap is sent when a new task is created in the task_tracking database. It logs when a range is modified on the TS7700 Virtualization Engine.
hydModifyRemovalThreshold	This trap is sent when a new task is created in the task_tracking database. It logs a change to the cache of temporary removal threshold on the TS7700 Virtualization Engine.
hydModifyRolePermissions	This trap is sent when a new task is created in the task_tracking database. It logs a change to role permissions on the TS7700 Virtualization Engine.
hydMoveListLogicalVolumes	This trap is sent when a new task is created in the task_tracking database. It logs moving a list of logical volumes on the TS7700 Virtualization Engine.
hydMoveLogicalVolumePools	This trap is sent when a new task is created in the task_tracking database. It logs moving of logical volume pools on the TS7700 Virtualization Engine.
hydMovePoolsLogicalVolumes	This trap is sent when a new task is created in the task_tracking database. It logs the moving of pools for a list of logical volumes on the TS7700 Virtualization Engine.
hydMoveQuantity	This trap is sent when a new task is created in the task_tracking database. It logs when a move or eject of a quantity of physical volumes occurs on the TS7700 Virtualization Engine.
hydMoveRange	This trap is sent when a new task is created in the task_tracking database. It logs when a move or eject of a range of physical volumes occurs on the TS7700 Virtualization Engine.
hydNodeHealth	This trap is sent when a new task is created in the task_tracking database. It logs the node health on the TS7700 Virtualization Engine.
hydOperationalMode	This trap is sent when a new task is created in the task_tracking database. It logs that the TS7700 Virtualization Engine is in operational mode.
hydOperatorInterventionsChange	This trap is sent when a new task is created in the task_tracking database. It logs when operator interventions are changed on the TS7700 Virtualization Engine.
hydOperatorInterventionsClear	This trap is sent when a new task is created in the task_tracking database. It logs when operator interventions are cleared on the TS7700 Virtualization Engine.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydOwnershipTakeover	This trap is sent when a new task is created in the task_tracking database. It logs an ownership takeover on the TS7700 Virtualization Engine.
hydOwnershipTakeoverMode	This trap is sent when a new task is created in the task_tracking database. It logs the ownership takeover mode on the TS7700 Virtualization Engine.
hydPerformDB2Reorg	This trap is sent when a SMIT command is executed. It logs performing a database (DB2 [®]) reorganization on the TS7700 Virtualization Engine.
hydPerformSwitchover	This trap is sent when a SMIT command is executed. It logs the event of switching to a new microcode image on the TS7700 Virtualization Engine.
hydPremigrateIvols	This trap is sent when a SMIT command is executed. It logs when all resident logical volumes are premigrated to tape (-p) on the TS7700 Virtualization Engine.
hydPrepareNonConcurrentLoad	This trap is sent when a SMIT command is executed. It the log preparation of a non-concurrent 3956-CC6 microcode load on the TS7700 Virtualization Engine.
hydProgressText	The message with a progress information for the task, this can be empty if it is not sent in the trap. Access the TS7700 Virtualization Engine Management Interface to view the progress text.
hydProgressTextId	The message ID that maps to a string with a more detailed description of the current progress of a task. The full string is shown in the TS7700 Virtualization Engine Management Interface. The text may be sent in the hydProgressText value.
hydProgressTextInserts	The specific inserts for the message with details on the progress of the task. Used to insert context-sensitive values into the static message mapped to hydProgressTextId.
hydPromoteRecallQueue	This trap is sent when a new task is created in the task_tracking database. It logs a promotion of the recall queue on the TS7700 Virtualization Engine.
hydReclaimSchedule	This trap is sent when a new task is created in the task_tracking database. It logs when an inhibit reclaim schedule is added or modified on the TS7700 Virtualization Engine.
hydReconfigureAllTape	This trap is sent when a SMIT command is executed. It logs the usage of vtd_hardconf_config, which reconfigures all tape devices on the TS7700 Virtualization Engine.
hydRemoteLogin	This trap is sent when a new task is created in the task_tracking database. It logs a remote login on the TS7700 Virtualization Engine.
hydRemoveClusterFromGrid	This trap is sent when a SMIT command is executed. It logs the removal of a cluster from the grid on the TS7700 Virtualization Engine.
hydRemoveClusterHardwareChange	This trap is sent when a new task is created in the task_tracking database. It logs the removal of a cluster due to hardware change on the TS7700 Virtualization Engine.
hydRemoveDefectiveControllerCard	This trap is sent when a SMIT command is executed. It logs the removal of a defective cache controller adapter card on the TS7700 Virtualization Engine.
hydRemoveDefectiveDisk	This trap is sent when a SMIT command is executed. It logs the removal or replacement of a defective system hard disk (not 3956-Cxx disk cache) on the TS7700 Virtualization Engine.
hydRemoveDefectiveEthernetCard	This trap is sent when a SMIT command is executed. It logs the removal of a defective Ethernet adapter card on the TS7700 Virtualization Engine.
hydRemoveDefectiveFibre	This trap is sent when a SMIT command is executed. It logs the removal or replacement of a defective fibre switch on the TS7700 Virtualization Engine.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydRemoveDefectiveHostCard	This trap is sent when a SMIT command is executed. It logs the removal of a defective host adapter card on the TS7700 Virtualization Engine.
hydRemoveDefectiveRouter	This trap is sent when a SMIT command is executed. It logs the removal or replacement a defective router on the TS7700 Virtualization Engine.
hydRemoveDefectiveTapeCard	This trap is sent when a SMIT command is executed. It logs the removal of a defective tape adapter card on the TS7700 Virtualization Engine.
hydRemoverClusterDisasterRecovery	This trap is sent when a new task is created in the task_tracking database. It logs the removal of a cluster due to disaster recovery on the TS7700 Virtualization Engine.
hydRepairFibrePaths	This trap is sent when a SMIT command is executed. It logs repairing fibre paths to disk cache controllers on the TS7700 Virtualization Engine.
hydRepairLogicalVolumes	This trap is sent when a new task is created in the task_tracking database. It logs the repair of damaged logical volumes on the TS7700 Virtualization Engine.
hydResetCallHomeDaemon	This trap is sent when a SMIT command is executed. It logs a reset of the call home daemon on the TS7700 Virtualization Engine.
hydResetFCPPath	This trap is sent when a SMIT command is executed. It logs the reset of a fibre channel path (FCP) on the TS7700 Virtualization Engine.
hydResetFCPPath2	This trap is sent when a SMIT command is executed. It logs the reset of an FCP on the TS7700 Virtualization Engine (Duplicate SMIT type entry).
hydResetHostAdapterCode	This trap is sent when a SMIT command is executed. It logs the reset of host adapter code on the TS7700 Virtualization Engine.
hydResetNetworkInterface	This trap is sent when a SMIT command is executed. It logs the reset of a network adapter interface on the TS7700 Virtualization Engine.
hydResetNetworkInterface2	This trap is sent when a SMIT command is executed. It logs the reset of a network adapter interface on the TS7700 Virtualization Engine (Duplicate SMIT type entry).
hydResetRouter	This trap is sent when a SMIT command is executed. It logs the reset of the router on the TS7700 Virtualization Engine.
hydResetRouter2	This trap is sent when a SMIT command is executed. It logs the reset of the router on the TS7700 Virtualization Engine (Duplicate SMIT type entry)
hydRestart3957	This trap is sent when a SMIT command is executed. It logs a shut down and restart of the 3957-V06/VEA on the TS7700 Virtualization Engine.
hydResumeFailedHotSwap	This trap is sent when a SMIT command is executed. It logs resumption of operations following a failed adapter card hotswap on the TS7700 Virtualization Engine.
hydResyncDatabase	This trap is sent when a SMIT command is executed. It logs a resynchronization of the database with the physical library inventory on the TS7700 Virtualization Engine.
hydResyncTapeDrive	This trap is sent when a SMIT command is executed. It logs a resynchronization of a tape drive following activation of tape drive code on the TS7700 Virtualization Engine.
hydRLogin	This trap is sent when a SMIT command is executed. It logs a remote log in on the TS7700 Virtualization Engine.
hydRLogout	This trap is sent when a SMIT command is executed. It logs a remote log out on the TS7700 Virtualization Engine.
hydRunFibreSwitchSetup	This trap is sent when a SMIT command is executed. It logs when the fibre switch setup is run on the TS7700 Virtualization Engine.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydRunFibreSwitchUtility	This trap is sent when a SMIT command is executed. It logs when the fibre switch utility is run on the TS7700 Virtualization Engine.
hydRunPFE	This trap is sent when a SMIT command is executed. It logs when PFE/Support Center provided functions are run from a CD-ROM on the TS7700 Virtualization Engine.
hydSecuritySettings	This trap is sent when a new task is created in the task_tracking database. It logs changes to the security settings on the TS7700 Virtualization Engine.
hydService	This trap is sent when a new task is created in the task_tracking database. It logs service on the TS7700 Virtualization Engine.
hydServicePrep	This trap is sent when a new task is created in the task_tracking database. It logs a service prep initiated from the interface on the TS7700 Virtualization Engine.
hydSetCustomerRouterConfig	This trap is sent when a SMIT command is executed. It logs when customer router configuration is set on the TS7700 Virtualization Engine.
hydSetDateAIX	This trap is sent when a SMIT command is executed. It logs when the date/time using the AIX Tool (ONLY for first time installs) is set on the TS7700 Virtualization Engine.
hydSetDateStandard	This trap is sent when a SMIT command is executed. It logs when the date/time using standard format is set on the TS7700 Virtualization Engine.
hydSetFullRouterConfig	This trap is sent when a SMIT command is executed. It logs when the full router configuration is set on the TS7700 Virtualization Engine.
hydSetLocalGridTSSCIP	This trap is sent when a SMIT command is executed. It logs when the local grid TSSC IP is set on the TS7700 Virtualization Engine.
hydSetNTPAddress	This trap is sent when a SMIT command is executed. It logs when the NTP server address for date/time synchronization is set on the TS7700 Virtualization Engine.
hydSetTSSCRouterConfig	This trap is sent when a SMIT command is executed. It logs when the TSSC router configuration is set on the TS7700 Virtualization Engine.
hydShutdown3957	This trap is sent when a SMIT command is executed. It logs when the 3957-V06/VEA is shut down on the TS7700 Virtualization Engine.
hydShutdownCache	This trap is sent when a SMIT command is executed. It logs when the cache (3956-Cxx) and 3957-V06/VEA are shut down on the TS7700 Virtualization Engine.
hydShutdownNode	This trap is sent when a new task is created in the task_tracking database. It logs that a node was shutdown on the TS7700 Virtualization Engine.
hydSmitInvokedCommand	This trap is sent when a new task is created in the task_tracking database. It logs when a command is invoked in SMIT on the TS7700 Virtualization Engine.
hydSNMPSettings	This trap is sent when a new task is created in the task_tracking database. It logs changes to the SNMP settings on the TS7700 Virtualization Engine.
hydSpeedDuplexSettings	This trap is sent when a SMIT command is executed. It logs showing or changing the customer network speed and duplex settings on the TS7700 Virtualization Engine.
hydStandAloneDemount	This trap is sent when a new task is created in the task_tracking database. It logs that a stand-alone volume was demounted on the TS7700 Virtualization Engine.
hydStandaloneMount	This trap is sent when a new task is created in the task_tracking database. It logs that a stand-alone volume was mounted on the TS7700 Virtualization Engine.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydStatus	The current status of the task. The possible values are: in progress (1), finished with success (2), cancelled (3), failed (4), finished successfully with some extra information provided (5), finished successfully with some warnings (6), in the process of cancelling (7)
hydSynchronizeTime	This trap is sent when a SMIT command is executed. It logs the synchronization of time between clusters on the TS7700 Virtualization Engine.
hydTapeDriveUtilities	This trap is sent when a SMIT command is executed. It logs the usage of tape drive utilities (tapeutil) on the TS7700 Virtualization Engine.
hydTaskId	A unique ID assigned to each task in the TS7700 Virtualization Engine database.
hydTaskName	The string representation of the task type. This value should be the same value that is mapped to hydType.
hydTimeCreated	The timestamp when the task record is created. The time is in GMT. The timestamp is given in the following format: YYYY-MM-DD-HH.MM.SS.SSSSS
hydTotalSteps	The total number of steps involved in completing this particular task. Used in conjunction with the hydCurrentStep to determine progress of a task. Since the notification is sent when the task is first created, the user will not see a progression of the task. The management interface for the TS7700 Virtualization Engine provides updated status on the progression of a task.
hydType	The integer specifies the type of task that was initiated by the user. Current values are: Insert logical volumes (1), Delete logical volumes (2), Stand-alone mount (3), Import (4), Export (5), Operational mode (6), Microcode update (7), Bring node offline (8), Shutdown node (9), Ownership Takeover mode (10), Bring online (11), Modify feature licensing (12), Add, modify, or delete user (13), Modify role permissions (14), Modify date and time settings (15), Modify node nickname (16), Modify cluster properties (17), Modify grid properties (18), Generic (19), Service (20), Stand-alone demount (21), Account Management (22), Cluster Network Settings (23), Write-Protect Mode (24), Node Health (25), Cluster Health Scan (26), Copy Policy (27), Disaster Recovery (28), Modify Pool Encryption (29), Modify Key Manager (30), Cancel operation (31), Repair damaged logical volumes (32), Ownership Takeover (33), Promote recall queue (34), Remove cluster - hardware change (35), Remove cluster - disaster recovery (36), Add or Modify Category (37), Delete Category (38), Add or Modify Construct (39), Delete Construct (40), Modify Pool (41), Modify Range (42), Delete Range (43), Add/Modify Inhibit Reclaim Schedule (44), Eject unassigned physical volume(s) (45), Move/Eject Quantity of Physical Volumes (46), Move/Eject Range of Physical Volumes (47), Cancel Move/Eject of Volumes (48), Modify Cluster Pair Properties (49), Operator Interventions change (50), Operator Interventions clear (51), Move List of Logical Volumes (52), Move Pools for List of Logical Volumes (53), Modify Logical Volumes (54), Move Logical Volume Pools (55), Copy Export (56), Cancel Copy Export (57), Add or Modify Library Port Access Group (58), Delete Library Port Access Group (59), Cluster Families (60), Security Settings (61), SNMP Settings (62), InfoCenter Settings (63), Temporary Lower Removal Threshold (64), Modify Cache Temporary Removal Threshold (65), Login/Logout (66), Copy Export Settings (67)
hydUpdateAIXLevel	This trap is sent when a SMIT command is executed. It logs an update to the AIX maintenance level on the TS7700 Virtualization Engine.
hydUpdateVPD	This trap is sent when a SMIT command is executed. It logs an update to VPD from current physical router settings on the TS7700 Virtualization Engine.

Table 63. SNMP MIB definitions (continued)

Trap type	Description
hydUserControlledEvent	This trap is sent when a SMIT command is executed. It logs the addition or removal of a user-controlled event for online capability on the TS7700 Virtualization Engine.
hydUserName	The username that was used to log in to the TS7700 Virtualization Engine and initiate the particular task.
hydVary3957Offline	This trap is sent when a SMIT command is executed. It logs when the 3957-V06/VEA is varied offline on the TS7700 Virtualization Engine.
hydVary3957Online	This trap is sent when a SMIT command is executed. It logs when the 3957-V06/VEA is varied online on the TS7700 Virtualization Engine.
hydVaryHostAdapterOffline	This trap is sent when a SMIT command is executed. It is sent when offline host adapters are varied on the TS7700 Virtualization Engine.
hydVaryHostAdapterOnline	This trap is sent when a SMIT command is executed. It is sent when online host adapters are varied on the TS7700 Virtualization Engine.
hydVaryTapeOffline	This trap is sent when a SMIT command is executed. It logs when a tape drive is varied offline on the TS7700 Virtualization Engine.
hydVaryTapeOnline	This trap is sent when a SMIT command is executed. It logs when a tape drive is varied online on the TS7700 Virtualization Engine.
hydWriteProtectMode	This trap is sent when a new task is created in the task_tracking database. It logs write-protect mode on the TS7700 Virtualization Engine.
ibmTaskTrackingNotificationsGroup	This group defines those notifications that MUST be implemented by a compliant implementation.
ibmTaskTrackingObjectsGroup	This group defines those MIB objects that MUST be implemented by a compliant implementation.

Related information

“Connecting to the management interface” on page 219

Chapter 5. Managing

This section provides instructions for connecting to the TS7700 Virtualization Engine Management Interface and shutting down the TS7700 Virtualization Engine.

Connecting to the management interface

This topic describes how to connect to the IBM Virtualization Engine TS7700 Management Interface.

Before you begin

The TS7700 Virtualization Engine must first be installed and configured. A supported web browser must also be installed.

Note: Refer to the following table for a list of supported browsers.

Table 64. Supported browsers

Browser	Version supported	Version tested
Internet Explorer	6.0.x, 7.x, 8.x†	7.x
Mozilla Firefox	2.0.x, 3.0.x, 3.5.x, 3.6.x	3.5

†If you are operating a microcode level of 8.7.0.xx or earlier and using Internet Explorer version 8.x (IE8) to view the TS7700 Virtualization Engine Management Interface, it is suggested to turn on IE8 Compatibility View in the browser. To turn on IE8 Compatibility View:

1. Open the TS7700 Virtualization Engine Management Interface for a cluster using IE8.
2. In the browser menu bar, select **Tools>Compatibility View** or select the **Compatibility View** button on the browser address bar.

The management interface now displays as if an earlier version of Internet Explorer is being used. IE8 remembers this setting and should use Compatibility View each time the management interface address is entered.

About this task

The following steps help you connect to the TS7700 Virtualization Engine Management Interface through an installed web browser.

Procedure

1. In the address bar of a supported web browser, enter **http://** followed by the **virtual IP** entered during installation, followed by **/Console**. The virtual IP is one of three customer IP addresses given during installation. The complete URL takes this form: **http://virtual IP address/Console**.
2. Press the **Enter** key on your keyboard or the **Go** button on your web browser.

Bookmarking Note: The web browser redirects to **http://virtual IP address/cluster ID associated with virtual IP address**. If you bookmark this link and the cluster ID changes, you must update your bookmark before the bookmark resolves correctly. Alternatively, you can bookmark the more

general URL, <http://virtual IP address/Console>, which does not require an update following a cluster ID change.

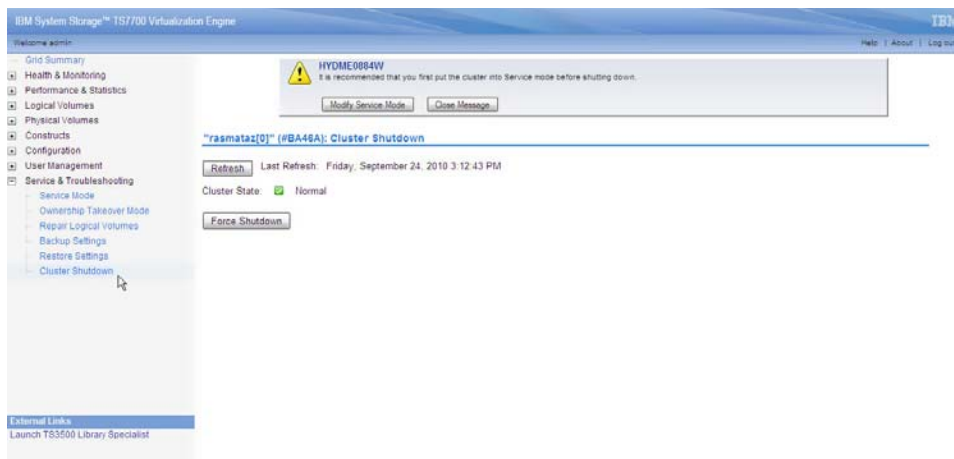
3. The login page for the management interface loads. The default login name is **admin** and the default password is **admin**.

Shutting down the TS7700 Virtualization Engine

This page provides instructions to power off a TS7700 Cluster.

To power off a TS7700 Cluster, you must be logged in to the TS7700 Management Interface.

1. Connect to the management interface of the TS7700 Cluster you want to shut down. Refer to the topic *Connecting to the management interface* in the **Related information** section for instructions to log in to the management interface for a given TS7700 Cluster.
2. From the **Grid Summary** panel navigate to **Service & Troubleshooting>Cluster Shutdown**, as shown in Figure 40.



ts77h026

Figure 40. Cluster Shutdown panel of the TS7700 Management Interface

3. Refer to the user assistance (help) topic **Cluster Shutdown** for instructions to power off (force a shutdown) of the TS7700 Cluster.

Important: Before you power off a TS7700 Cluster you must read the information contained in the **Cluster Shutdown** user assistance (help) topic. You can view this topic by:

- a. Selecting the **Help** link in the top right corner of the **Cluster Shutdown** panel
- b. Selecting the topic link *Cluster Shutdown* as listed in the **Related information** section.

Related information

“Connecting to the management interface” on page 219

Chapter 6. Recovering

This section provides information related to recovering lost data and testing grid failover.

Recovering lost data

This topic describes how to recover lost data.

About this task

The capability to resume business operations in the event of a product or site failure is provided by the grid configuration of the TS7700 Virtualization Engine. In a grid configuration, two or three TS7700 clusters are interconnected and can replicate data created on either TS7700 cluster to the other.

As part of a total systems design, you must develop business continuity procedures that instruct I/T personnel what actions to take in the event of a failure. The best time to test the procedures is during an initial installation of the system or at some interval.

For more information about recovering lost data, see *IBM Virtualization Engine TS7700 Series Grid Failover Scenarios* at <http://www-03.ibm.com/support/techdocs/atstr.nsf/Web/AdvSearch>.

Testing grid failover

This topic describes how to test for grid failover.

Before you begin

You must be familiar with how to use the virtual tape systems attached to zOS environments.

About this task

For documentation about how to test grid failover, refer to:

- *IBM Virtualization Engine TS7700 Series Grid Failover Scenarios*

This document is available from the IBM Techdocs search portal link in the **Related information** section. Enter the document title in the **Enter optional search string:** field, then click **Search**. The most recent version of the *IBM Virtualization Engine TS7700 Series Grid Failover Scenarios* document is then returned.

This document contains information to assist with the creation of a test plan. In addition, you can also find a series of grid failover test scenarios for zOS, which were performed in an IBM laboratory environment. Single failures of all major components and communication links and some multiple failures are simulated.

Not all possible grid failover situations are covered in *IBM Virtualization Engine TS7700 Series Grid Failover Scenarios*. However, you can find documentation that focuses on the scenarios that demonstrate the critical hardware and microcode failover capabilities of the TS7700 Grid configuration.

Related information

 <http://www-03.ibm.com/support/techdocs/atmastr.nsf/Web/AdvSearch>

Glossary

Glossary

This glossary defines the special terms, abbreviations, and acronyms used in this publication and other related publications.

If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at the following Web site: <http://www.ibm.com/ibm/terminology>.

3U Three rack-unit

3592 Tape Drives

Refers collectively to 3592 J1A tape drives and TS1120 tape drives that emulate 3592 J1A tape drives

A

A Ampere

ac Alternating current

ACF Automatic cartridge facility

ACS Automatic class section

AES Advanced encryption standard

AIX Advanced interactive executive. IBM's implementation of the UNIX operating system. The RS/6000 system, among others, runs the AIX operating system.

alter To change

ALMS Advanced library management system

amp Ampere

amsl Above mean sea level

ASCII American National Standard Code for Information Interchange. A 7-bit coded character set (8 bits, including parity check) that consists of control characters and graphic characters.

AOTM

Autonomic Ownership Takeover Manager

ASMI Advanced system management interface

assignment

The naming of a specific device to perform a function

asynchronous

Pertaining to two or more processes that do not depend upon the occurrence of specific events such as common timing signals

attention (notice)

A word for calling attention to the possibility of danger to a program, device, or system, or to data. Contrast with *caution* and *danger*.

ATTN Attention

audit logging

The process of keeping a log of all activities of interest to security personnel. These activities are those that can negatively affect operations if completed incorrectly or maliciously. They include such events as: login attempts, configuration changes, status changes, and code updates.

authentication

The process of recognizing a user through a valid combination of user id and password.

local authentication

Each machine maintains an internal database of user IDs, with corresponding passwords and roles.

Storage Authentication Service policy authentication

A Role-Based Access Control method of authentication that uses LDAP to create a central repository for storage and management of user IDs, passwords, and roles.

authorization

The process of authorizing an authenticated user to access a specific resource.

B

B Bytes

back up

To make additional copies of documents or software for safekeeping

BCR Buffer channel remainder register

bezel Decorative and safety cover

binding

A term used to refer to the process of persistently saving a type or attribute property of a volume. Prior to the binding of the property, any derived or assigned properties can be utilized, but they are not permanent until the binding event occurs. Once the binding succeeds, the type and or attributes are said to be "bound" to the volume.

buffer A routine or storage used to compensate for a difference in rate of data flow or time of occurrence of events, when transferring data from one device to another

bus A facility for transferring data between several devices located between two end points, only one device being able to transmit at a given moment

BVIR Bulk volume information retrieval

C

°C Degrees Celcius

capacity

The amount of data that can be contained on a storage medium, expressed in bytes of data

caution (notice)

A word to call attention to possible personal harm to people. Contrast with *attention* and *danger*.

CE Customer engineer. Synonymous with field engineer and service representative.

CEC Central electronics complex

CIM The Common Information Model: an implementation-neutral, object-oriented schema for describing network management information. The Distributed Management Task Force (DMTF) develops and maintains CIM specifications.

CLI Command line interface: atype of computer interface in which the input command is a string of text characters.

cluster

The combination of a TS7700 Virtualization Engine, 3953 L05 Library Manager, and aTS3500 Tape Library to form a virtual tape subsystem

cluster family

A group of clusters all configured with the same family value in vital product data (VPD).

cm Centimeter

command

A control signal that initiates an action or the start of a sequence of actions

Composite Library ID

The library sequence number reported to a host by each attached virtual device

concurrent

Refers to diagnostic, maintenance, or replacement procedures that can be performed on a system without interrupting customer applications

construct

A collective term used to refer to the policies that automate storage management through classification of data sets. These include:

- Storage Groups
- Management Classes
- Storage Classes

- Data Classes

controller

Also called control unit, or CU.

copy The replication of a logical volume from one site to another across the connecting infrastructure

CPU Central processing unit

CRC Cyclic redundancy check: an error detection technique used by the data link layer to determine if all the bits that were sent were also received.

CST Cartridge storage tape

CSV Comma-separated value

ctrl Control

CU Control unit. Also called controller.

CUID A world-unique, 12-byte, 24-hex digit value assigned to a media cartridge that identifies a volume beyond volume serial. This identifier is also referred to as a World Wide Identifier (WWID).

D

DAA Device allocation assistance

danger (notice)
A word to call attention to possible lethal harm to people. Contrast with *attention* and *caution*

DASD
Direct access storage device

data Any representations such as characters or analog quantities to which meaning is or might be assigned

dc Direct current

DDM Disk drive module: a field-replaceable unit (FRU) that consists of a single disk drive and its associated packaging; also see E-DDM and EV-DDM

DDR1 Double data rate

degraded
Decreased quality of output or throughput or increased machine error rate

detent A catch or lever that holds another part in place

Device allocation assistance
A function that allows the host to query the TS7740 Virtualization Engine to determine which clusters should be preferred for a private (specific) mount request.

DFSMS
Data facility system managed storage
An operating environment that helps automate and centralize the management of storage. To manage storage, DFSMS provides the storage administrator with control over data class, storage class, management class, storage group, and automatic class selection routine definitions.

DHCP Dynamic host configuration protocol
In the Internet suite of protocols, a client/server protocol that is used to centrally locate and distribute configuration information.

disk-only
A cluster that does not attach to a physical tape library; it stores all data in cache.

Distributed Library ID
The unique library sequence number possessed by each cluster in a grid configuration

DK Data key

DMA Direct memory access

DRAM
Dynamic random-access memory: storage in which the cells require repetitive application of control signals to retain stored data.

DST Dedicated service tool: the part of the service function used to service the system when the operating system is not running.

DVD RAM
Digital video disk random-access memory

DVD-ROM
Digital video disk read-only memory

DWDM
Dense wavelength-division multiplexing

E

EBCDIC
Extended binary-coded decimal interchange code: a coded character set consisting of 8-bit coded characters.

EBTERM
Terminal emulator for OS/2

EC Edge connector
Engineering change

ECC Error checking and correction
Error correction code

ECCST
Extended capacity cartridge storage tape

E-DDM and EV-DDM
Enhanced disk drive module and Enhanced Value disk drive module

EEDK Externally encrypted data key

EEH Extended (or enhanced) error handling

EEPROM
Electrically erasable programmable read-only memory

EIA Electronics Industries Association

EIA unit
A unit of measure established by the Electronic Industries Association that is equal to 44.45 mm (1.75 in.)

EiB Exbibyte; IEC Standard is 1024 pebibytes

EKM Entry key mask

EMC Electromagnetic compatibility

EPO Emergency power off

EPROM
Erasable programmable read-only memory: a type of memory chip that can retain its contents

without electricity. Unlike the programmable read-only memory (PROM), which can be programmed only once, the EPROM can be erased by ultraviolet light and then reprogrammed.

equipment check

An asynchronous indication of a malfunction

EREP Environmental recording, editing, and printing: the program that formats and prepares reports from the data contained in the error recording data set.

Error log

A dataset or file in a product or system where error information is stored for later access

ESD Electrostatic discharge

The flow of current that results when objects having a static charge come into close enough proximity to discharge.

An undesirable discharge of static electricity that can damage equipment and degrade electrical circuitry.

ESS Embedded Security Services or Enterprise Security Services.

A Tivoli component for authentication that provides an abstraction layer between storage devices and an LDAP server.

F

°F Degrees Fahrenheit

fault symptom code (FSC)

A hexadecimal code generated by the drive or the control unit microcode in response to a detected subsystem error

FC Feature code

FCP Fibre channel protocol: the serial SCSI command protocol used on fibre-channel networks.

FE Field engineer, synonymous with customer engineer or service representative

FFC	Failing function code		attributes and data are replicated across the clusters to ensure the continuation of production work
FICON	Fibre connection channel: a fibre-channel communication protocol designed for IBM mainframe computers and peripherals.		
FID	FRU Identifier (may be more than one FRU)	H	
field replaceable unit (FRU)	An assembly that is replaced in its entirety when any one of its components fails		
file	A named set of records stored or processed as a unit. Also referred to as a dataset.		
format	The arrangement or layout of data on a data medium		
FRU	Field replaceable unit		
FSC	Fault symptom code		
ft.	Feet		
FTP	File transfer protocol		
functional microcode	Microcode that is resident in the machine during normal customer operation		
G			
g	Gram		
Gb	Gigabits; IEC Standard is 1000 megabytes		
GB	Gigabytes		
Gbps	Gigabits per second		
GHz	Gigahertz		
GiB	Gibibyte; IEC Standard is 1024 mebibytes		
GMT	Greenwich Mean Time		
gNode	The combination of the distributed nodes hNode and vNode in the TS7700 Virtualization Engine		
grid	A series of clusters connected to one another by means of TCP/IP to form a disaster recovery solution where logical volume		
			grid network The TCP/IP infrastructure connecting a grid
			GUI Graphic user interface
			HBA Host bus adapter
			HCD Hardware configuration definition
			hertz (Hz) Unit of frequency. One hertz equals one cycle per second.
			hex, HEX Hexadecimal
			HIPPI High performance parallel interface
			hNode A distributed node in the TS7700 Virtualization Engine that performs all management of a logical volume residing in disk cache or physical tape after it has been created or altered by the host system through a vNode
			HSL High-speed link
			HSM Hierarchical storage management: an automatic method to manage and distribute data between the different storage layers. The storage layers can include high-performance disk units, compressed disk units, and tape library devices.
			HTML Hypertext markup language
			Hz Hertz (cycles per second)
		I	
			IB InfiniBand, a point-to-point high-speed switch fabric interconnect architecture
			ICSF Integrated cryptographic service facility
			ID Identification Identifier

identifier (ID)

In programming languages, a lexical unit that names a language object; for example, the names of variables, arrays, records, labels, or procedures. An identifier usually consists of a letter optionally followed by letters, digits, or other characters.

One or more characters used to identify or name a data element and possibly to indicate certain properties of that data element

A sequence of bits or characters that identifies a program, device, or system to another program, device, or system

IEC International Electrochemical Commission

IML Initial microprogram load

in. Inch

initial microprogram load (IML)

The action of loading a microprogram from external storage to writable control storage

initiator

The component that executes a command. The initiator can be the host system or the tape control unit.

interface

A shared boundary. Examples include a hardware component to link two devices or a portion of storage or registers accessed by two or more computer programs.

interposer

The part used to convert a 68-pin connector to a 50-pin D-shell connector

intervention required

Manual action is needed.

I/O, IO

Input/output: data provided to the computer or data resulting from computer processing.

IOA Input/output adapter

A functional unit or a part of an I/O controller that connects devices to an I/O processor.

For devices, the electrical circuits on a logic card that connect one device to another.

IOP Input/output processor: a functional unit or the part of an I/O controller that processes programmed instructions and controls one or more input/output devices or adapters.

IP Internet protocol

IPL Initial program load: the process that loads the system programs from the system auxiliary storage, checks the system hardware, and prepares the system for user operations.

ISMF Interactive storage management facility: an Interactive System Productivity Facility (ISPF) application that provides an interactive set of space management functions for users and storage administrators.

J

JCL Job control language: a command language that is used to identify a job to an operating system and to describe the job's requirements.

K

KB Kilobyte

KEK Key-encrypting key

kg Kilogram

KiB Kibibyte

km kilometer

kVA Kilovolt amperes

L

L2 Level 2 cache

lb. Pound

LAN Local Area Network: a computer network within a limited area.

LC A type of operational fiber connector

LDAP	Lightweight Directory Access Protocol. A standard protocol for authenticating users and authorizing access to resources, typically used to grant access levels to directories on disk.	mask	A pattern of characters that controls the retention or elimination of portions of another pattern of characters. To use a pattern of characters to control the retention or elimination of portions of another pattern of characters
LED	Light emitting diode	MB	Megabytes
LM	Library manager	Mbps	Megabits per second
LMA	Library manager adapter	MDE	Microcode detected error
loadable	Having the ability to be loaded	MES	Miscellaneous equipment specification An equipment installation or upgrade that is performed on site by an IBM Service Representative.
Logical partition	A subset of a single server that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system.	MHz	Megahertz
Logical volume	A virtual volume that has been read from the cache DDMS and written to a physical volume	MiB	Mebibyte
LPAR	A function that enables the creation of logical partitions. See <i>logical partition</i> .	micro	One millionth
LTPA	Lightweight Third-Party Authentication, also called Single-Sign-On. An authentication process that uses a cookie containing an LTPA token to enable a web user to reuse the same login across physical servers.	microcode	One or more microinstructions. A code, representing the instructions of an instruction set, implemented in a part of storage that is not program-addressable. To design, write, and test one or more microinstructions. See also <i>microprogram</i> .
LW	Long wave laser	microinstruction	A basic or elementary machine instruction
M		microprogram	A group of microinstructions that when executed performs a preplanned function. The term microprogram represents a dynamic arrangement or selection of one or more groups of microinstructions for execution to perform a particular function. The term microcode represents microinstructions used in a product as an alternative to hard-wired circuitry to implement certain functions of a processor or other system component.
m	Meter	MIM	Media information message
magnetic tape	A tape with a magnetic surface layer on which data can be stored		
MAP	Maintenance analysis procedure: in hardware maintenance, a step-by-step procedure that assists an IBM service representative to trace a symptom to the cause of the failure.		

mm Millimeter

MM Multimode fiber

modifier
An element that changes the meaning of another element or instruction

mount *physical mount*: A host command to load a tape cartridge into a tape drive

logical mount: A virtual action in which a logical volume is assigned to a virtual tape drive

ms Millisecond

MTMS
Machine type/model/serial number

multipath
Describing a situation in which more than one path has been defined

MVS Multiple virtual storage

N

N/A Not applicable

NAT Network address translation

The conversion of a network address that is assigned to a logical unit in one network into an address in an adjacent network.

In a firewall, the conversion of secure Internet Protocol (IP) addresses to external registered addresses. This enables communications with external networks but masks the IP addresses that are used inside the firewall.

NENR Non-Erasable Non-Rewritable

A compliance term that refers to a solution that not only prevents rewrite (Write Once, Read Many, or, WORM), but also prevents deletion (erasing) through retention. LWORM (logical WORM), used with host software retention characteristics, provide a NENR-compliant solution.

NFS Network file server: a protocol,

developed by Sun Microsystems, Incorporated, that allows a computer to access files over a network as if they were on its local disks.

NIM Network installation management

node A single replaceable unit within a IBM Virtualization Engine TS7700. Nodes are the elements that run the functional code and perform all the system logic. Each node consists of one or more processors, memory, and I/O ability

NONCE
Number used once

A number or value expected to only occur once in a data payload which greatly decreases the probability that a resulting cryptographic hash against the payload or similar payload will produce the same hash outcome more than once.

NTP Network time protocol

NVRAM
Non-volatile random-access memory: random access memory (storage) that retains its contents after the electrical power to the machine is shut off. A specific part of NVRAM is set aside for use by the system read-only storage for the boot device list.

O

ODM Object data manager: a data manager intended for the storage of system data. The ODM is used for many system management functions. Information used in many commands and SMIT functions is stored and maintained in the ODM as objects with associated characteristics.

offline
Pertaining to the operation of a functional unit that is not attached to a controlling device such as a mainframe or a control unit. Contrast with *online*.

online Pertaining to the operation of a

functional unit that is attached to a controlling device such as a mainframe or a control unit. Contrast with *offline*.

overrun

Loss of data because a receiving device is unable to accept data at the rate it is transmitted

P

parameter

A variable that is given a constant value for a specified application and that may denote the application

Partially Online

When at least one vNode is offline and at least one is online

PC Personal computer

PCC Power control compartment: the rack component that logically controls the application of alternating current power to the units in the rack.

PCI Peripheral component interconnect: a local bus for personal computers that provides a high-speed data path between the processor and attached devices.

PDF Portable document format: a standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally via e-mail, the Web, intranets, or CD-ROM; and can be viewed with the Acrobat Reader.

PDU Power distribution unit

Physical volume

A physical tape drive

PiB Pebibyte

PLF Perform library function

POR Power-on reset

pool A group of physical tape cartridges.

port A physical connection for communication between systems or components.

POST Power-on self test

power-on self test (POST)

A series of diagnostic tests that are run automatically by a device when the power is turned on.

Premigration

When a virtual volume is read from the cache DDMs and written to a physical volume

PTF Program temporary fix: a fix that is made available to all customers. A program temporary fix is tested by IBM. It contains a PTF record.

PtP Peer-to-peer

PWR Power

R

RACF Resource access control facility

RAID Redundant array of independent disks: a collection of two or more disk physical drives that present to the host an image of one or more logical disk drives. In the event of a single physical device failure, the data can be read or regenerated from the other disk drives in the array due to data redundancy.

RAID-5

Uses block-level striping with parity data distributed across all member disks.

RAID-6

Uses block-level striping with two parity blocks distributed across all member disks.

RAID-10

Uses striping on a mirrored array of member disks.

RAM Random access memory

random access memory (RAM)

A memory system to which data

is entered and from which data is retrieved in a non-sequential manner

RAS Reliability, availability, and serviceability

RBAC Role-Based Access Control

A term used to describe centralized Authentication and Authorization.

Recall When a logical volume is moved from a physical volume to the cache and becomes a virtual volume

recoverable error
An error condition that allows continued execution of a program

ref Reference

RIO RISC input/output

RISC Reduced instruction set computing: a computer that uses a small, simplified set of frequently used instructions for rapid processing.

RMM Removal Media Manager component within host tape management software.

RO Read only

ROT Read ownership takeover

RPMES
Returned Part Miscellaneous Equipment Specification

RSA Rivest-Shamir-Adleman key pairs

RUN Rewind unload processing

R/W Read/write

S

s Second (unit of time)

SAA Scratch allocation assistance

SC A type of optical fiber connector

Scratch allocation assistance (SAA)
An extension of the device allocation assistance (DAA) function for scratch mount requests. It filters the list of clusters in a grid to return to the host a smaller list of candidate

clusters specifically designated as scratch mount candidates.

SCSI Small computer system interface

SDAC Selective device access control

SDC Scan dump control

SDS Scan dump size

sec Second (unit of time)

Selective device access control (SDAC)
A function that allows only certain logical control units or subsystem ids within a composite library to have exclusive access to one or more VOLSER ranges of volumes for host-initiated mounts, ejects, and attributes or categories changes.

SFP Small Form-factor Pluggable module

SIM Service information message: a message, generated by a storage subsystem, that is the result of error event location and analysis. A SIM indicates that some service action is required.

SLDC Streaming lossless data compression

SM Single-mode fiber

small computer system interface (SCSI)
An input and output bus that provides a standard interface between computer systems

SMI-S Storage Management Initiative - Specification

SMIT System management interface tool

SMS System management services

SMSplex
System-managed storage complex. A group of storage devices managed collectively by a single operating system. The system automates storage management through classification of data sets and objects.

SNIA The Storage Networking Industry Association

SNMP	Simple Network Management Protocol SNMP is used to monitor network-attached devices.	specific error condition. The system reference code can be displayed on the console from the problem log. The characters that identify the name of the unit that detected the condition and the reference code that describes the condition.
SNMP MIB	Simple Network Management Protocol Management Information Block A file used by an SNMP monitoring application to relate a message identifier to a corresponding text string	
SNMP Monitoring Application	An application running on a network-attached server. It receives SNMP traps from network-attached devices, expands those traps using a MIB file, and can take a variety of actions based on the SNMP traps, including filtering, keeping a history log, and sending emails or text messages to users.	
SNMP trap	An SNMP message sent by a network-attached device to an SNMP monitoring application. The trap typically contains information to identify the device that sent it, a message identifier, and parameter data.	
SPCN	System power control network: an asynchronous serial communications network. SPCN connects the power system in participating components to the operating system and can report critical changes and power failures in those components to the operating system. SPCN gives the operating system control of electrical power.	
SR	Service representative. Synonymous with field engineer and customer engineer.	
SRAM	Static random access memory	
SRC	System reference code A group of characters that identifies the machine status or a	
SRN	Service Request Number	
SSA	Serial Storage Architecture: an American National Standards Institute (ANSI) standard, implemented by IBM, for a high-speed serial interface that provides point-to-point connection for peripherals, such as storage arrays.	
SSL	Secure sockets layer: a security protocol that provides communication privacy. With SSL, client/server applications can communicate in a way that is designed to prevent eavesdropping, tampering, and message forgery.	
SSPC	System Storage Productivity Center This is an appliance consisting of an IBM server with preloaded Tivoli software including Tivoli Productivity Center.	
scratch pool	A group of physical tape cartridges that are ready for use by any write job.	
Stacked volume	A physical volume that contains more than one logical volume.	
subsystem	A secondary or subordinate system, usually capable of operating independently of, or asynchronously with, a controlling system	
SUID	System unique identification	
SW	Short wave laser	
sync	Synchronous, synchronize. Occurring with a regular or predictable time relationship	

T

- TAC** Technical area code
- tape controller**
A device that provides the interface between a system and one or more tape drives. Synonymous with *control unit*
- TB** Terabytes
- TCDB** Tape catalog database
- TCP/IP**
Transmission Control Protocol/Internet Protocol. With regard to a tape library, the protocol used for the LAN communication path between the mainframe and the Library Manager
- TS7740 cache**
Refers collectively to the disk storage media within the TS7740 Cache Controller and the TS7740 Cache Drawers
- TiB** Tebibyte
- TKLM**
Tivoli Key Lifecycle Manager
- TSM** Tivoli Storage Manager
- TSSC** TS3000 System Console
- TS7700 Virtualization Engine**
A TS7720 Virtualization Engine or TS7740 Virtualization Engine.
- TS7720 Virtualization Engine**
A TS7700 Virtualization Engine that stores all data in disk cache and does not attach to a physical library. Characterized by TS7720 Server models 3957-VEA and 3957-VEB.
- TS7740 Virtualization Engine**
A TS7700 Virtualization Engine that stores data in disk cache and on physical tape in an attached physical library. Characterized by TS7740 Server models 3957-V06 and 3957-V07.

U

- UART** Universal synchronous receiver/transmitter
- URC** Unit reference code

The last 4 characters of the SRC.

A group of numbers displayed on the console or control panel that identifies failing parts, system or device states, or system or device status conditions.

- USB** Universal serial bus: aPlug-and-Play (Intel standard) interface between a computer and add-on devices (such as keyboards and printers). USB allows a user to add a new device to a computer without having to add an adapter card or to turn the computer off.

utilities
Utility programs

utility programs
A computer program used for general support of the processes of a computer; for instance, a diagnostic program

V

V06/V07
A server subsystem for the TS7700 Virtualization Engine used with an attached library and is specific to the TS7740 Virtualization Engine

VEA/VEB
A server subsystem for the TS7700 Virtualization Engine used with the disk-only storage solution, one that does not attach to a physical library, and is specific to the TS7720 Virtualization Engine

V ac Volts alternating current

Virtual tape drives
Emulated tape drives that occur when the TS7740 Server emulates the function and operation of 3490 Enhanced Capacity (3490E) tape drives

Virtual volume
Data storage on DDMs that shows the same characteristics to a host application as a physical tape volume and contains data written or read through a virtual tape drive

vNode
A distributed node in the TS7700 Virtualization Engine that presents the image of virtual drives to the host system

VOLSER
Volume serial number

An identification number in a volume label that is assigned when a volume is prepared for use on the system.

VPD Vital Product Data

The information contained within a component that requires nonvolatile storage used by functional areas of the component, and information required for manufacturing, RAS, and engineering.

VTS Virtual Tape Server

W

WAN Wide area network: a network that provides communication services between devices in a geographic area larger than that served by a local area network (LAN) or a metropolitan area network.

WBEM
Web-Based Enterprise Management

word A character string that is convenient for some purpose to consider as an entity

WORM
Write Once, Read Many

Any storage media that allows data to be written only once per storage unit and never changed for secure archival purposes. It is allowed to add new content that does not change previously written units of storage.

WOT Write-ownership takeover

Write-mount count
A 16-bit sister value of WWID (World Wide Identifier) that represents the total number of times an LWORM volume is

mounted and modified due to a write operation. This value is seeded to zero for a newly bound LWORM volume prior to the first write from BOT (beginning of tape).

WTI World trade interplant

WWID
World Wide Identifier

A world-unique, 12-byte, 24-hex digit value assigned to a media cartridge that identifies a volume beyond volume serial. This identifier is also referred to as a cartridge unique identifier or (CUID).

WWNN
World wide node name: a unique 64-bit identifier for a host containing a fibre-channel port.

Appendix. Notices

Accessibility

Accessibility features provide users who have disabilities with the ability to successfully access information and use technology.

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

Features

These are the major accessibility features in the *IBM Virtualization Engine TS7700 Introduction and Planning Guide*, GA32-0567 information:

- You can use screen-reader software and a digital speech synthesizer to hear what is displayed on the screen. PDF documents have been tested using Adobe Reader version 7.0. HTML documents have been tested using JAWS version 9.0.
- You can operate features using the keyboard instead of the mouse.

Navigating by keyboard

You can use keys or key combinations to perform operations and initiate menu actions that can also be done through mouse actions. You can navigate the *IBM Virtualization Engine TS7700 Introduction and Planning Guide*, GA32-0567 information from the keyboard by using the shortcut keys for your browser or screen-reader software. See your browser or screen-reader software Help for a list of shortcut keys that it supports.

Accessing the publications

Information presented by the *IBM Virtualization Engine TS7700 Introduction and Planning Guide*, GA32-0567 is also available in HTML format in the *IBM Virtualization Engine TS7700 Customer Information Center*, at the following Web site: <http://publib.boulder.ibm.com/infocenter/ts7700/cust/index.jsp>.

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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

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This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Industry Canada compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conform à la norme NMB-003 du Canada.

European Union Electromagnetic Compatibility Directive

This product is in conformity with the protection requirements of European Union (EU) Council Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

Attention: This is an EN 55022 Class A product. In a domestic environment this product might cause radio interference in which case the user might be required to take adequate measures.

Responsible Manufacturer:

International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
914-499-1900

European community contact:

IBM Deutschland GmbH
IBM Technical Regulations, Department M456
IBM-Allee 1, 71139 Ehningen, Germany

Australia and New Zealand Class A Statement:

Attention: This is a Class A product. In a domestic environment this product might cause radio interference in which case the user might be required to take adequate measures.

Germany Electromagnetic compatibility directive: Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2004/108/EG zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der EN 55022 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung der IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung der IBM gesteckt/eingebaut werden.

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"Warnung: Dieses ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funk-Störungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen zu ergreifen und dafür aufzukommen."

Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten

Dieses Produkt entspricht dem "Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)." Dies ist die Umsetzung der EU-Richtlinie 2004/108/EG in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC EG Richtlinie 2004/108/EG) für Geräte der Klasse A

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:

International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
Tel: 914-499-1900

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:

IBM Deutschland GmbH
Technical Regulations, Abteilung M456
IBM-Allee 1, 71139 Ehningen, Germany

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 Klasse A.

People's Republic of China Class A Electronic Emission statement

中华人民共和国“A类”警告声明

声明

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Taiwan contact information

This topic contains the product service contact information for Taiwan.

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Japan Voluntary Control Council for Interference (VCCI) Class A Statement

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VCCI-A

**Japan Electronics and Information Technology Industries
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高調波ガイドライン適合品

jeita1

Korean Communications Commission (KCC) Class A Statement

이 기기는 업무용(A급)으로 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

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rusemi

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