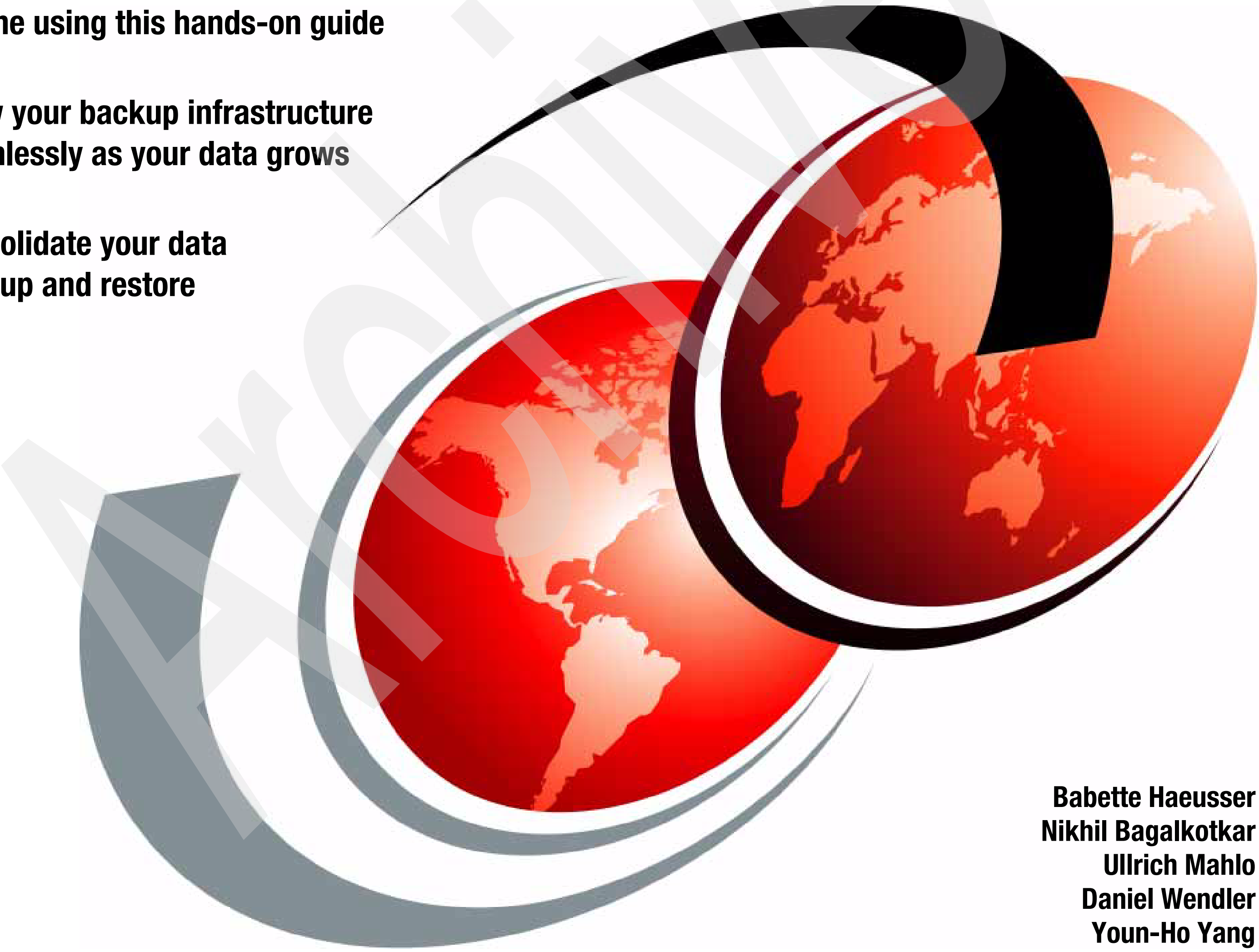
# IBM Virtualization Engine TS7500:

## Planning, Implementation, and Usage Guide

- Get the best of Tape and Virtualization Engine using this hands-on guide
- Grow your backup infrastructure seamlessly as your data grows
- Consolidate your data backup and restore





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# IBM Virtualization Engine TS7500: Planning, Implementation, and Usage Guide

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**Note:** Before using this information and the product it supports, read the information in “Notices” on page xiii.



**Second Edition (November 2008)**

This edition applies to IBM Virtualization Engine TS7530 and to all IBM tape products as generally available at the time of publishing.

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# Preface

This IBM® Redbooks® publication describes IBM Virtualization Engine™ TS7500 and helps you plan, implement, and use the TS7500. This version of the book has been updated with the latest enhancements to the TS7520 and now also includes the TS7530 functions and features.

This books is intended for system programmers, storage administrators, hardware and software planners, and other IT personnel involved in planning, implementing, and operating the TS7500 Virtualization Engine as well as anyone seeking detailed technical information about the TS7520 and the TS7530 versions of the Virtualization Engine.

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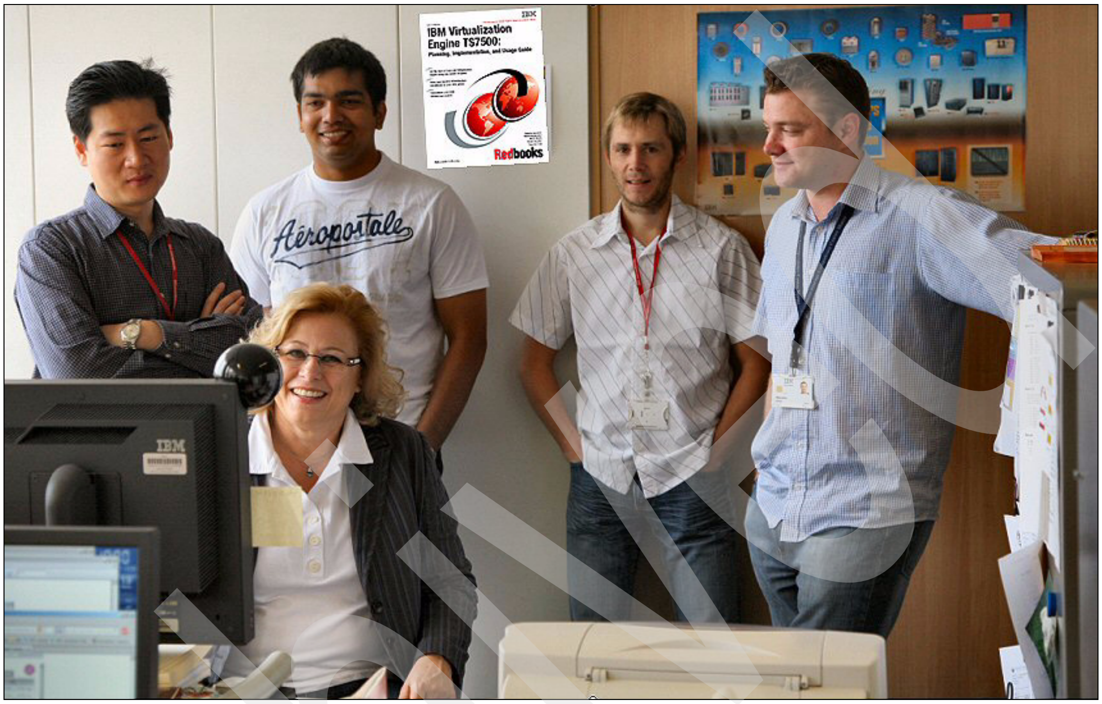


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# Summary of changes

This section describes the technical changes made in this edition of the book. This edition may also include minor corrections and editorial changes that are not identified.

Summary of Changes
for SG24-7520-01
for IBM Virtualization Engine TS7500: Planning, Implementation, and Usage Guide
as created or updated on November 19, 2008.

## November 2008, Second Edition

This revision reflects the addition, deletion, or modification of new and changed information described below.

### New information

- IBM Virtualization Engine TS7530
- IBM Virtualization Engine TS7520 R2.2 enhancements



Part 1

# Introducing the TS7500 Virtualization Engine

In this part of the book, we provide an overview of IBM Virtualization Engine TS7520 and TS7530, the second and third generations of the TS7500 Virtualization Engine. We describe architecture and features to allow you to position the TS7500 Virtualization Engine within your enterprise-wide backup strategy.

The TS7510 Virtualization Engine, the first generation of the TS7500, is described in *IBM Virtualization Engine TS7510: Tape Virtualization for Open Systems Servers*, SG24-7189.

1

# The TS7500 Virtualization Engine

In this chapter, we introduce the IBM Virtualization Engine TS7500, an IBM solution comprising hardware and software and designed to assist Open System backups. We discuss the components that make up IBM Virtual Tape solution for Open Systems and functionalities offered by the TS7500.



## 1.1 Overview

The TS7500 Virtualization Engine (Figure 1-1) is an offering from IBM designed to simplify the backup and restoration activities of the organization and reduce total cost of ownership. The TS7500 solution offers its users:

- Enterprise class performance
- High scalability and capacity
- Investment protection
- Infrastructure simplification
- Reduction in backup and restore time

*Figure 1-1 IBM TS7500 Virtualization Engine*

The TS7500 Virtualization Engine is designed to help the tape processing requirements in Open System environments. By using the tiered storage hierarchy of disk and tape the TS7500 delivers enhanced performance, simultaneously providing the organization with additional capacity, reduced processing times, and reduced administrative overhead.

The TS7500 Virtualization Engine uses IBM hardware technology and virtualization software to help emulate IBM tape products. The TS7530 Virtualization Engine represents the third generation of the TS7500. The predecessors of the TS7530 Virtualization Engine are the TS7520 and the TS7510. Figure 1-2 graphically depicts the various generations of TS7500 against the timeline.

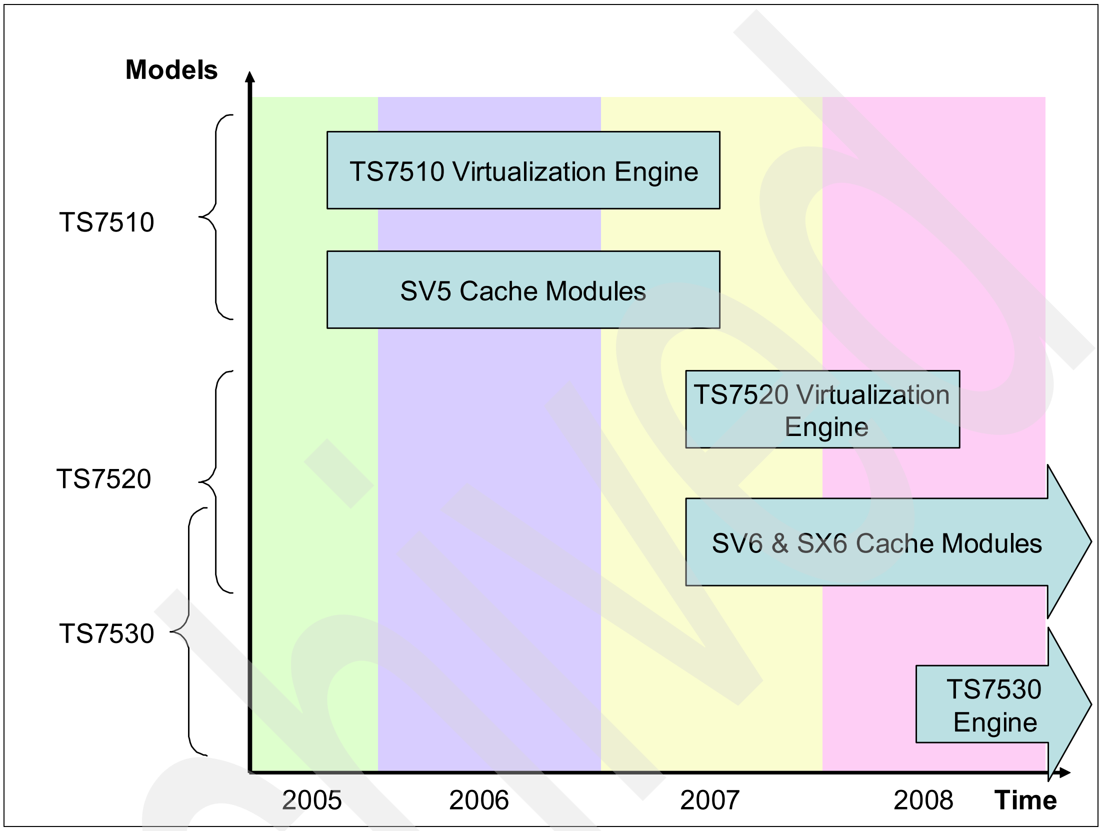



*Figure 1-2 Generations of TS7500*

The TS7500 provides you with multiple functionalities like enhanced caching, hosted backup, and Network Data Management Protocol (NDMP) support, which help you simplify your backup infrastructure. IBM Virtualization Engine technology can be effectively configured to provide high availability via network replication between two IBM TS7500 Virtualization Engines over an network using iSCSI protocol or a Fibre Channel storage area network (SAN) protocol.

**Note:** In this IBM Redbooks pubication we refer to the TS7530 Controller when we refer to the TS7500 Virtualization Engine, SV6 when we refer to TS7500 Cache Controller, and SX6 when we refer to the TS7500 Cache Modules unless otherwise mentioned.

## 1.1.1 Positioning the TS7500

IBM TS7500 Virtualization Engine is a high-performance, high-capacity Open Systems virtual tape offering is designed for:

- Reduction in Backup window
- Reduction in recovery time objective (RTO)
- Data sharing and resource virtualization
- Backup consolidation
- High availability
- IT infrastructure simplification with integrated server, disk, and tape solution

The TS7500 solution is a tape virtualization solution for Open Systems attachment over Fibre Channel or iSCSI interfaces. It can achieve significant operational efficiencies by storing the most recent data in the TS7500 disk cache. As data ages, the older data may be migrated to real tape for long-term storage. Since data can now be written to virtual tape via the disk cache, inefficiencies in the back up to tape can be greatly reduced. Fewer personnel may be needed to administer the backup process when it includes virtual tape.

The TS7500 solution provides host connectivity through the following:

- Up to 12 Fibre Channel ports per node for tape or host server attachment
- Up to 10 Ethernet ports per node for iSCSI server attachment, network replication, or NDMP

The TS7500 differs from many other Open Systems virtual tape offerings, since it enables either direct tape attachment or parallel tape attachment. With direct tape attachment, tape drives or libraries are physically attached to the TS7500 solution. With parallel tape attachment, tape drives or libraries are attached to the host server and data is transferred from the TS7500 solution through the host server to tape drives or libraries that are physically attached to the host server.

The TS7500 can help reduce the backup window in many installations. Since robotic movement, tape load/thread, and physical tape search and rewind are eliminated in virtual tape, the effective utilization of the Fibre Channel interfaces is high. This means that more tape jobs can be run to virtual tape over a single interface than to real tape. If the backup window is reduced, the time allowed for migration to real tape is increased (This happens because when there is no backup running, the TS7500 hardware can be utilized for exporting data to physical tape.), thus potentially reducing the number of real tape drives needed for longer term data storage.

The TS7500 solution is designed to improve business continuity by providing better restore times. By having the data in the disk cache, the TS7500 solution can help reduce restore times. With up to 4,096 virtual tape drives and up to 512 virtual tape libraries, each backup server can be allocated its own virtual resources, allowing multiple and disparate backup applications to use the same physical resources. This offers the users infrastructure simplification, justifying the costs involved. Multiple different tape libraries and tape drives can be aggregated to one or more TS7500 solutions, helping centralize the backup resources.

The addition of the TS7500 solution into your tape backup architecture can help provide significant reduction in operational overheads as well as performance benefits.

## 1.1.2 Technology overview

Today organizations face increasing challenges related to ensuring the safety of their growing amount of data. Users must ensure data protection of their increasing data, while the time available for backups is either fixed or is reducing. The TS7500 Virtualization Engine offers high-performance backup solutions without the drawbacks associated with tape-based backup like back-hitching, tape load time, tape unload time, and seek time.

You can achieve backup window reduction where robotic movement, tape load/thread, and physical tape search and rewind cause delays to the backup by using TS7500 virtual tape volumes to minimize or eliminate the delays. With TS7500 virtual volumes and mechanical delays minimized, you can increase the effective utilization of the Fibre Channel interfaces. Increased utilization means that you can potentially run more backup jobs to virtual tape than to physical tape over a single interface.

The TS7500 solution is a combination of IBM hardware and software designed to provide tape virtualization for servers connecting via Fibre Channel or iSCSI. The TS7500 works along with the existing tape infrastructure to provide the users with increased operational simplicity and improved backup performance. The TS7500 leverages existing Fibre Channel SANs to transfer data to and restore data from disk-based virtual tapes.

The TS7500 can be scaled up easily by adding Virtualization Engines, cache controllers, and cache modules, making it easy to grow the backup infrastructure along with the data growth. IBM TS7530 delivers a throughput of over 4,000 MB/s[1] in the four-node configuration, and the TS7500 Virtualization Engine solution can scale up to 1768 TB using 1 TB hard disk drives and RAID 5.

The TS7500’s capacity and performance can be harnessed by creating up to 512 virtual libraries, 4,096 virtual tape drives, and over 256,000 tape cartridges. The TS7500 can emulate IBM TS3100, TS3200, TS3310, TS3500, 3583, and 3582 Tape Libraries having the LTO2, LTO3, LTO4, 3592-JA1, or TS1120 Tape Drives. TS7500 Virtualization Engine’s emulation capabilities and support for a wide variety of backup application vendors offers infrastructure simplification for the organization. Multiple tape libraries and tape drives can be aggregated to one or more TS7500s, helping centralize the backup resources and further reduce the operational cost.

The TS7500 has been designed to enhance business continuity support by providing functionalities for network-based replication and related functions like network compression and network encryption. By using the replication functionalities we can ensure that the data is not lost due to natural disasters or system failure. The TS7500 Virtualization Engine helps improve business continuity by supporting better restore time during recovery due to presence of the data on disk drives instead of tape media.

The TS7500 Virtualization Engine is an Open Systems virtual tape product designed to augment the backup and restore process in the organization. The TS7500 emulates Tape Libraries populated with Linear Tape-Open (LTO) or IBM 3592/TS1120 tape drives. TS7500 virtual tape libraries can emulate LTO2, LTO3, LTO4, IBM 3592-JA1, and TS1120 tape drives to increase the speed and reliability of existing third-party backup applications. As in a conventional tape system, the TS7500 Virtualization Engine supports bar code labels as a mechanism to identify tapes.

With the TS7500, you can create virtual tapes and have the system automatically allocate additional space as needed. This functionality of TS7500 virtual tape volumes helps you to minimize the impact of backup applications that only use a small fraction of the total space available on a tape cartridge.

[1] The performane figures mentioned are approximate figures and the performance of the system may vary depending on the configuration and usage.

For additional data protection, or to efficiently utilize space in the TS7500, you can export the data on virtual tapes to one or more physical tapes connected to the TS7500 Virtualization Engine solution.

The TS7500 differs from many other open system virtual tape products by enabling either parallel tape attachment or direct tape attachment:

**Parallel tape** You attach physical tape drives and libraries to the backup server, and you attach the backup server to the TS7500. The backup application can be configured to write data directly to physical tape, or stage backup data in the TS7500 Virtualization Engine cache and later copy the data to physical tape.

**Direct tape** You attach physical tape drives and libraries directly to the TS7500 Virtualization Engine. The backup application will stage data to physical tape via TS7500 Virtualization Engine's cache.

Management of the TS7500 is performed via the console installed on a Windows-based PC and attached to the TS7500 via an Ethernet connection. The TS7500 solution's configuration includes IBM Virtualization Engine TS7500 Software, which executes on TS7500 Virtualization Engine hardware.

## 1.2 TS7500 building blocks

The TS7500 Virtualization Engine contains two major components that may be further subdivided in to subcomponents, namely:

- TS7500 Virtualization Engine solution software
- TS7500 Virtualization Engine solution hardware

The TS7500 Virtualization Engine solution software can be subdivided into two basic categories:

- Basic functionalities
- Enhanced functionalities

Apart from the basic functionalities that are provided with the system, the users have can purchase any of the enhanced functionalities depending upon their requirements. These functionalities can be enabled as and when the need arises via entering the license key for the required functionalities.

> **Note:** We recommend that you always ensure that the current hardware configuration is capable of supporting the additional load due to the addition of software licenses and features. Some of the enhanced functions like hosted backup require additional CPU and memory cards to be installed in the Virtualization Engine.

The TS7500 hardware can be divided into five components, of which three units have to be ordered mandatory, while some units are required only when an expansion frame is required to be connected or an external tape library has to be connected to the TS7500 Virtualization Engine solution. The three basic components of the TS7500 Virtualization Engine solution hardware are the Virtualization Engine (TS7500 Virtualization Engine solution node), cache controller, and gigabit Ethernet switches. The Virtualization Engine provides the TS7500 with processing power and performance while the cache controller and cache modules add capacity to the TS7500. Cache modules are required to increase the capacity on the TS7500. Moreover, it should also be noted that the TS7500 Virtualization Engine will not deliver its maximum rated performance if it does not have a sufficient number of disks at the back-end to read data from parallelly.

When the setup involves more than one frame for the TS7500 the users need to include the Fibre Channel switches in their configuration to link the two frames. The Fibre Channel switches are not available for user connections and can only be used for internal connections of the TS7500 solution. The cache module can be used to provide capacity to the TS7500 Virtualization Engine solution. Figure 1-3 graphically describes the components of TS7500.

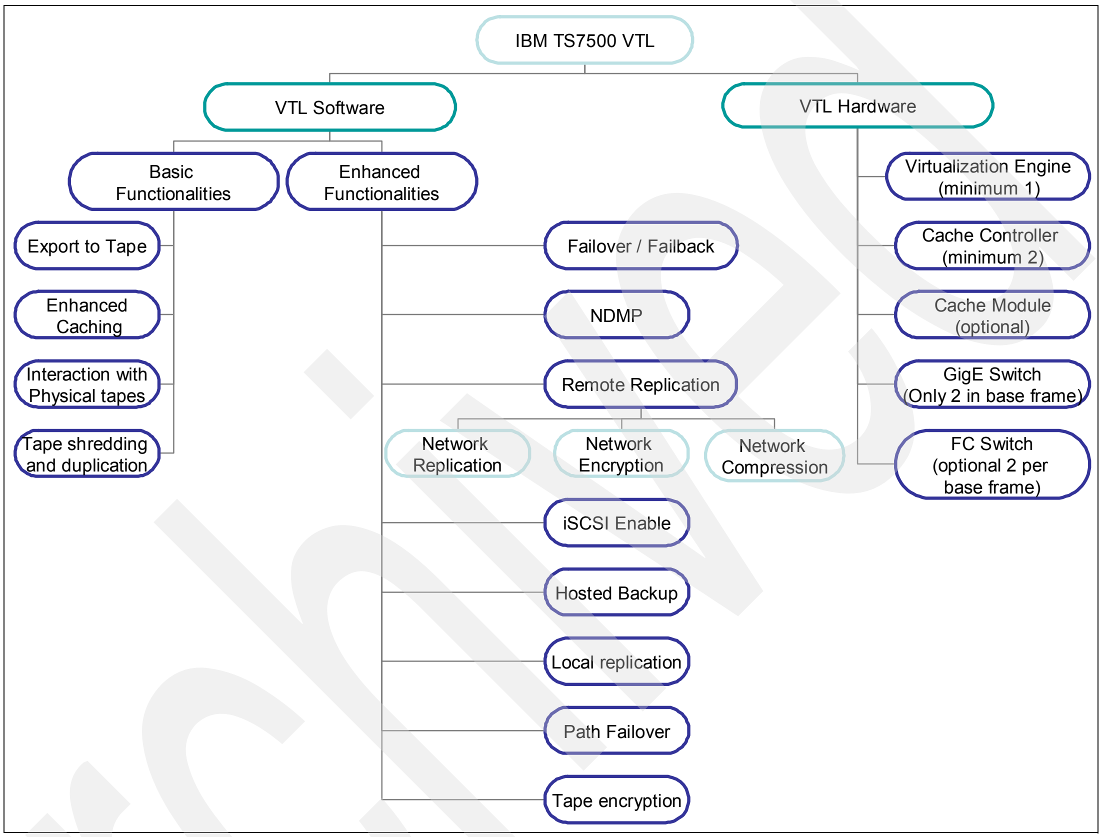



*Figure 1-3 Diagrammatic representation of the TS7500 Virtualization Engine*

## 1.3 TS7500 software architecture and components

IBM Virtualization Engine TS7500 Software Version 3 Release 1 provides tape library, tape drive, and tape volume emulation. It includes the following features and functions, which are explained later in this chapter:

- Tape virtualization: tape drive, tape library, and tape media virtualization
- Exporting to and importing from physical tape
- Enhanced caching
- High availability (failover/failback)
- Hosted backup
- Network Data Management Protocol support
- Internet SCSI (iSCSI) protocol support
- Secure tape
- Tape encryption
- Control path failover (CPF) and data path failover (DPF)
- Hardware-based data compression

- Software-based data compression
- Local replication
- Network replication
- Network encryption
- Network compression
- Data shredding
- Tape duplication
- Call Home functionality

## 1.3.1 Tape virtualization functions

In this section we describe the virtualization levels and the virtualization capabilities of the TS7500. We describe the three main levels of virtualization:

- Tape library virtualization
- Tape drive virtualization
- Tape volume virtualization

### Tape library virtualization

The IBM TS7500 Virtualization Engine has been designed to create a virtual copy of the supported models of IBM Tape Libraries. The TS7500 can be configured to emulate any of the supported IBM tape libraries. In this emulated tape library we have the ability to select any number of slots subject to the maximum possible slot count in the library. To all the applications accessing the TS7500 it will behave just like the library that it is emulating, thus making it transparent to the backup application. This feature ensures compatibility with independent software vendors (ISVs) for backup applications attaching to the TS7500. Each backup client, from an ISV, can attach to the tape library the same way it did to an actual library without needing additional software. The virtual library will respond to all the SCSI commands that the library being emulated would respond to.

IBM Virtualization Engine TS7520 virtualizes or emulates the following IBM tape libraries:

- IBM TS3500 Tape Library (also known as 3584) with IBM 3592 Model J1A or TS1120 Tape Drives, or with IBM Ultrium 2, Ultrium 3, or Ultrium 4 Tape Drives
- IBM TS3100 Tape Library with IBM Ultrium 3 or Ultrium 4 Tape Drives
- IBM TS3200 Tape Library with IBM Ultrium 3 or Ultrium 4 Tape Drives
- IBM TS3310 Tape Library with IBM Ultrium 3 or Ultrium 4 Tape Drives
- IBM 3582 Tape Library with IBM Ultrium 2 or 3 Tape Drives
- IBM 3583 Tape Library with IBM Ultrium 2 or 3 Tape Drives
- IBM TS7510 Virtualization Engine with TS1120 Tape Drives, 3592 Model JA1 Tape Drives, or IBM Ultrium 2, 3, or 4 Tape Drives
- IBM TS7520 Virtualization Engine with TS1120 Tape Drives, 3592 Model JA1 Tape Drives, or IBM Ultrium 2, 3, or 4 Tape Drives
- IBM TS7530 Virtualization Engine with TS1120 Tape Drives, 3592 Model JA1 Tape Drives, or IBM Ultrium 2, 3, or 4 Tape Drives

During virtual library creation, you can also select a virtual library type of TS7510, TS7520, or TS7530. These virtual TS7500s emulate IBM TS3500 library models with the tape drive technology selected. TS7530, TS7520, are TS7510 are only used if your backup application vendor requires them. Check with your backup application vendor for further requirements.

When we have a physical tape library associated with the TS7500 we need to ensure that the TS7500 has a corresponding virtual library with the same form of drives and virtual tapes. This ensures that the tapes being exported to the library or being imported from the library have a consistent format between the TS7500 Virtualization Engine and the physical library. Table 1-1 depicts the relationship between the supported emulation of libraries on TS7500 and supported physical connectivity of libraries on TS7500.

*Table 1-1 Virtualization and back-end support compatibility*

| Tape library and drive | Supported as virtual library | Supported as a physical library/drive for back-end tape |
|---|---|---|
| TS3582 with LTO2 or LTO3 | Yes | Yes |
| TS3583 with LTO2 or LTO3 | Yes | Yes |
| TS3400 with TS1120 | Yes | Yes |
| TS3100/TS3200<br>with LTO3 or LTO4 | Yes | Yes |
| TS3310<br>with LTO3 or LTO4 | Yes | Yes |
| TS3500<br>► With LTO2, LTO3 or LTO4<br>► With 3592 JA1 or TS1120 | Yes<br>Yes | Yes<br>Yes |
| TS3494 with 3592 JA1 or 1120[a]<br>3490 or 3590 | No<br>No | Yes<br>No |
| TS7510/TS7520/TS7530[b]<br>► With LTO2, LTO3, or LTO4<br>► With 3592 E or TS1120 | Yes<br>Yes | No<br>No |

a. The TS3494 can be connected as a physical library in the back end but it cannot be emulated on the TS7500 Virtualization Engine. To use 3494 as a physical back-end tape, we must select a supported virtual library with the drive type similar to the drives type on the physical TS3494 (for example, TS3500 with 3592/TS1120), then use 3494 as the physical library.

b. For most backup applications, the TS7500 presents itself to the server as the emulated library. However, some backup applications require knowledge of connection to a virtual tape library. Hence, the TS7500 can also present itself as a TS7500.

**Note:** You must ensure that the virtual libraries that you create have a sufficient number of cartridge slots, as it is not possible to increase the number of slots in the virtual library on the fly. The only way to increase the slot count is by recreating the entire virtual library. Hence, we highly recommend keeping a sufficient buffer of the number of slots in the virtual library.

## Tape drive virtualization

You can configure IBM TS7500 Virtualization Engine to look like any of our tape drives specified below:

- IBM Linear Tape-Open (LTO) Generation 2 Tape Drives with 196 GB cartridges
- IBM LTO Generation 3 Tape Drives with 400 GB cartridges
- IBM LTO Generation 4 Tape Drives with 800 GB cartridges
- IBM 3592 Model J1A Tape Drives with 300 GB cartridges
- IBM TS1120 Model E05 Tape Drives with 460 GB cartridges

The capacities listed are the default size for each technology provided by the IBM TS7500 Virtualization Engine. The TS7500 supports 256 drives per virtual library created in the TS7500.

Each virtual library can have only one type of virtual tape drive defined. If a virtual library is created with LTO Generation 3 Tape Drives, you cannot add LTO Generation 4 drives, 3592-J1A Tape Drives, or TS1120 Tape Drives to it later like you can in a physical tape library. If you want to change the drive type, you must create a new virtual library, and then migrate your data from one library to another. Table 1-2 lists the TS7500 emulation rules for a single node configuration (one TS7500 Virtualization Engine), a dual-node HA configuration (two TS7500 Virtualization Engines), and a four-node dual HA pair configuration (four TS7500 Virtualization Engines). For more information about high-availability configurations, see 1.3.4, “High availability (failover/failback)” on page 22.

*Table 1-2 TS7500 virtualization characteristics*

| One node | Two nodes | Four nodes |
|---|---|---|
| Up to 128 virtual libraries | Up to 256 virtual libraries | Up to 512 virtual libraries |
| Up to 1,024 virtual tape drives | Up to 2,048 virtual tape drives | Up to 4,096 virtual tape drives |
| Up to 64,000 virtual cartridges[a] | Up to 128,000 virtual cartridges | Up to 256,000 virtual cartridges |

a. For 64,000 virtual cartridges, a minimum of 4 GB of RAM is required in the node.

Even though IBM TS7500 Virtualization Engine is emulating LTO Generation 2, LTO Generation 3, Generation 4,3592-J1A, and TS1120 Tape Drives, it is only emulating the format of the devices. It is not emulating the speed of the actual drives.

> **Tip:** If physical tape libraries are attached to TS7500, choose the virtual drive type based on the attached physical tape drives to which data on the virtual volumes will be migrated.

### Virtual tape volumes

Virtual tapes volumes are associated with the drive that is chosen. If you choose LTO Generation 3 drives, the virtual tape volumes have LTO Generation 3 capacity. The default for virtual volume allocation is controlled by function called Capacity On Demand (COD). COD sets an initial allocation for each virtual volume created. With COD default settings, the initial space allocation for all media types is 5 GB. Using COD default settings, a minimum of 5 GB of space will be allocated for a virtual tape volume once it is mounted into a virtual drive. While writing to a virtual volume, the volume expands in size in increments defined by the volume type. The increment sizes are:

- An LTO Generation 2 virtual volume increments by 5 GB.
- An IBM 3592-J1A virtual volume increments by 5 GB.
- An LTO Generation 3 virtual volume increments by 7 GB.
- An LTO Generation 4 virtual volume increments by 12.5 GB.
- A TS1120 virtual volume increments by 8 GB.

Due to this incremental allocation of space for the virtual volumes we can have a larger number of virtual tape volumes in the TS7500 when compared to the situation where each volume reserves the size equivalent to its maximum capacity of the tape being emulated. Thus, with the capacity on demand capability, we can have a larger number of backup jobs running at any point in time on the TS7500. Figure 1-4 shows the allocation method for virtual tape volumes using capacity on demand.

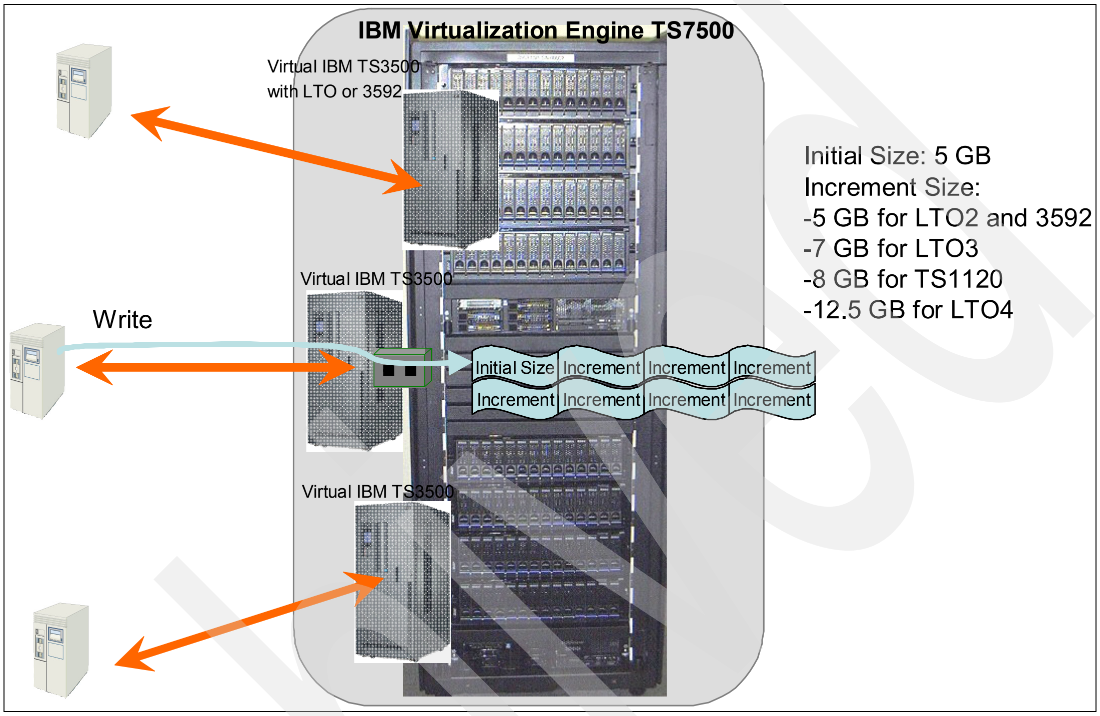



*Figure 1-4 Graphical description of capacity on demand in TS7500*

> **Important:** With capacity on demand, when a virtual tape volume is reused by the ISV software, the IBM Virtualization Engine TS7500 reduces the volume to the initial size of 5 GB.

## 1.3.2 Exporting to and importing from physical tape

Import and export are standard functions of a physical tape library and they are also functions of a TS7500 Virtualization Engine. To import or export physical tapes you must attach a supported physical IBM tape library to the TS7500.

### Import function

Figure 1-5 illustrates the process of the import command. A TS7500 Virtualization Engine is on the left and a physical TS3500 library (this could be any supported physical library) is on the right. The import must be done manually at the Virtualization Engine console to move data from a physical cartridge in the TS3500 to a virtual volume on the TS7500.

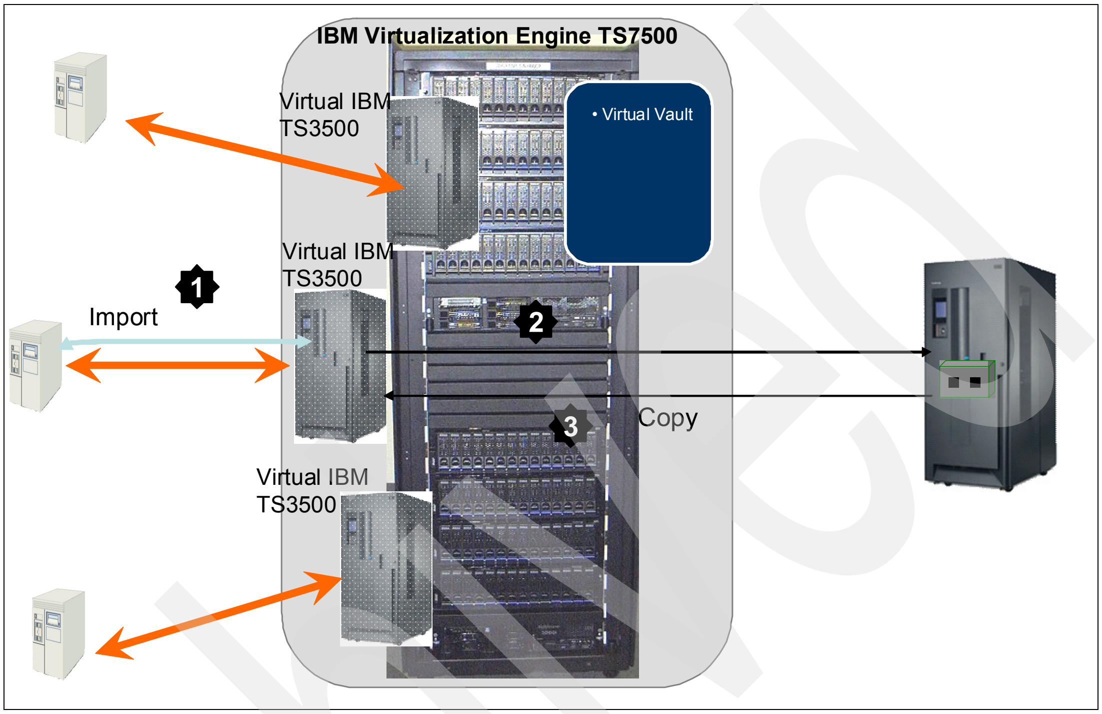



*Figure 1-5 Import flow*

Once you connect to the physical tape library, you can import data from any physical tape attached to that library. There are three different modes for importing a physical tape for use as a virtual tape resource:

- Copy mode

  Copy mode copies the entire physical tape, block-by-block, to a virtual tape.

- Direct access mode

  Direct access mode links a physical tape to a virtual tape during the import process. No disk storage space is used. This allows quick access to data stored on the physical tape and avoids time needed to import the entire physical tape. This process can only be used for data restoration. The physical tape is in a Read-Only mode and cannot be used for backup.

- Recycle mode

  Recycle mode only copies the first 10 MB of the physical tape and nothing else. It tries to preserve the tape header (plus or minus a few MB) without copying the backup data. This mode is useful if you want the ISV backup software to see the tape, but you know that the data no longer needs to be retained. Here only the headers are copied for the tape, as when there is a write to the virtual volume the writing is started immediately after the header creating a virtual tape, which is different from the physical tape at the back end.

The import flow is:

1. Using the TS7500 Management Console, the operator selects a physical tape and requests a remote copy.
2. The TS7500 requests a mount of the physical tape.
3. The data is copied from the physical tape cartridge to a virtual tape volume in a virtual library.

### Export function

When exporting a virtual tape to a physical tape, you must first move it to a section of the TS7500 Virtualization Engine called the *virtual vault*. Upon exporting to the tape the user has the option of encrypting the data on tape through the secure tape functionality discussed in 1.3.9, "Secure tape" on page 25. Figure 1-6 illustrates the export operation.

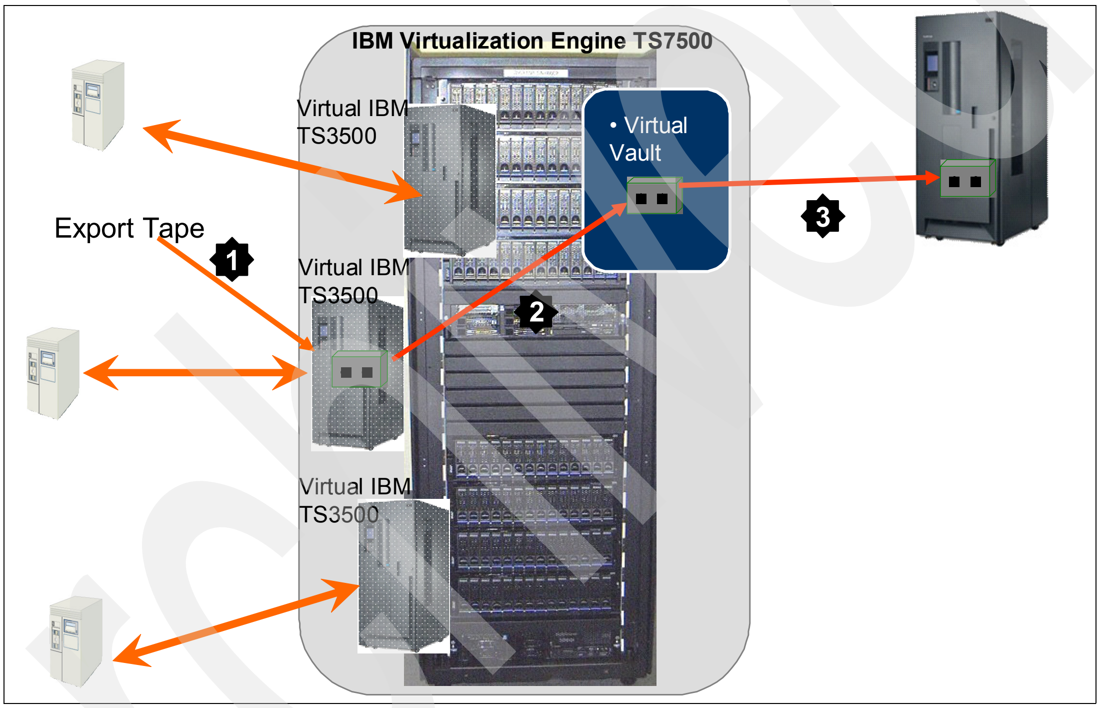



*Figure 1-6 Export flow*

The export flow is:

1. Using the TS7500 Management Console, the operator selects a virtual tape to export and moves it to the virtual vault.
2. Using the TS7500 Management Console, the operator initiates the export.
3. The data is copied from the virtual volume to a physical volume in an attached library.

You can manually move any virtual tape to the virtual vault by using the TS7500 Virtualization Engine console. We recommend that you do *not* do this, because it causes discrepancy in the cartridge inventory list of the backup application that can only be corrected by rerunning a library inventory.

> **Tip:** Unless you want to rerun the inventory command of the backup application, do not use the TS7500 Virtualization Engine console to export virtual volumes from the library.

When the tape is in the virtual vault, you can export it using the Export Tape option. If a tape has never been mounted on a virtual drive, you are prevented from moving it to the virtual vault, and the Export Tape option will not be available.

Like the import function, the export function also has multiple options:

- Move mode.

  Move mode moves the virtual tape to a physical tape based on a grace period setting. When you select zero days as the grace period, the virtual volume is immediately deleted when the export has finished. If the grace period is set to one day, the cartridge is deleted after one day.

- Copy mode.

  Copy mode moves the virtual volume to the virtual vault of IBM Virtualization Engine TS7500 and creates a physical tape in the externally attached physical tape library. Therefore, a virtual volume and an actual tape reside within IBM TS7500 Virtualization Engine's virtual vault and in the externally direct attached tape library.

- Eject physical tapes to I/E slots after export.

  This is an option that can be turned on or off. It causes the exported physical tape to automatically move to one of the I/O slots on the physical library.

### Export Physical Copy function

Export Physical Copy is an automatic export performed when the ISV backup software ejects the virtual tape. Options for Export Physical Copy are copy and move. You can optionally specify whether to move the tape to the import/export slots after this operation has finished and whether to encrypt the data using the secure tape functionality. See 1.3.9, "Secure tape" on page 25, for more information.

When you activate the Export Physical Copy function, you are given the ability to match the virtual barcode with an existing physical barcode. Export Physical Copy only works on virtual tapes that have been created using a physical barcode on a physical tape in the attached physical library. See Figure 1-7.

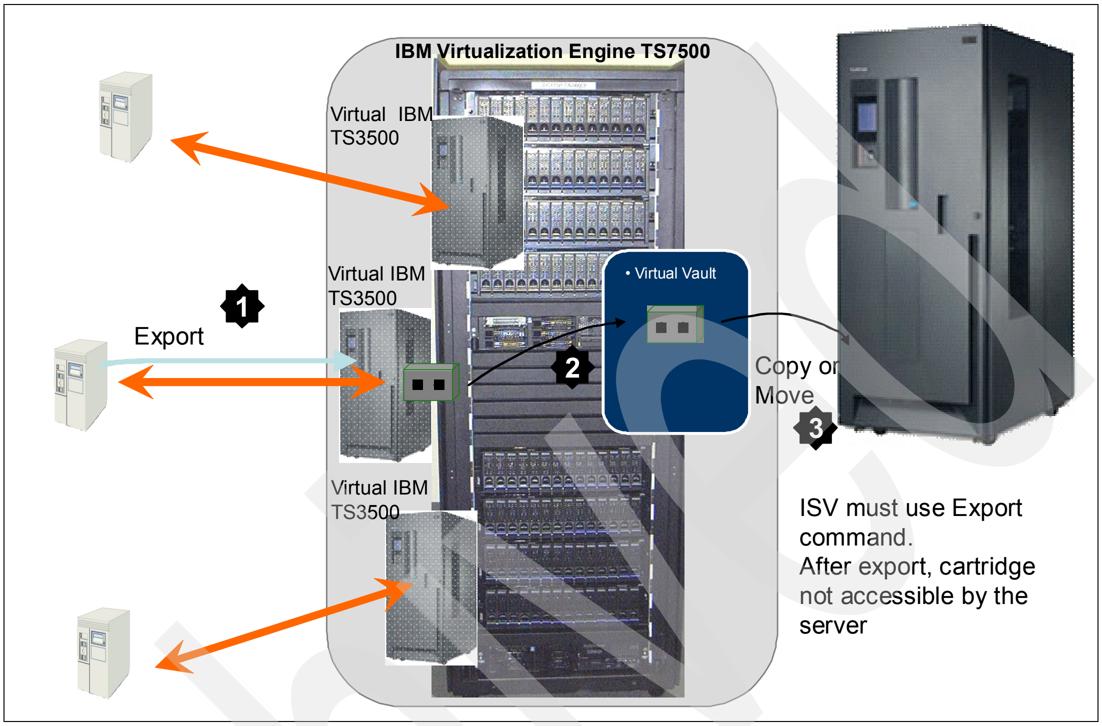



*Figure 1-7 Export Physical Copy flow*

The Export Physical Copy data flow is:

1. Export of data from a virtual volume to a physical volume starts when a backup application using the TS7500 issues an export command.
2. The virtual tape is moved to the virtual vault.
3. The virtual tape is copied from the virtual vault to a physical tape with the same barcode in the attached physical library.

## 1.3.3 Enhanced caching

The Enhanced Tape Caching function enhances the functionality of the TS7500 Virtualization Engine by acting as a cache to your physical tape library, providing transparent access to data within the TS7500 Virtualization Engine cache and an attached physical library. With the Enhanced Tape Caching function, tapes always appear to be inside virtual libraries and are visible to the backup application regardless of whether the data is actually on disk or tape. Backup applications have direct access to data whether the data is on disk or physical tape.

The Enhanced Tape Caching function provides advanced flexibility that allows you to set up policies that automatically trigger data migration to physical tapes based on criteria, such as the number of days that data has been on disk or the amount of used disk space. With Enhanced Tape Caching, you cannot only determine which events will act as a trigger for data movement, but also when they will occur. For example, you can set the policy to migrate the data immediately or at a specific time or day. This enables data to be written to physical tapes as a background process without impacting production servers. You can also set up a reclamation policy that allows you to specify when the data that has been migrated to physical tape can be deleted from the disk to make space for new virtual tape volumes. To use Enhanced Tape Caching, you must enable the option, set your migration and reclamation policies, and create a cache for each of your physical tapes.

Figure 1-8 shows the movement of data with Enhanced Tape Caching:

1. A backup application writes data to a virtual Tape Volume Cache.
2. At the predefined trigger, the TS7500 Virtualization Engine copies the data.
3. Copy is done from the virtual tape volume to the physical tape with the same barcode in an attached physical tape library.
4. Based on the reclamation policy, the TS7500 Virtualization Engine can also reclaim the cache used by the virtual Tape Volume Cache.

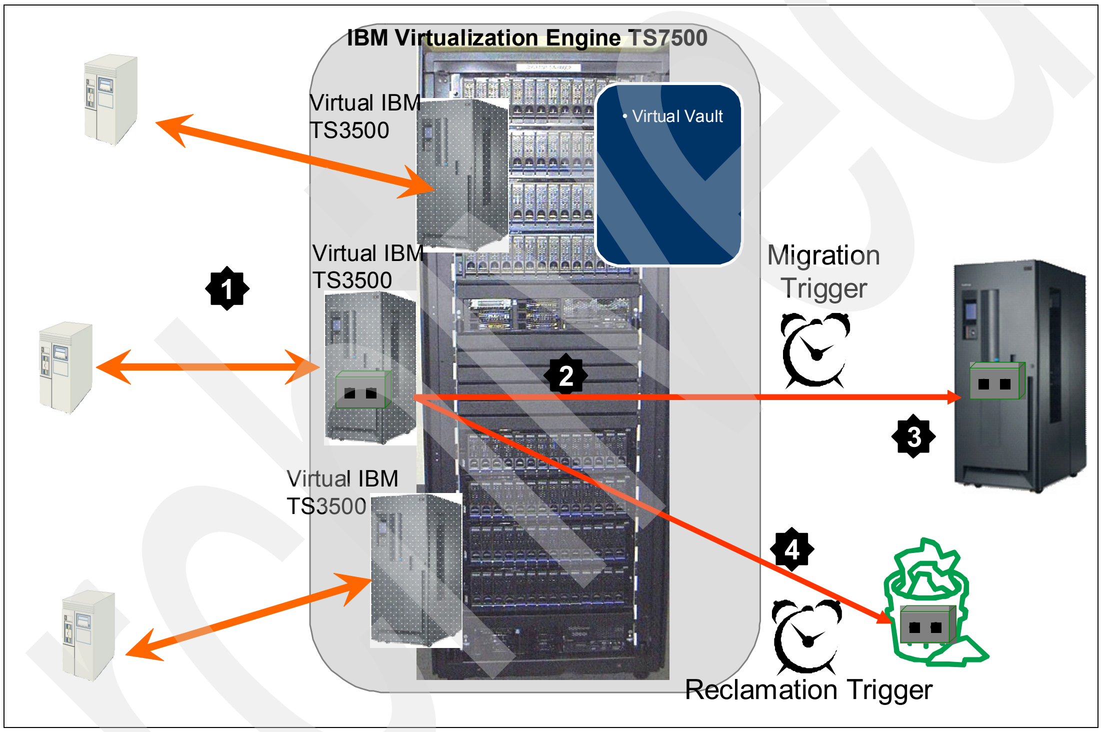



*Figure 1-8 Enhanced caching flow*

> **Restriction:** You cannot use Enhanced Tape Caching if you are currently using the Export Physical Copy or Export Network Copy for a virtual tape or virtual library.

Enhanced Tape Caching requires physically attached backend tape libraries. When using Enhanced Tape Caching, a cache (virtual tape volume) is created for physical tape volumes in an attached physical library. There is a one-to-one relationship between the virtual Tape Volume Cache and the physical tape volume. The virtual Tape Volume Cache and the physical volume have the same barcode or volume serial number. A backup application connected to the TS7500 only sees the virtual Tape Volume Cache. The TS7500, not the backup application, performs all operations with the physical volume.

When a virtual Tape Volume Cache is created, the backup application initially reads and writes from the virtual Tape Volume Cache. While the virtual tape volume is in cache, all reads and writes continue to the virtual Tape Volume Cache. Using triggers (time or policy based), the TS7500 migrates the data from the virtual Tape Volume Cache to the physical tape with the same barcode. The TS7500 can either leave the virtual volume and its data in cache or can reclaim the disk space used by the virtual Tape Volume Cache based on the defined reclamation policies. The Enhanced Tape Caching function writes data to physical tape volumes in a manner so that they maintain the format used by the backup application.

**Attention:** When a virtual volume tape cache is created, the TS7500 Virtualization Engine copies *no* user data from the physical tape with the same barcode to the virtual volume tape cache. The initial write to the virtual volume tape cache is started at beginning of tape (BOT). You can specify copying metadata to the virtual volume tape cache.

The time-based migration triggers are:

- Daily: Time of day

  Data is migrated from the virtual volume tape cache to the physical tape cartridge with the same barcode at the specified time of day.

- Weekly: Day of week and time of day

  Data is migrated from the virtual volume tape cache to the physical tape cartridge with the same barcode on the specified day at the specified time.

Policy-based migration triggers are:

- Age of data in days

  Data is migrated from the virtual volume tape cache to the physical tape cartridge with the same barcode when the data has been in cache for the specified number of days.

- Disk capacity

  Data is migrated from the virtual volume tape cache to the physical tape cartridge with the same barcode when the disk cache usage has reached a specified percentage.

- Last referenced dates

  Data is migrated from the virtual tape volume to the physical tape cartridge with the same barcode if it has not been referenced in the specified number of days. In this method of migration the volumes that are rarely accessed for read or write are the first ones to be exported (moved).

- End of backup

  - Data is migrated from the virtual volume tape cache to the physical volume with the same barcode when the virtual volume tape cache is unloaded from the virtual drive.
  - The Only if tape full option is available. If this option is selected the data is migrated from the virtual volume to the physical tape cartridge after the tape has reached its maximum capacity.

- Delay migration until

  Data is migrated from the virtual volume tape cache to the physical tape cartridge with the same barcode at the specified time of day.

You can specify either time-based or policy-based triggers. Within the policy-based triggers you can specify *and* or *or*. For example, you can specify data migration after five days *and* delay migration until 2 p.m. Or you can specify data migration after the data has aged for five days *or* disk capacity is 80% used.

The space replication policy triggers are:

- Immediate

  Cache is deleted when the data migration to the physical tape volume with the same barcode is successfully completed.

- No more space

  Cache is deleted when no more disk space is available for creating cached volumes.

- Retention period

  Cache is deleted after a specified number of days.

When the disk space for a virtual Tape Volume Cache is reclaimed, the TS7500 maintains a pointer, referred to as a direct link tape, to the virtual tape barcode that corresponds to the physical tape barcode to which the data was migrated. If a backup application needs to access a volume for which the cache has been deleted, the TS7500 manages the access to the data as defined in Table 1-3.

*Table 1-3 Tape access after cached, deleted, or reclaimed*

| Operation | Action |
|---|---|
| Read. | 1. TS7500 loads the required physical tape cartridge.<br>2. The backup application reads the data from the physical tape cartridge via the TS7500. |
| Append write. | 1. TS7500 loads the required physical tape cartridge into a physical tape drive.<br>2. The backup application writes the data to the physical tape cartridge via the TS7500. |
| Write from beginning of tape with label verification (scratch mount) by a backup application. | 1. TS7500 loads the required physical tape into a physical tape drive.<br>2. The backup application performs label verification on the physical tape cartridge.<br>3. The backup application begins to write.<br>4. The TS7500 creates a new virtual volume tape cache with the same barcode as the physical tape.<br>5. The backup application writes to the virtual volume tape cache.<br>6. The TS7500 unloads the physical tape after the backup application writes to the virtual volume tape cache. |

**Important:** If a backup application performs a write from beginning of tape without label verification, the TS7500 does *not* create a new virtual volume tape cache. The backup application writes data to the physical tape via the TS7500.

## Enhanced Tape Caching considerations

For fast access and to reduce physical tape requirements with Enhanced Tape Caching, we recommend that you retain the virtual volume tape cache until the virtual volume is full or until you have no further need for the virtual Tape Volume Cache under normal circumstances. By maintaining the volume in cache, you will not require a tape mount for read or subsequent non-scratch write. To maintain virtual volumes in cache you must size the TS7500 appropriately. For more information about sizing the TS7500, see.5.2, “Sizing considerations” on page 145.

When the enhanced caching is being enabled for a particular library the tape labels for the virtual library and the physical library connected at the back-end should match. The best way to accomplish this task is to synchronize the physical library with the TS7500 and create virtual volumes using the metadata from the physical cartridges. It should be noted, however, that the content in the physical cartridges that have been imported will be overwritten with the data in the virtual volume after the migration trigger occurs.

When using enhanced caching along with compression there are some considerations that must be kept in mind. The following scenarios explain this:

- *Scenario 1*: There is compression enabled on the TS7500 while there is no compression available on the physical tape attached at the back-end.

  In this example, we store data of 200 GB on the virtual tape volume for Ultrium 2 format in a compressed form on the TS7500. Now if we want to export this virtual tape to the physical tape the data will be decompressed and exported to the LTO 2 Tape. Here the size of virtual volume will exceed the size of the physical volume and the export will fail. To avoid this situation size the virtual volume proportionately to the average compression ratio leaving a sufficient buffer.

- *Scenario 2*: There is compression enabled on the physical tape attached at the back-end and compression is not available on the TS7500.

  In this example, we store data of 800 GB on the virtual tape volume for Ultrium 4 format in a non-compressed form on the TS7500. If we want to export this virtual tape to the physical tape with compression enabled, the data will be exported to the LTO 4 Tape and will be compressed at the tape using hardware compression present on the tape. In this scenario due to the tape compression of 2:1, the 800 GB of data present in the virtual volume only occupies 400 GB of the physical tape, leading to inefficient usage of cartridges. Here we have to size the virtual volumes to take care of the compression and ensure maximum utilization of the cartridges.

- *Scenario 3*: There is compression enabled on both the physical tape attached at the back-end and on the TS7500.

  In this example, since the compression ratios for the TS7500 Virtualization Engine and the physical tape will be different there is a chance for the virtual volumes size to exceed the size of the physical tape. Hence, here it is always advisable to size the virtual volumes up to 10% smaller than the physical tape.

- *Scenario 4*: There is no compression enabled on either the physical tape attached at the back-end or the TS7500.

  In this example, There are no sizing mismatches and the virtual volumes size is equal to that of the physical tape cartridge.

If a virtual volume tape cache is migrated and the cache is reclaimed, you cannot restore the virtual volume tape cache with the data from the corresponding physical tape volume. You can only access the data from the physical tape volume via the TS7500.

## 1.3.4 High availability (failover/failback)

You use the optional high availability (HA) or failover/failback function when a TS7500 Virtualization Engine takes over the identity of a second HA TS7500 Virtualization Engine due to a hardware or software failure that affects the proper operation of the TS7500 Virtualization Engine. For the TS7500 to operate in the high availability mode there are a few considerations that have to be kept in mind:

- The failover and failback between two TS7500 Virtualization Engines can occur only if the two nodes are in the same physical frame (3952-F05).
- The virtualization engine nodes forming the failover pair must have identical configurations.
- Each virtualization engine in the failover pair must be allotted two separate static Ethernet IP addresses per server per Ethernet port. One of these addresses will be dedicated to communicating the heartbeat signal between the two engines, while the other can be used as a regular service port.
- The ISV applications accessing the nodes might have to be restarted after the failover or failback has occurred. This has to be done, as there will be a time of no response from the failed server before the failover is initiated and there will be an additional lag until the failover occurs.
- Hosted backup and NDMP do not fail over and those jobs cannot be continued after a failover event.

The high-availability function is illustrated in Figure 1-9 (normal state) and Figure 1-10 on page 23 (failover state).

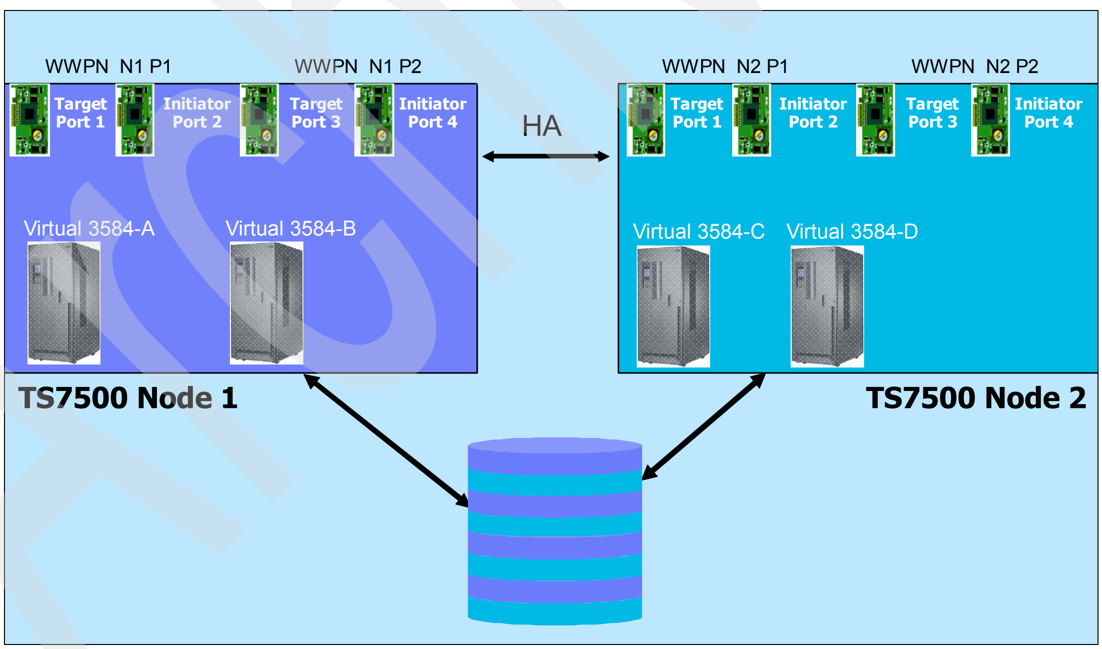



*Figure 1-9 High availability or failover/failback: normal state*

In a normal state with high availability or failover/failback, two TS7500 Virtualization Engine servers or nodes in one 3952-F05 frame are configured to share cache. Each node has its own virtual libraries, connections to back up application servers, and allocated cache. At the top of the boxes representing each node you can see the WWPNs that represent the target port connections to back up application servers. In the boxes you can see the virtual libraries. The striping on the cache indicates that each node accesses its own assigned cache.

Each TS7500 Virtualization Engine has an internal database used for holding the information about the TS7500 Virtualization Engine solution. These databases are mirrored to ensure that at any point in time any one of two engines is aware of all the virtualized components of the entire TS7500 system.

In a failover state, one of the two TS7500 Virtualization Engine nodes suffers a failure. In Figure 1-10, TS7500 node 1 has failed. The WWPNs for node 1 are assumed by node 2. The virtual libraries for node 1 are now logically managed by node 2 and all cache is available and used by node 2. These changes are logical only. The physical connections remain in place for use when the failback occurs.

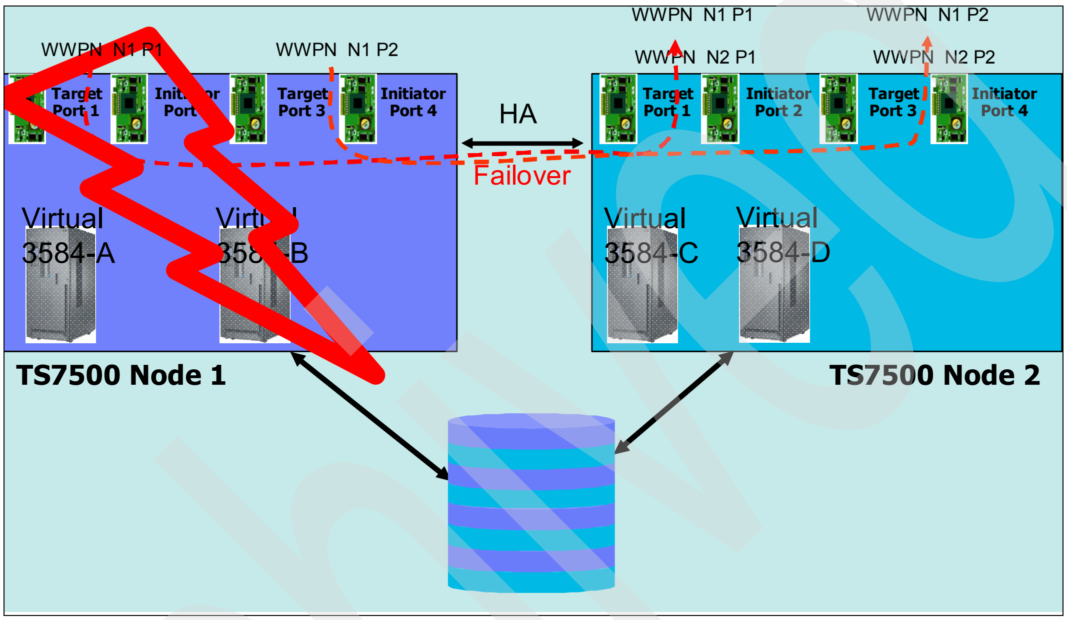



*Figure 1-10 High availability or failover/failback: Failover state*

The high-availability function provides redundancy for the TS7500 storage network, protecting you from potential problems such as storage device path failure or TS7500 Virtualization Engine failure.

You must purchase the high-availability configuration of the TS7500 Virtualization Engine to use this function.

## Storage device path failure

A storage device path failure can be caused by the failure of one of the attached cables. The high-availability option can eliminate this potential failure point by providing a multipath configuration. The TS7500 Virtualization Engine automatically detects all paths to the storage devices. If one path fails, the TS7500 automatically switches to another active path. This is available as a chargeable feature.

## TS7500 Virtualization Engine failure

The TS7500 high-availability option ensures that the TS7500 Virtualization Engine solution is capable of providing service to its clients even if one of its virtualization engines fails. This ensures that there is minimal downtime for the TS7500 Virtualization Engine solution.

In the high-availability configuration the two TS7500 Virtualization Engines are configured to monitor each other. The TS7500 Virtualization Engine uses a unique monitoring system to ensure the health of the servers. This self monitor checks each of the TS7500 Virtualization

Engine processes and their connectivity to the attached storage devices. In a high-availability configuration, the TS7500's intelligent heart-beat monitor continuously monitors the other server. When a heartbeat is retrieved, the results are evaluated. If this heartbeat fails, the TS7500 that received the failed heartbeat starts catering to the clients attached to both virtualization engines in the high availability (HA) pair.

In the event that one of the TS7500 Virtualization Engines in the high-availability pair fails to fulfill its responsibilities, the other TS7500 Virtualization Engine performs a takeover of the failing TS7500 Virtualization Engine's identity. This failover is achieved by the alive engine by spoofing the worldwide port names of the failed engine on its own ports, thus enabling the data traffic to be automatically routed away from the engine that has failed to the engine that is alive.

## 1.3.5 Hosted backup

The optional hosted backup function allows the users to install their backup applications directly onto the TS7500 Virtualization Engine, providing the users with a high bandwidth connection between the backup server and the virtual backup devices. With hosted backup the users can entirely eliminate the need for dedicated backup servers. The ISV backup application for the hosted backup can be installed on a dedicated LUN in the TS7500.

We must add an additional CPU and system memory module to the TS7500 Virtualization Engine before we can add the hosted backup feature to handle the additional load created by the backup application on the virtualization engine.

If hosted backup is installed the failover and failback functionality for the TS7500 Virtualization Engine cannot be deployed as the two nodes on the virtualization engine.

For more information about hosted backup refer to the *IBM Virtualization Engine for Tape TS7500 User's Guide Version 3, Release 1*, GC27-2179.

## 1.3.6 Network Data Management Protocol (NDMP) support

The NDMP backup support option allows certified backup applications and industry-standard NAS devices to perform backup and restore using the NDMP protocol over an IP network.

With NDMP backup support, the virtualization engine for tape appliance acts as an NDMP server, centralizing management by eliminating locally attached tape devices from each NAS device. When a backup occurs, data is moved from the NAS device directly to the virtual library.

With NDMP support when a backup occurs, data is moved from an NAS device directly to the virtual library. For providing NDMP support on the TS7500 Virtualization Engine the TS7500 creates a hosted NDMP server that connects with the external backup application to provide support for backup of NAS appliances.

For more information refer to the *IBM Virtualization Engine for Tape TS7500 User's Guide Version 3, Release 1*, GC27-2179.

## 1.3.7 Internet SCSI (iSCSI) protocol support

The optional iSCSI function allows SCSI commands to be used over an IP network and allows hosts to connect using Ethernet instead of Fibre Channel. The supported host platforms are Windows and Linux.

If the user wishes to deploy network replication between two TS7500 Virtualization Engine solutions located at two different sites, the customer can connect the two units over a WAN using iSCSI. The availability of the iSCSI protocol on the virtualization engine reduced the cost of the solution due to the use of IP network and its functionalities. Moreover, since the iSCSI functionalities are built into the virtualization engine customers do not have to invest in costly multiprotocol routers.

For more information refer to the *IBM Virtualization Engine for Tape TS7500 User's Guide Version 3, Release 1*, GC27-2179.

## 1.3.8 Tape encryption

With physical tape libraries attached to the TS7500 Virtualization Engine, you can use two methods to encrypt your physical tape cartridges:

- TS7500 Secure Tape function or software-based encryption
- TS1120 or LTO4 native tape drive encryption

You can use the TS7500 Secure Tape function to write encrypted data to TS7500 supported tape technologies that do not support native tape encryption. These physical tape drives must be in a supported physical tape library that is directly attached to the TS7500.

If you have encryption-capable tape drives attached to the TS7500 as backend tape, you can use the native Library-Managed Encryption capabilities of the tape drive using the Encryption Key Manager.

The TS7500 Secure Tape function and native tape encryption are mutually exclusive functions. We recommend that you use native tape encryption if you are using TS1120 or LTO4 Tape Drives as backend tape or any later tape technology that supports native tape encryption.

## 1.3.9 Secure tape

The encryption on the TS7500 Virtualization Engine can be performed either via software encryption (secure tape) or via hardware encryption (tape encryption). Library-based hardware encryption/tape encryption can be used when the drives being used at the back end are capable of hardware encryption (IBM Ultrium 4 Tape Drives and IBM TS1120 Tape Drives support hardware-based encryption). If the drives connected to the TS7500 at the backend do not have hardware encryption capabilities they can use the software encryption on the TS7500 for securing the data on the physical tape. We recommend using hardware-based encryption wherever possible as it reduces the computation load on the virtualization engine and also ensures independence of backed up data from the TS7500 for decryption of data.

The software-based encryption functionalities on the TS7500 are provided with the secure tape license. The secure tape function uses the Advanced Encryption Standard (AES 128) algorithm published by the National Institute of Standards and Technology, an agency of the United States government. With this option, you can create one or more keys that can be used to encrypt the data when it is exported to physical backend tape and to decrypt when it is imported back to virtual tapes. The data on the tape cannot be read or decrypted without using the appropriate key. The secure tape function provides portable media protection so that data is protected when it is exported to physical media, thereby reducing your exposure to lost or misplaced media.

The secure tape function works with your existing backup application environment with no change to the backup application. Encryption occurs during the migration to physical backend tape and can be done outside the backup window to reduce the performance impact.

**Note:** In case of Secure Tape encryption on the TS7500, note that cartridges encrypted using software-based encryption on the TS7500 can be read only by other TS7500 attached libraries/drives having the same version of TS7500 software.

### Key management

With this feature, you can create one or more keys that can be used to encrypt the data when it is exported to physical tape and decrypt it when it is read from the physical tapes. The data on the tape cannot be read without being decrypted using the appropriate key.

Each key consists of a secret phrase. For additional security, each key is password-protected. You must provide this password to change the key name, password, or password hint, or to delete or export the key.

You must perform two steps to use the secure tape function to encrypt/decrypt a virtual volume:

1. Create the keys to use for encryption.
2. Assign those keys to virtual volumes.

You can assign the keys during the creation of a cached library, when performing library synchronization, when renewing cache for a physical volume, or when setting your Export Physical Copy options. For more information about these functions refer to 12.6, “Key management” on page 413, and 12.7, “Exporting a key” on page 421.

Once you have created one or more keys, you can export them to a separate file called a key package. To send encrypted tapes to other locations with a TS7500 Virtualization Engine, you must also send them the key package. By importing the key package, administrators at the other sites can decrypt the tapes when they are read by the TS7500 Virtualization Engine.

**Important:** When transporting key packages to other sites, you must also transport the password for the key package. You must create a secure method for transmitting the key package password. You should follow your local security procedures.

### Secure tape considerations

Since the tape data compressed by the TS7500 V3R1 software cannot be compressed using native hardware compression if you use Enhanced Tape Caching, you might need more physical volumes than you used without the secure tape function and Enhanced Tape Caching functions. For example, assume that a physical 200 GB tape contains 400 GB with 2:1 backup compression:

- Without compression
  - The virtual volume contains 200 GB.
  - The TS7500 software encrypts 200 GB.
  - The 200 GB cannot be compressed by native tape drive compression.
  - You require two virtual and two physical volumes to contain the 400 GB of data.

- With compression enabled
  - The virtual volume can contain 400 GB occupying 200 GB of space due to backup compression.
  - Data is decompressed before encryption.
  - The TS7500 software encrypts 400 GB.
  - The 400 GB of this data cannot be compressed by native tape drive compression, as it is encrypted.
  - The 400 GB will not fit on one physical tape and the migration job will fail when writing to a 200 GB physical tape. This is why backup compression is not suggested when using the TS7500 software encryption.

With the secure tape function, keys are managed per TS7500 Virtualization Engine server. There is no centralized keystore for multiple TS7500 Virtualization Engines. Keys can be assigned to a single tape or to multiple tapes. If you assign multiple keys to multiple tapes you must keep track of which key was assigned to which tape.

To read or append to a tape encrypted with the secure tape function, you must supply the appropriate key. You can reuse or scratch an encrypted tape by performing an unencrypted write from beginning of tape.

### 1.3.10 Control Path failover and data path failover (DPF)

The optional path failover function, control path failover and data path failover, provides automatic control path failover to a preconfigured redundant path without aborting the current job in progress. It also provides failover for multiple redundant paths in a SAN environment by automatically providing error recovery to retry the current operation using an alternate, preconfigured path without aborting the current job in progress. This can provide flexibility in SAN configuration, availability, and management.

Figure 1-11 shows the configuration of a backup application server and TS7500 using the path failover function.

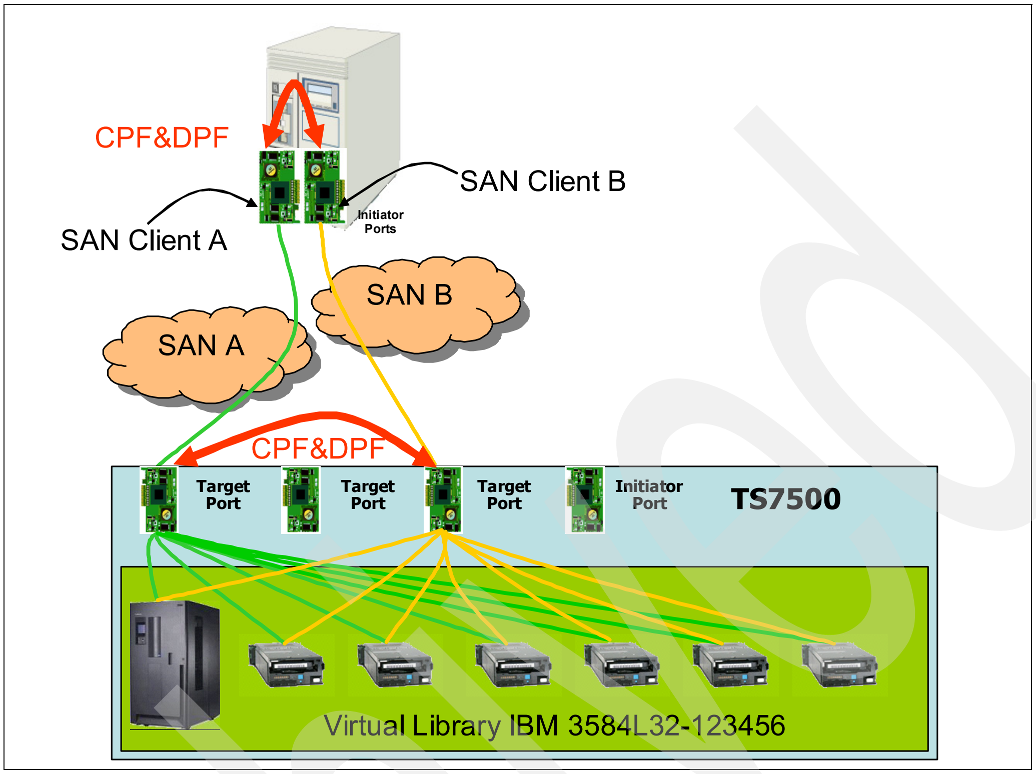



*Figure 1-11 Path failover configuration*

For more information, refer to 5.3.6, “Fibre Channel ports and host assignment equals load balancing” on page 163, and the *IBM Virtualization Engine for Tape TS7500 User's Guide Version 3, Release 1*, GC27-2179.

## 1.3.11 Hardware-based data compression

With the new TS7530 Virtualization Engine users have the capability to add compression cards to their virtualization engine. These cards perform data compression for the TS7500 Virtualization Engine without degrading the performance of the TS7500 Virtualization Engine solution.

The TS7500 compression saves disk space by compressing files so that more data can be stored by a virtual tape drive. The increase in capacity is directly related to the compressibility of the data being backed up. If you can compress the data being backed up by a factor of up to 2:1, you can store up to twice as much information about the virtual tape. The data compression ratio in the real world is greatly affected by the type of data being compressed. If the data being compressed is a zip, gif, pdf, and so on, file they cannot be compressed further, while simple text files or bitmap image files can be compressed to a great extent.

The TS7500 Virtualization Engine supports two types of compression:

- Hardware compression: Uses the compression card
- Software compression: Uses an LZO algorithm that runs on the VE for Tape server

The compression settings of the backup application do not affect TS7530 compression. TS7530 compression, whether hardware or software, is enabled and disabled for all virtual tape drives in the TS7530.

**Note:** If you are already using software compression that is supplied by your backup application, you should not use TS7500 Virtualization Engine solution compression. Using both types of compression will cause the TS7500 Virtualization Engine solution to try to compress already compressed data, and this can slow down your backups.

### 1.3.12 Software-based data compression

Backup compression is an option of the data backup operation that you can turn on or off at any time from the TS7500 Virtualization Engine console. Software-based backup compression decreases the performance speed of the TS7500 Virtualization Engine. If performance is an issue, you can consider not using backup compression or using the hardware-based compression available in the TS7530 Virtualization Engine.

However, if performance is not an issue, software compression can significantly increase the amount of data placed into each virtual tape volume.

Alternately, the user can purchase the option feature that adds processors to the TS7500 to improve the performance when using software asked backup compression. The TS7500 can take a total of three additional processor packages.

With backup compression turned on, you must size the virtual tape cartridges approximately 10% smaller than the physically attached back-end drives. If the amount of data on the virtual tape exceeds the amount of space on the physical tape, the export functions (export, Export Physical Copy, and cached tape migration) will fail.

### 1.3.13 Local replication

The optional local replication feature allows you to make a copy of a complete virtual volume in the same TS7530 Server. This function is the same as network replication except that the target and source servers are the same. In local copy we make a duplicate copy of the selected virtual volume within the same server to a different LUN. In local copy since the source and duplicate virtual volume are in the same server the copy takes less time compared to the network copy. However, the local copy provides very limited disaster recovery capabilities.

For more information refer to the *IBM Virtualization Engine for Tape TS7500 User's Guide Version 3, Release 1*, GC27-2179.

### 1.3.14 Network replication

Network replication provides a method to recover from complete data loss by sending copies of data offsite. Network replication can copy data from TS7500 (source) to another TS7500 (target). One TS7500 can be a target for many other *source* TS7500. One TS7500 can be a target from one or more source TS7500s, but can itself also be a source TS7500 and replicate its own data to another TS7500.

There are three methods of network replication:

- Remote copy
- Replication
- Export Network Copy

To use the network replication function, you need two IBM TS7500 Virtualization Engines:

- The local TS7500 that serves virtual tape drives to your backup servers
- A disaster recovery/remote TS7500

## Remote copy

Remote copy is a manually triggered, one-time replication of a local virtual tape. Upon completion of the remote copy, the tape resides on the primary TS7500 and in either the virtual vault or a virtual library on the remote TS7500.

You cannot perform remote copy on a tape that has already been configured for Export Network Copy. When using remote copy, the copied tape can reside either in one of the virtual tape libraries or in the virtual vault. The remote copy option preserves the barcode from the TS7500 Virtualization Engine from which the remote copy was initiated.

Figure 1-12 illustrates the remote copy movement. The local TS7500 Virtualization Engine is on the left and the remote TS7500 is on the right.

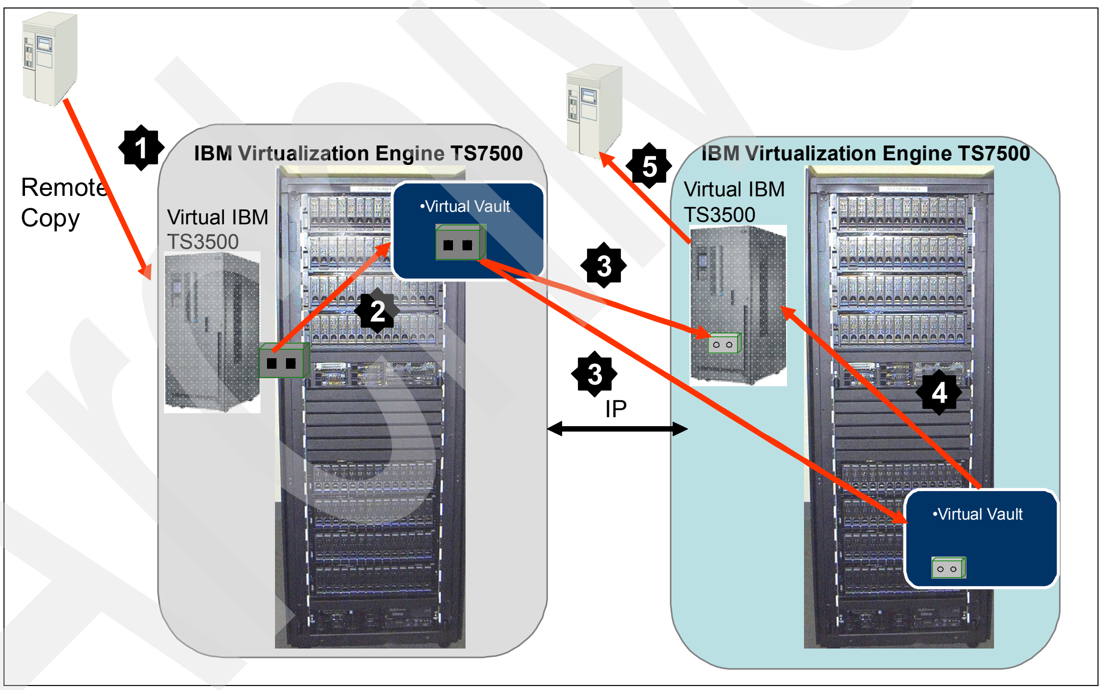



*Figure 1-12 Remote copy data flow*

The remote copy flow is:

1. Using the TS7500 Management Console for the local system, the operator selects a virtual tape and moves it to the virtual vault.
2. The operator selects the volume in the virtual vault and selects remote copy.
3. The data is copied from the virtual volume on the local system to a virtual volume in the remote system virtual vault or directly into a virtual library.

4. If sent to the virtual vault, the virtual volume must be moved from the remote system virtual vault into a remote system virtual library.
5. Virtual volumes in a remote system virtual library are available to the backup application.

## Replication

The network replication under the TS7500 reacts to different triggers to initiate replication based on whether the enhanced caching has been enabled on the unit. However, the operation methodology under both the situations is similar:

- Enhanced caching enabled

  The TS7500 Virtualization Engine can be configured to use the policies defined for enhanced caching to act as triggers for network replication. With the latest version of TS7500 the users have the option to select whether they want to conduct replication before they migrate the data to physical tape or whether they want to conduct migration before they replicate the data. Here the trigger for migration is provided by the enhanced caching module based on the rules configured for enhanced caching. After specifying the sequencing of migration and replication activities, network replication works along with the enhanced caching present on the TS7500 to provide a disaster recovery solution for the user.

- Enhanced caching disabled

  When enhanced caching has been disabled the replication process is either triggered by a scheduled event or when the new or changed data on virtual volume reaches a certain predetermined size. Here the parameters based on whether the replication takes place are defined by the user.

When replication is configured, a local virtual volume is created and linked to the virtual replica on the remote TS7500 Virtualization Engine solution. A replica tape is always linked to the original virtual tape. It cannot be used by any virtual library or for import/export by the remote TS7500 Virtualization Engine until this linked relationship is broken. This condition is also known as *promoting a replica*.

The replica tape receives incremental changes from the local source tape, ensuring that the two tapes are always in-sync at the end of a replication session. This is why it is a *dedicated relationship*. Since the incremental changes are trackable (because we know that no one else is writing to or accessing the replica), there is no need to replicate or create a remote copy of the entire tape at each replication interval.

Data traveling across the replication path can be compressed, encrypted, or both. Additional feature codes are required to activate these features. If the replica is promoted, it is placed in the virtual vault on the remote virtualization engine, with the same barcode label as the source virtual tape. It can then be used like any other virtual tape.

Figure 1-13 illustrates replication movement. The left TS7500 is the local engine and the right TS7500 is the remote. Data replicates from the local to the remote utilizing the replication process. If the local engine fails, to use a replica that is on the remote TS7500, the virtual replica sitting in the replication repository must be promoted to a virtual volume and moved to the virtual vault. From the virtual vault, you must move the virtual tape to a virtual library from which it can be accessed.

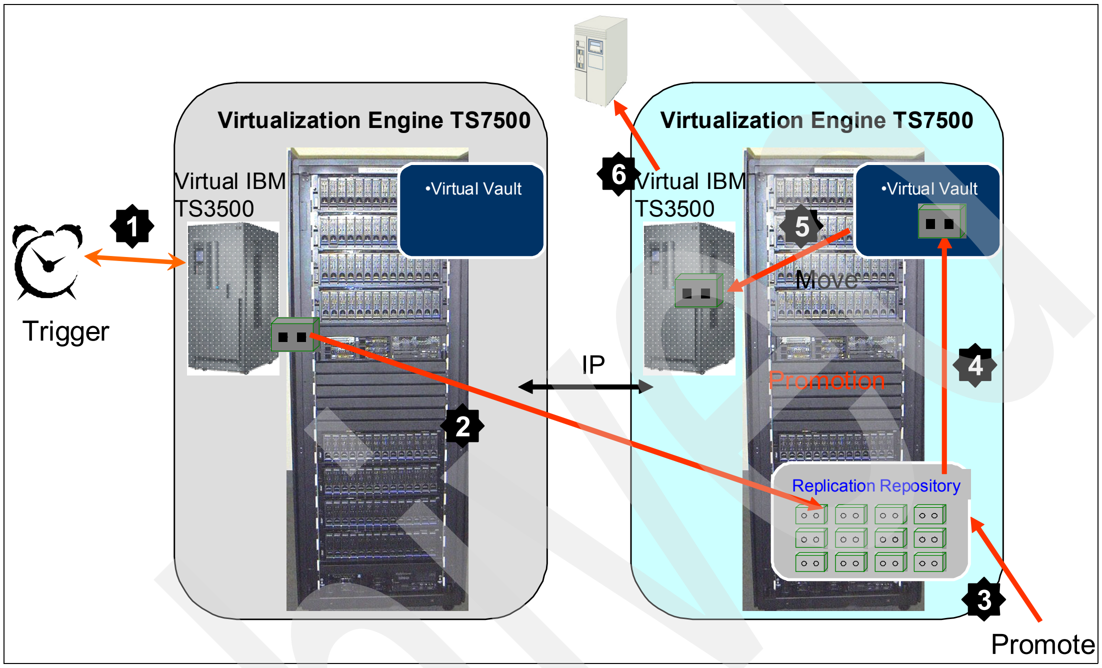



*Figure 1-13 TS7500 replication*

The Replication data flow is as follows:

1. Replication for a volume starts when the specified trigger event occurs.
2. New or changed data is copied from the virtual tape on the local TS7500 to a replication copy in the replication repository.
3. If a problem occurs on the local TS7500 and a replicated volume is required, the operator promotes the required virtual volume.
4. Promotion moves the virtual volume to the virtual vault and the replication link is broken.
5. The operator issues a command to move the virtual volume from the virtual vault to the appropriate virtual library.
6. The virtual volume is now located in the virtual library.
7. A backup application can access the virtual volume using normal processes to add a tape volume.

## Export Network Copy

As mentioned previously, *Export Physical Copy* involves a one-time copy or move of the virtual tape when the backup software has sent an export command (backup application command that issues a SCSI move medium to I/O slot). Export Network Copy provides for the same, one-time copy or move after the eject, but the destination is the remote TS7500 Virtualization Engine instead of a local backend physical library.

Figure 1-14 illustrates the Export Network Copy process. The left side shows the local TS7500 and the right side shows the remote TS7500. The local TS7500 initiates the Export Network Copy function that sends a one-time copy or move after the export command to the backup TS7500 Virtualization Engine. The virtual volume is then placed in the replication repository.

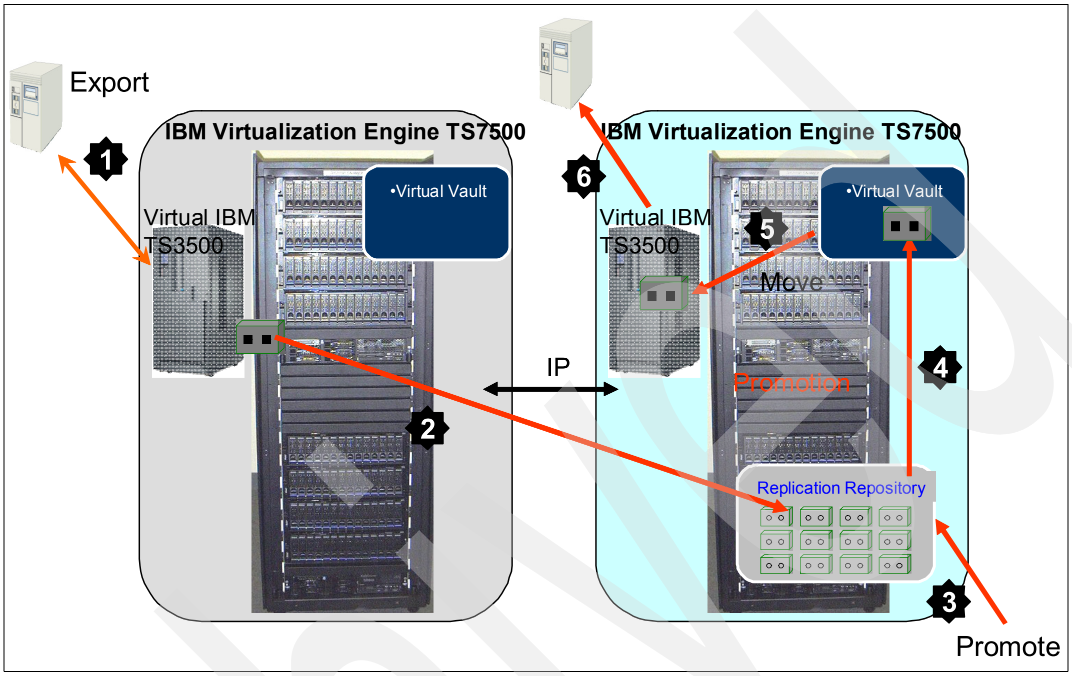



*Figure 1-14 Export Network Copy flow*

The Export Network Copy data flow is:

1. Replication for an entire volume starts when a backup application using the local TS7500 issues an export command.
2. The virtual tape is moved to the local virtual vault.
3. The virtual tape is copied from the local virtual vault to the remote replication repository.
4. If a problem occurs on the local TS7500 and a replicated volume is required, using the TS7500 Management Console, the operator promotes the required virtual volume.
5. Promotion moves the virtual volume to the virtual vault and the replication link is broken.
6. Using the TS7500 Management Console, the operator issues a command to move the virtual volume from the virtual vault to the appropriate virtual library.
7. The virtual volume is now located in the virtual library.

A backup application can access the virtual volume using normal processes to add a tape volume.

## 1.3.15 Network encryption

Network encryption is an optional feature for network replication for the TS7500 Virtualization Engine. With this feature, the local TS7500 encrypts the data being sent to the remote TS7500 Virtualization Engine just prior to transmission and sends it across the line. The remote TS7500 decrypts the data as it is received. The TS7500 performs software-based encryption using the Diffie-Hellman algorithm. Network encryption impacts the performance throughput of the TS7530 Virtualization Engine.

The TS7500 Virtualization Engine has an optional feature, processor, which can be added to the TS7500 to improve performance when using network encryption. Up to three optional processor packages can be added to a TS7500 Virtualization Engine.

> **Important:** The network replication feature is a prerequisite for the network encryption and network compression features. If two TS7500 Virtualization Engines are configured in a high-availability configuration, these features must exist on both TS7500 Virtualization Engines.

### 1.3.16 Network compression

Network compression is an optional feature for the TS7500 Virtualization Engine. With this feature, the local TS7500 compresses the data being sent to the remote TS7500 Virtualization Engine just prior to transmission and sends it across the line. The remote TS7500 decompresses the data as it is received. If the data is already compressed using backup compression, the local TS7500 does not decompress the data and then recompress it for transmission. The TS7500 performs software-based compression using an LZ algorithm. Network compression impacts the performance throughput of the TS7500 Virtualization Engine.

Even though the TS7530 can support data compression cards, network-based compression is possible only via software. However, since the bandwidth for replication is less than that of normal backups the amount of data to be compressed is substantially less, hence software-based compression works fine here.

> **Important:** Network compression is only used in data transfers of virtual tape volumes between the local and remote TS7500.
>
> If you are using both network compression and network encryption, data compression is performed first followed by data encryption.

See Chapter 5, “Configuration and planning” on page 129, for more details about ordering these feature codes.

### 1.3.17 Data shredding

Data shredding is a new function currently available on Version 3 of the TS7500 Virtualization Engines software. If the tape cartridges are not encrypted, data present on the tapes that are being recycled can be read. This happens because reuse of tape only rewrites contents from the beginning of tape, leaving contents of the remaining tape unchanged. Data shredding is designed to ensure the security of the information on tapes that are being recycled or disposed off. With the data shredding functionality the TS7500 directs the virtual tape library writing on the cartridge to rewrite the entire length of the cartridge with data designed to ensure zero recoverability.

Data shredding is the irreversible deletion of virtual volumes from the disk cache. To perform tape shredding, you must move the lines to be shredded to the virtual vault so that you can select them. Once you have selected them, you can perform the tape shredding. Data shredding follows the Department of Defense 5220.22 standard, which is a triple-pass algorithm that overwrites all the data with a single character, followed by overwriting the data with the complement of the character, and finally followed by overwriting the data with random characters.

After this write operation has been completed there is no way to recover the data that was earlier written to the tape. Since this operation requires rewriting the entire tape is relatively time consuming compared to the tape recycling method.

### 1.3.18 Tape duplication

Tape duplication is a new function available with the TS7500 Virtualization Engine. The prerequisite for tape duplication is to have two or more physical libraries at the backend. After tape duplication is enabled, upon export of the virtual tape cartridge to the physical library multiple physical copies of the virtual cartridge will be made.

Tape duplication is an automatic replication of the physical tapes on the connected library. Tape duplication functionality starts operating when we have any operation executed on the TS7500 solution that requires movement of virtual volume to the physical tape.

When we activate tape duplication on the virtual library and specify the number of copies that we require, we need to have the an equivalent number of physical libraries connected in the back end with tape cartridges having identical labels. See Figure 1-15.

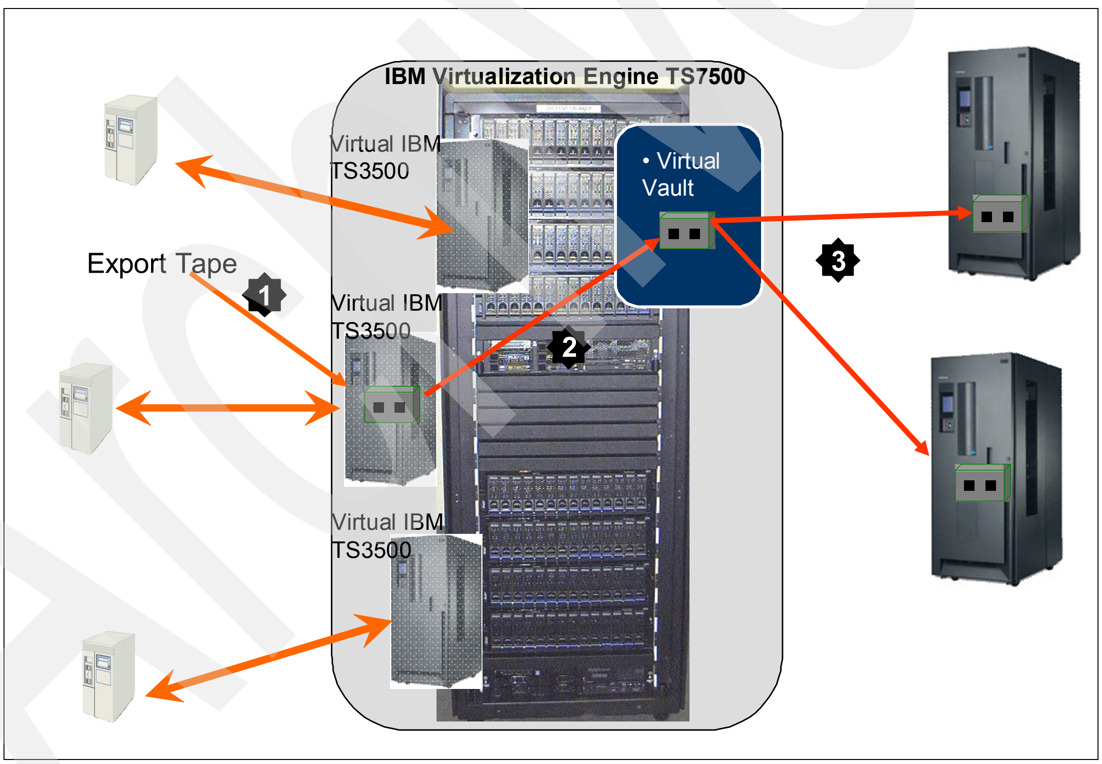



*Figure 1-15 Tape duplication*

The Export Physical Copy data flow is:

1. The tape duplication starts when there is an operation that requires movement of virtual volume to physical library.
2. Two separate export jobs are created with separate Job-ids.
3. The data from the virtual volume is copied simultaneously onto the multiple tape cartridges having the same label (in different physical libraries).

The virtual tape is copied from the virtual vault to a physical tape with the same barcode in both attached physical libraries.

### 1.3.19 Call Home

Call Home is a unique customer support utility that proactively identifies potential system or component failures and automatically notifies IBM using the IBM Electronic Service Agent™ program. Using preconfigured scripts (called triggers), Call Home monitors a set of predefined, critical system components (memory, disk, and so on). When an error is triggered, Call Home captures the appropriate information needed to diagnose the reported problem and this information is then sent to IBM. With Call Home, IBM is able to contact the customer to take corrective measures within the shortest amount of time, ensuring optimum service uptime and IT efficiency for the TS7500 Virtualization Engine.

The Call Home installation has some network requirements in order to install easily and function properly. The TS7500 Virtualization Engine (VE) servers in the local network must meet the following requirements before installing Call Home:

- IBM Virtualization Engine TS7500 server and the VE console workstation being used as the Call Home gateway server must be able to resolve each other using their fully qualified host names. This can be achieved in one of the following ways:
  - By setting up the TS7500 node and the Call Home gateway server on the same DNS
  - By configuring hosts files on both servers
- The Call Home gateway server must be on the same subnet mask as the TS7500 Virtualization Engine server even if a DNS network is not used.
- The Call Home gateway server must be able to reach the Internet in order to communicate with IBM Support.
- If you are using DNS names to access the TS7500 Virtualization Engine for iSCSI or replication purposes, additional DNS names such as eth1 or bond0 are required to resolve the appropriate IP addresses.
- For Fibre Channel switch events, the Fibre Channel switch or switches in the TS7500 server rack must also be configured on the same network as the server nodes. The TS7500 nodes should be able to successfully ping the IP address of any Fibre Channel switches.

For more information refer to the *IBM Virtualization Engine TS7530 Call Home Function Setup Guide,* GC27-2169, which is available from the IBM Support Web Site at:

http://www.ibm.com/support

## 1.4 TS7500 Virtualization Engine Software

A customer-supplied management console and the IBM Virtualization Engine TS7500 Software Version 3 Release 1 program are required. The TS7500 Virtualization Engine attaches to selected IBM System p®, IBM System i®[2], RS/6000®, RS/6000 SP, IBM System x, Netfinity®, IBM System z® (Linux only), Sun™, HP-UX, Windows 2003, Linux, and other UNIX® and PC servers. Appropriate levels of host software are required.

IBM Virtualization Engine TS7500 V3R1 software must also be ordered and installed with each TS7500 Virtualization Engine.

[2] System i support is available under the IBM Request for Price Quotation (RPQ) program.

## 1.4.1 TS7500 Virtualization Engine management console

A management console is used for configuration, management, and service support for the TS7500 Virtualization Engine. This console is required by the TS7500. A customer can either supply this console or optionally order it from IBM. If you order a management console, you must place it as a separate order from the TS7500 solution.

The IBM TS7500 V3 R1 Virtualization Engine for Tape Console program runs on this management console and must be installed by the customer prior to TS7500 initial installation and configuration. IBM TS7500 V3 R1 Virtualization Engine for Tape Console is a graphical user interface (GUI) that is used to configure and manage the TS7500 Virtualization Engine.

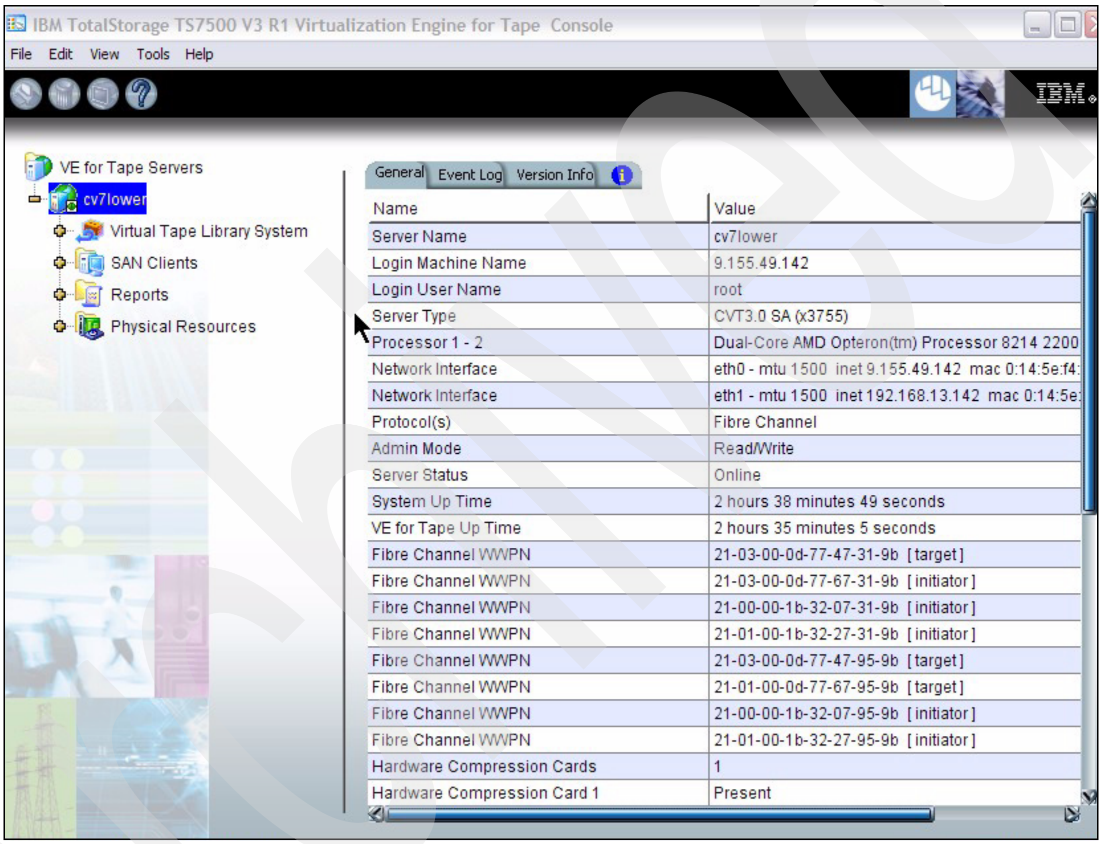



*Figure 1-16 IBM TS7500 V2 R1 Virtualization Engine for Tape Console*

## 1.4.2 Multi-node support

The optional multi-node support function provides the ability to define groups to include two or more TS7500 nodes in a TS7500 two-node or four-node system. Once a group is defined, you can manually share virtual volumes between the owner node and a remote node in a group by *borrowing* the virtual volume.

Backup applications attached to the remote or borrowing node can access the borrowed virtual volumes.

Backup applications attached to the owning node cannot access the borrowed volumes until the borrowed virtual volumes are manually returned.

For more information about grouping see 12.4, “Sharing virtual tapes through grouping” on page 391.

### 1.4.3 Command-line interface (CLI)

The TS7500 Virtualization Engine provides a simple utility that allows you to perform some of the more common TS7500 functions at a command line instead of through the TS7500 Virtualization Engine management console. You can use the command-line utility to automate many tasks and integrate the TS7500 with your existing management tools. For more information refer to the *IBM Virtualization Engine for Tape TS7500 User's Guide Version 3, Release 1*, GC27-2179.

## 1.5 Key features

Table 1-4 summarizes the key features for the TS7500 Virtualization Engine.

*Table 1-4 Key features of the TS7500 Virtualization Engine*

| **Number nodes** | **Single node configuration** | **Dual-node configuration** | **Four-node configuration** |
|---|---|---|---|
| Drive type and capacity | 750 GB or 1000 GB SATA | | |
| Maximum tape cache | 1.66 PB | | 1.76 PB |
| Library emulation | TS3500, TS3310,TS3200, TS3100, 3583, 3582 | | |
| Drive emulation | LTO2, LTO3, LTO4, 3592-JA1, TS1120 | | |
| Maximum virtual libraries | 128 | 256 | 512 |
| Maximum virtual drives | 1024 | 2048 | 4096 |
| Maximum virtual cartridges | 64,000 | 128,000 | 256,000 |
| Available slots | 2PCI-X, 4 PCIe | 4PCI-X, 8PCIe | 8PCI-X, 16PCIe |
| Maximum Fibre Channel interfaces | 16 | 32 | 64 |
| Fibre Channel speed | 4 Gb/s | | |
| Maximum iSCSI interfaces | 10 | 20 | 40 |
| iSCSI speed | 1 Gb/s | | |
| Throughput | 1000 MB/s[a] | 2000 MB/s[a] | 4000 MB/s[a] |

a. The numbers mentioned are approximate figures. The performance may vary depending on the setup and type of workload.

## 1.6 Product preview

It is the current intent of IBM to enhance the IBM Virtualization Engine TS7500 Series by supporting the new TS1130 Tape Drives announced by IBM. IBM intends to also include support for the high density TS3500 frames to be announced in 2008 with the TS7500 Virtualization Engine.

The TS1130 is the latest generation of the enterprise drive from the IBM product line, offering higher throughput and capacities than the earlier drives. The new drive is designed to offer high capacity, performance, reliability, and technology designed for the enterprise class and mainframe environments. It will be used as standalone tape drive and as internal drives in the TS3400 or the IBM System Storage TS3500 Tape Library.

**Note:** Previews provide insight into IBM plans and direction. Specific availability dates, ordering information, and terms and conditions will be provided when the product is announced.

2

# Backup architecture

This chapter provides an overview of different backup architectures. We discuss in general why backups are needed. In addition, we describe the difference in tape and disk backups and give you an overview of the various cost perspectives for disk and tape.

We discuss the following topics:

- What a backup is and why we perform backups
- Different backup architectures
- Differences in tape and disk backup
- An overview of virtual tape libraries



## 2.1 What a backup is and why we perform backups

Data is becoming more and more critical for an enterprise environment. Currently data availability must be guaranteed 24x7 because most enterprises cannot afford the cost of downtime or data unavailability. Business continuity is a major task for an enterprise to implement.

There are various metrics that are needed to gauge any backup requirement. These metrics are related to backup and restoration of the data in case of a failure:

**Backup window**
The backup window can be defined as the time required to copy all your data onto the backup device. The backup window is a function of the backup infrastructure available, the connection media, and the quantity of data to be backed up.

**Backup frequency**
This metric defines how frequently the backup operation is carried out. Using this metric we can understand the amount of data that will be lost in case of a scenario where we are recovering from the backup data.

For example, if we back up our data every day at 5:00 p.m. and if we have to recover after a failure that occurred at 1:00 p.m. today, we will use yesterday’s backed-up data. Thus, all the changes to data that happened from 5:00 p.m. yesterday up to today 1:00 p.m. will be lost.

**Backup type**
The backup being carried out can either be a full backup, where all the data to be protected is copied onto the backup equipment, or backup could be incremental backup, where only the data that has changed since the last backup operation will be copied onto the backup equipment.

**Recovery point objective (RPO)**
The recovery point objective is the acceptable amount of data loss that can be sustained when we recover from backed-up data after failure.

For example, if we have a policy to back up our data every day at 5:00 p.m. and if we have to recover after a failure that occurred at 4:59 p.m. today, we will use yesterday’s backed-up data. Thus, all the changes to data that happened from 5:00 p.m. yesterday up to today 4:59 p.m. will be lost. Thus, we have set our recovery point objective at 24 hours, which means that losing the data changes that have occurred in the last 24 hours is acceptable to us.

**Recovery time objective (RTO)**
The recovery time objective is the time required to restore all the backup data onto the system and bring it to the state in which it was when backup was performed.

**Recovery time objective for transaction integrity (RTOTI)**
The RTOTI is larger than the RTO. The RTOTI is required because after the RTO period only the systems are restored. The state of the applications running on the system has to be made such that the operations can be run by them smoothly. Only after the application is running in the proper state on the recovered system the recovery is complete.

Figure 2-1 explains the relationship between RPO,RTO and RTOTI.

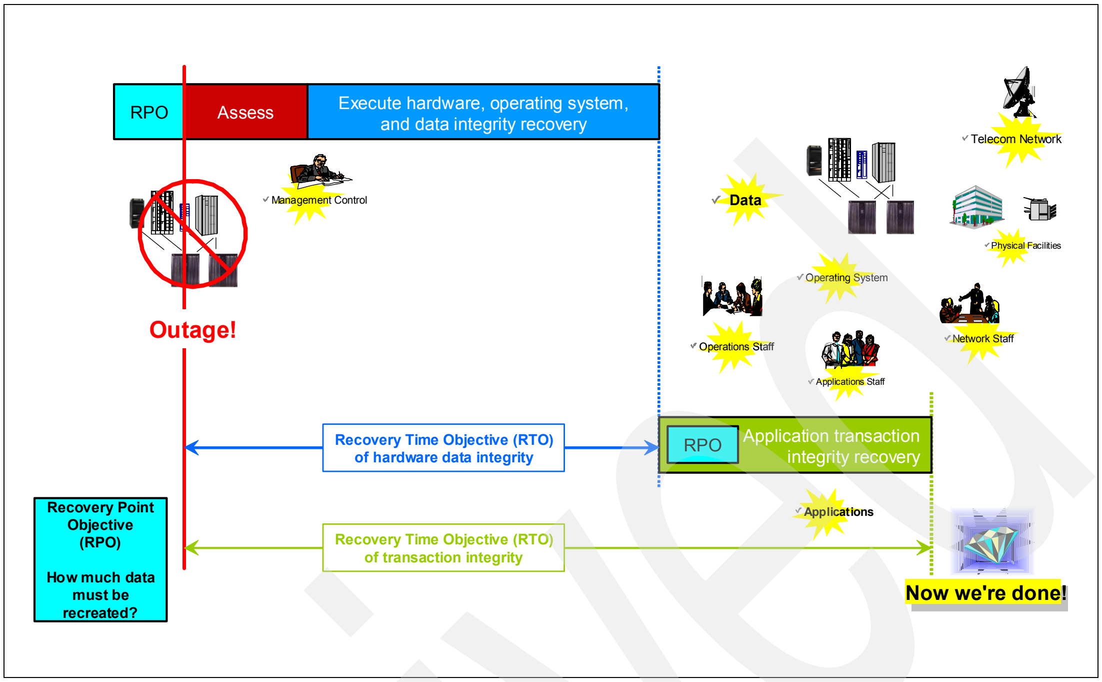



*Figure 2-1 RPO, RTO, and RTOTI relationship*

**Note:** In most cases RTO is has more importance than the backup window, as this metric defines the outage time after the failure and impacts the business directly. When discussing backup strategies it is important to discuss the RTO and RPO guidelines defined for the organization.

For further information about RPO, RTO, and RTOTI refer to the Redpaper publication on *IBM System Storage: Planning for Heterogeneous IT Business Continuity*, REDP-4063.

Different data availability tiers reflect the value of the data and indicate how long the enterprise can afford to work without the availability of the data. There are seven tiers (Figure 2-2) for business continuity, which address the three main areas:

- High availability
- Continuous operations
- Disaster recovery

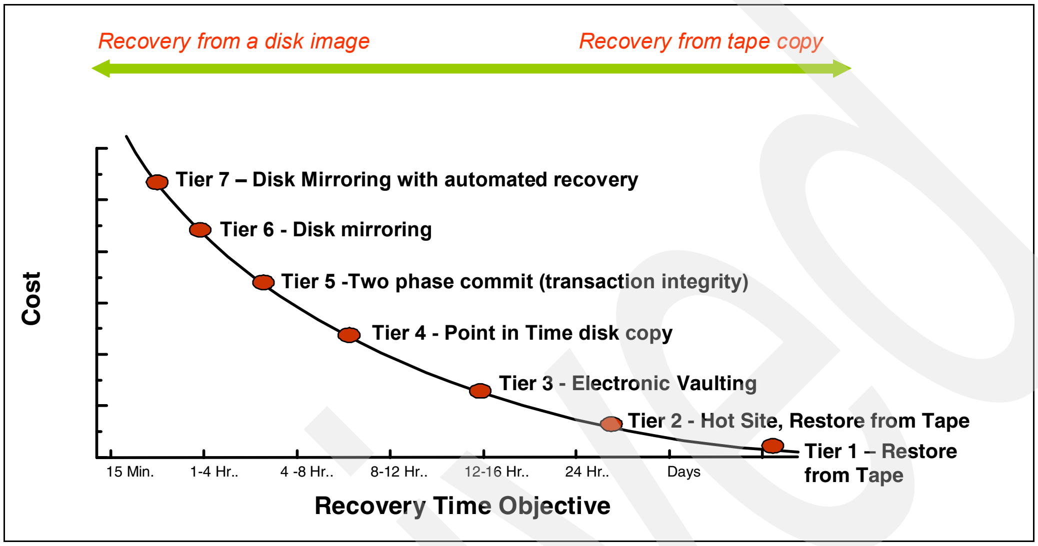



*Figure 2-2 Tiers of business continuity*

By categorizing business continuity technology into the various tiers, we have the capability to more easily match our desired recovery time objective with the appropriate set of technologies. The reason for multiple tiers is that as the RTO time decreases, the appropriate business continuity technologies for RTO must change. For any given RTO, there is always a particular set of optimum price/performance business continuity technologies. The concept of business continuity tiers is a common method used in today's best practices for business continuity solution design. It was originally developed by the IBM US SHARE User Group in 1988.

The concept of tiers is powerful, because the tiers concept recognizes that for a given customer recovery time objective, all business continuity products and technologies can be sorted in an RTO solution subset that addresses that particular RTO range. The tiers concept is also flexible. As products and functions change and improve over time, the tier chart only needs to be updated by the addition of that new technology into the appropriate tier and RTO.

The tiers chart in Figure 2-2 gives a generalized view of some of today's IBM business continuity technologies organized by tier. As the recovery time becomes shorter, more aggressive business continuity technologies must be applied to achieve that RTO (carrying with them their associated increase in value and capital cost).

The tiers also reflect the way an IT organization can incrementally grow and improve their information technology business continuity over time. Each preceding tier provides a foundation for the subsequent higher tier. Notice that implementing a higher tier does not remove the need for the lower tier. In fact, the higher tier can only exist because it is based upon the foundation of the tiers below it. See Figure 2-2.

Backup belongs to tiers 1 through 4 and is needed for disaster recovery. A disaster in which a restore from a backup is needed can be manifold. It can be a natural disaster, such as fire, hurricane, or flood. It can also be a technical defect from the storage system, such as a harddisk crash, or it can be software or firmware failure that destroys the file system or corrupts the data. It can be an application failure, where the data is no longer usable. You can create failures (human errors), delete files by accident, create an incorrect configuration, or incorrectly edit files, and so on. An attack, such as a virus, from outside your data center can require a restore.

Figure 2-3 explains the impact of type of failure on the RTO failure.

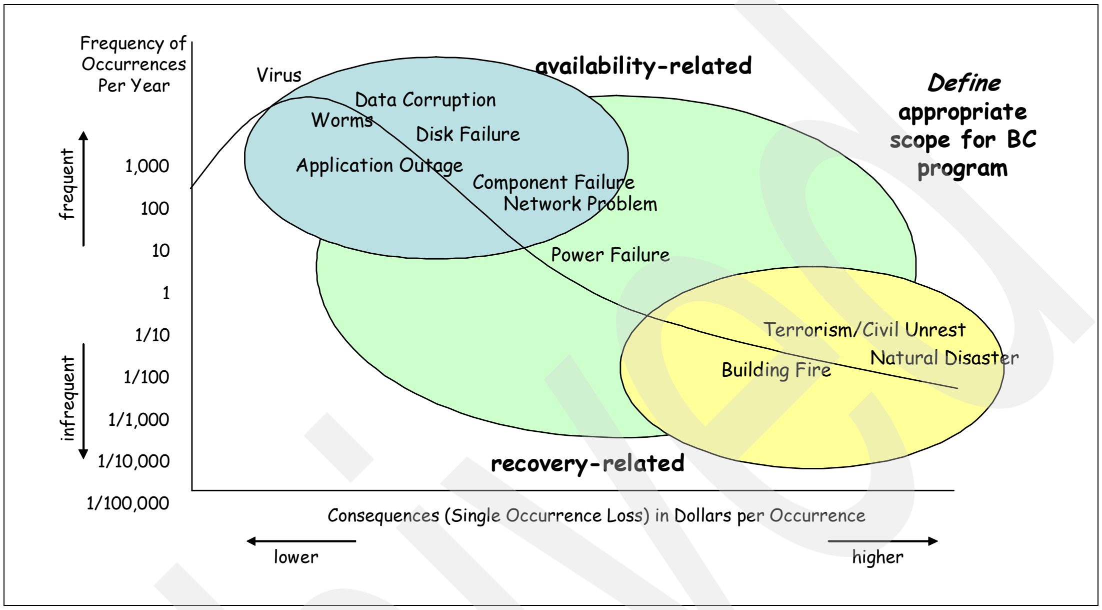



*Figure 2-3 Failures and impact on RTO*

Backups should be stored in different places, on different media, and using different software applications to create the backup. A backup on the same box or created with the same firmware does not meet all requirements for restoring the data at the occurrence of any kind of disaster.

Backup creates copies of normal production data, but it leaves the normal data as it is and does not move any of the original data from one place to another. Backup is not related to archiving or Information Lifecycle Management (ILM) of data. Archiving and ILM work with the original data and move the original data from one place to another. Archival and backup data might be stored on the same storage tier by using IBM physical tapes or virtual tapes, such as TS7500. You could use the same software application, such as Tivoli® Storage Manager, which can manage backup data and archive data. Keep in mind that there is just one version of archival data available, which is the original version. Consequently, archival data must be backed up also.

Backup should be designed for restore and not vice versa. You should always determine the purpose of a restore and what restore time is required. You should plan your backup based on the restore time requirement.

In general, there are two different kinds of restore:

- *Disaster recovery restore* means that you need to restore a large amount of data in a short amount of time.
- *Single file restore* means that you just want to restore one single file or just a few files.

For optimal performance of disaster recovery restore and single file restores, you may require different backup architectures.

## 2.2 Problems with the traditional backup

In the past, backup was always performed on tape drives. Clients connected over a LAN to the backup server stored backup data over the backup server to the tape drive (Figure 2-4).

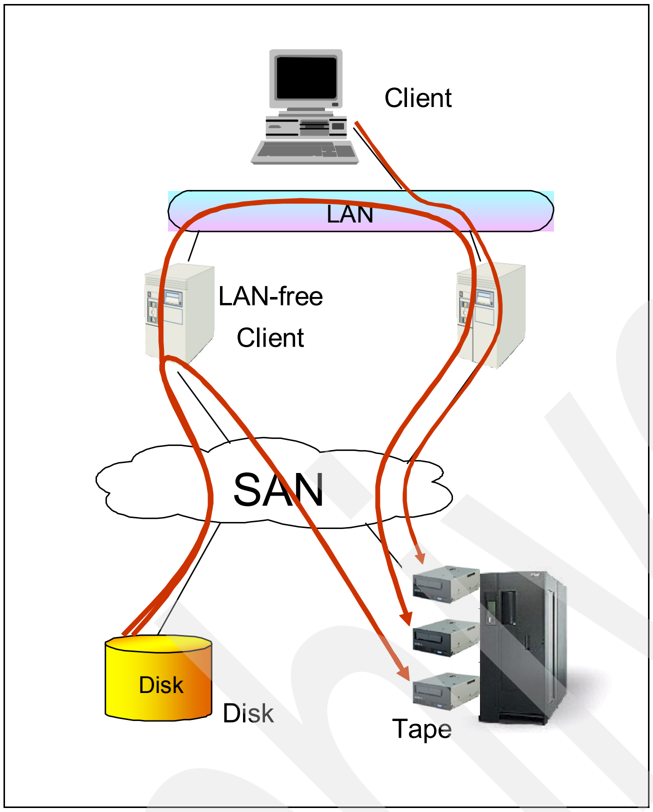



*Figure 2-4 Traditional backup*

Tape drives at that time were slow compared with tape drives today, but backup streams were also slow because most clients were connected over 10 Mbit/s or possibly 100 Mbit/s connections. In the past, tape drives fulfilled the requirements of backups and restores. Currently, tape drives are very fast (LTO4 = 120 MB/s, TS1120=104 MB/s; with compression up to 260 MB/s), but most of the clients are still connected over an 100 Mbit Ethernet. This means that a backup stream does not fully utilize a current tape drive.

With this poor tape drive utilization, more tape drives are required to meet the backup window, because a single tape drive can just write one stream at a time. Newer, faster tape drives will not shrink the backup window. Only more tape drives will shrink the backup window (Figure 2-5). In the example we use LTO4 tape drives, which have a throughput of 120 MB/s, but the backup jobs have a throughput of just 10–60 MB/s. Therefore, the speed of the LTO4 tape drives does not help shrink the backup window.

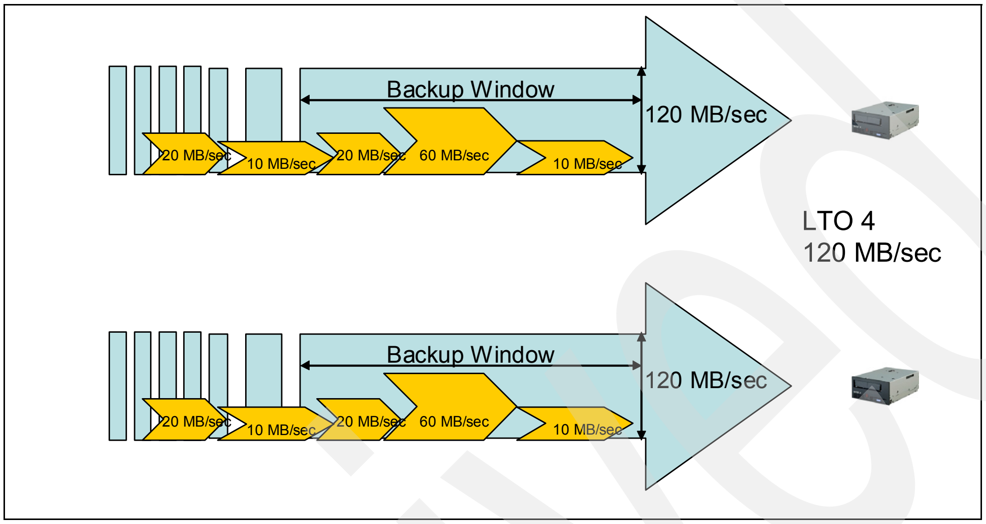



*Figure 2-5 Poor tape drive bandwidth utilization*

Newer IBM Tape drives do lower their speed (speed matching) to match the write and read speed of the server. In addition, IBM tape drives use a large data buffer to buffer slower reads and writes from the server. IBM tape drives provide the optimal performance, and the tape drive does not decrease the read or write speed if the read or write performance from the server is slower than the native performance of the tape drive. The general myth that reads and writes that are slower than the native speed of the tape drive will decrease the overall performance because the tape drive has to stop and start (known as start/stop or shoe-shining) is not true with IBM tape drives.

For several years, clients with access to the SAN can back up over the SAN directly to tape drives. Those backups are called *LAN-free backup*. LAN-free backup does not necessarily mean that the backup stream is faster. However, the LAN and the backup server are no longer the bottleneck, but the workload on the backup server and the LAN will be reduced. Now the LAN-free client and the file system where the data to be backed up reside are the bottleneck, so the tape drive utilization is not improved. In addition, some backup applications do not allow tape drives to be shared between multiple LAN-free clients and the backup server, so more tape drives are needed during the backup window.

In summary, the primary problem with traditional backup (backup directly to tape) is the poor bandwidth utilization, which drives the requirement for more tape drives during the backup window.

## 2.3 Back up to disk and back up disk to disk to tape (D2D2T)

The problems backing up directly to tape can be solved if a disk buffer is used in front of the tape drives. The advantage of this disk buffer compared with tape drives is that you can have several parallel streams to the disk buffer. Slow backups can now be run in parallel and do not need to run serialized. The data are now cached on the disk buffer during the backup and are migrated to tape drives later (Figure 2-6).

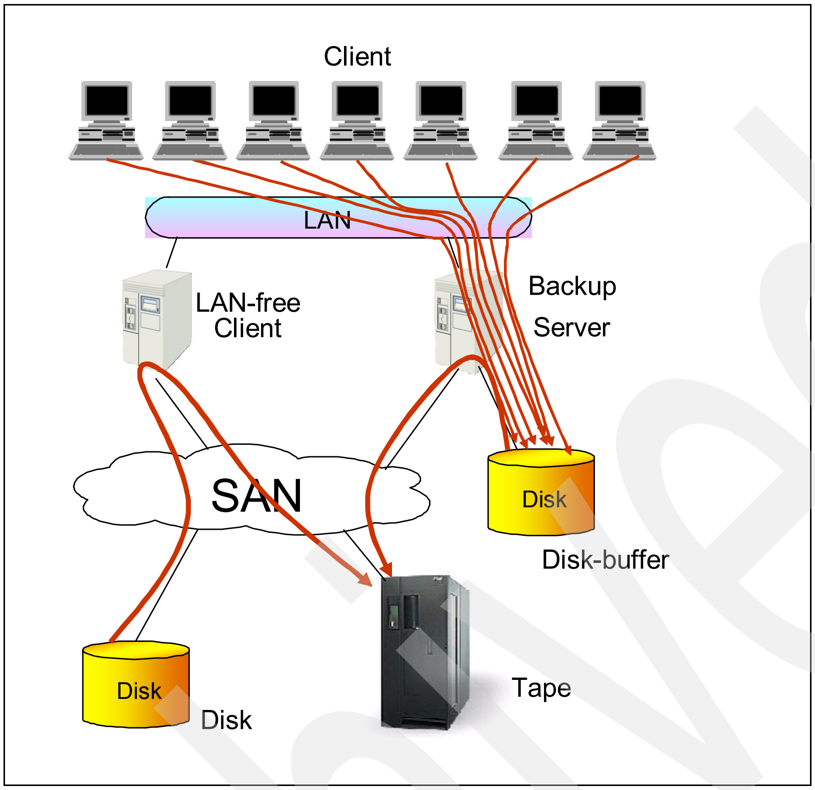



*Figure 2-6 D2D2T backup*

The advantage of the D2D2T backup is that the backup window may be reduced because of the parallelism of the backup streams. Less tape drives might be required because the bandwidth utilization gets improved. The migration from the disk buffer to the tape drive is intended to have high performance (Figure 2-7).

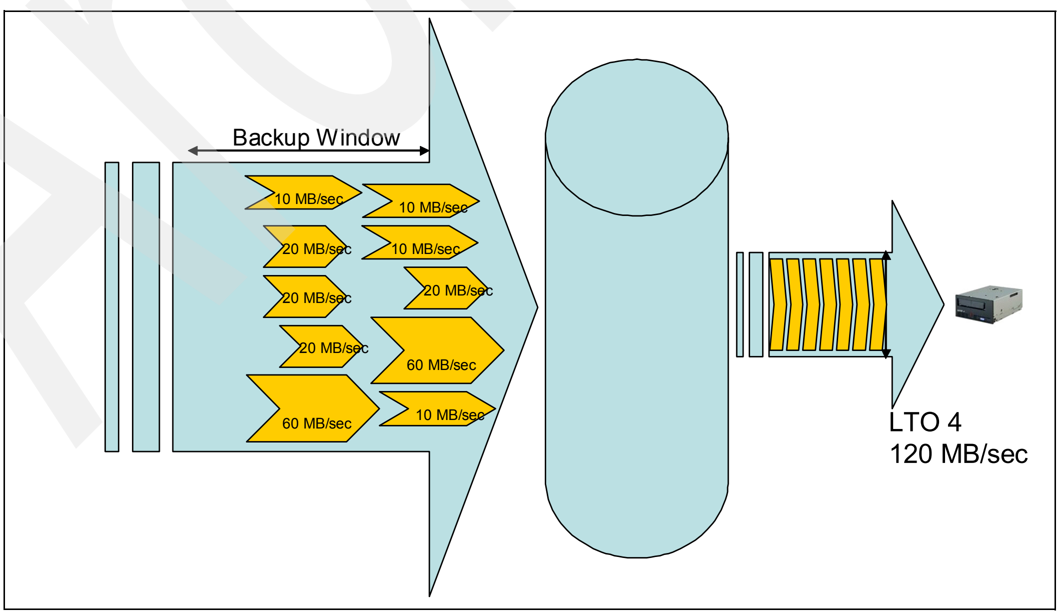



*Figure 2-7 Disk buffer allows backup parallelism*

Because some backup applications formerly supported only tape drives as a backup storage device, virtual tape libraries (VTLs) were developed. VTLs emulate tape drives and tape libraries on a disk system. The backup application sees tape libraries and tape drives, but data is backed up to disk devices (Figure 2-8). IBM TS7500 Virtualization Engine is a VTL.

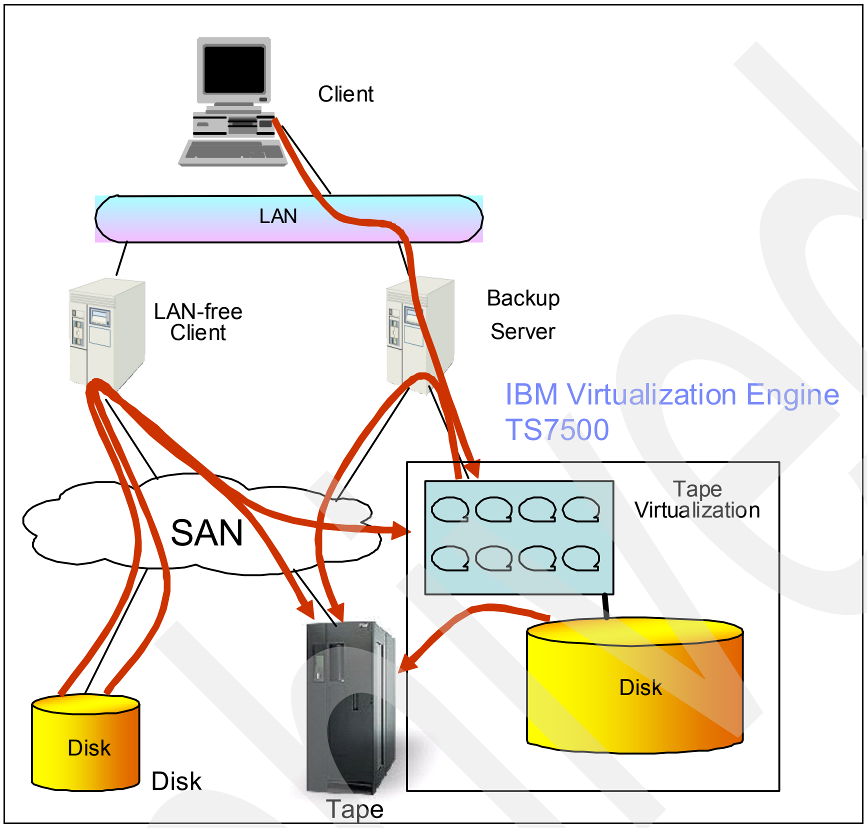



*Figure 2-8 Virtual tape library as disk buffer*

Some backup applications that support disk buffers, like IBM Tivoli Storage Manager, do not benefit, in general, from a VTL. However, a LAN-free backup to a disk buffer might only be possible if a shared file system, like IBM SAN File System or IBM GPFS™, is used with a disk buffer. For LAN-free backups, these backup applications can benefit from a VTL, since the LAN-free backups can, in most cases, go directly to tape because a VTL emulates tape drives.

## 2.4 Differences in tape and disk regarding backup and restore

Historically, a tape drive was considered a slow storage device. Perhaps you remember IBM 3570 with just 7 MB/s or IBM 3590 with 14 MB/s. Current IBM tape drive technologies are fast and can even be faster than disk systems.

IBM LTO4 Tape Drives, with up to 120 MB/s throughput, or IBM TS1130 Tape Drives, with up to 160 MB/s throughput, are very fast storage devices, and with compressible data, the TS1130 drives can reach a maximum throughput of about 260 MB/s. A single stream to the TS7500 can reach up to 200 MB/s, and with compression enabled, the throughput will be not higher. This means that a single backup to or restore from disk or virtual tape will not be faster than a backup to or restore from physical IBM LTO4 or IBM TS1130 Tape Drives.

But what is the problem with tape? Tape is a sequential device, which means that if you want to access a specific file on a tape media, you need to wind the tape media to the point where the file is stored. On average, this operation, called *locating*, takes 37 seconds on a TS1130 Tape Drive. Compared with a disk, which is a random device that provides almost immediate access to the file, the tape local is a disadvantage.

Restoring many small files from a tape system can take much longer than it would from a disk system, especially if the files are not consecutively stored on the tape media, since the tape drive needs to do a locate for every file. In a Tivoli Storage Manager environment with incremental backup and with less reclamation (reclamation reorganizes the tape media), you get tape media that is totally unstructured. This means that a restore of many small files takes much longer on tape than on disk or virtual tape.

With large data files, like database or large images, tape might be faster for restores because of the high transfer rate, up to 360 MB/s, and the minimal number of locates required.

**Note:** Tape is considered a high-speed streaming device.

Tape allows just one stream at a time. Therefore, there can be just one backup or just one restore job at a time on one tape drive. If you write a few MB/s to a tape drive that can deliver throughput of up to 360 MB/s, you waste a lot of throughput resources from the tape drive. Parallel backup to one tape drive is not possible. Here we see the advantage of disk and virtual tape, because you can have many streams to a virtual tape system. With the TS7500, you can have up to 1,024 tape drives on one node, which means that you can have up to 1,024 jobs in parallel to the TS7500. A disk or virtual tape system can improve your backup if you have many slow backup jobs running.

However, if you compare cost and TCO, there is a rule of thumb that backups slower than about 40 MB/s have a cost advantage when stored to disk or VTL, and backups faster than 40 MB/s can be stored cheaper to tape drives, even if you need more tape drives.

**Note:** Disk and virtual tape systems allow more parallel jobs running at a time. When determining the number of parallel jobs to run in a virtual tape library, you must consider that performance is limited by server and disk subsystem performance. Although you might be able to run 1,024 jobs in parallel, the performance of an individual job can be slower than if you were running fewer jobs in parallel.

What about capacity upgrade capabilities? A tape system can be easily upgraded if more capacity is needed. You need to add some additional cartridges and maybe increase the library slot capacity. IBM TS3500 Tape Library has significant upgrading capabilities, starting with 56 slots up to 6,884 slots, which gives you a range from about 16 TB to more than 6 PB. In addition, you can add additional tape drives if you need higher throughput. The scalability in capacity and performance are not related to each other in a tape system. In a disk system or virtual tape system, the performance is related to the number of disk drives used, which means that the performance is related to disk capacity. Each disk system and each virtual tape system has a limitation in capacity upgrades, which is much lower than on a tape library.

**Note:** Tape is an On Demand system with no relationship between capacity and performance upgrades.

Currently, energy use is more and more important, and managing energy efficiency is becoming a major task in the data center. A tape cartridge does not need any power. Current IBM tape drives need, at maximum speed, just 46 Watts, and if the tape drives are idle, they just need 5 Watts. A disk drive needs about 10 –15 Watts, but is always spinning, even you do not read or write data. In addition, when putting disk drives together in one drawer, you must add power for cooling and for the power supplies. A TS7500 Cache Controller, which holds 16 disk drives, consumes 390 Watts and has up to 13 TB usable capacity.

Electronic devices transform most of the electric energy into heat. When comparing the energy between tape and disk, you should not forget the energy that is needed for cooling. As an example, let us compare a TS7500 Virtualization Engine solution with about 1.4 PB and a TS3500 physical tape library with eight LTO4 tape drives:

- The TS3500 Tape Library consumes 185 Watts.
- Each LTO4 drive consumes 46 Watts.
- The TS7500 Virtualization Engine server (3954-CV6) requires 510 Watts.
- Each disk drawer (3955-SV6, 3955-SX6) requires 390 Watts.
- The total physical tape library consumes 553 Watts and the virtual tape library consumes 50,430 W.

This means that, running 24 hours a day, 365 days a year, for the TS3500 physical tape library you need about 4,800 kW/h and for the TS7500 Virtualization Engine solution you need about 440,000 kW/h. If assuming $0.15 per kW/h, then the TS3500 physical library costs about $730 per year and the TS7500 Virtualization Engine solution costs about $66,200 a year. To complete this comparison you have to include the cost for cooling. Assume that you need the same energy for cooling. The TS3500 physical tape library saves more than $131,000 in electric power cost (including cooling) per year. Considering that the TS3500 library runs for three to six years, the TS3500 physical library would save $390,000 to $780,000 in operating costs.

**Note:** Tape needs much less power and therefore has much lower operating cost than disk or virtual tape systems.

Let us summarize the comparison:

- Tape is a fast-streaming device. For large files, backup/restore from physical tape may be faster than from disk or a virtual tape library.
- Disk or a virtual tape library has higher restore performance for a large amount of small files compared to tape.
- Disk or a virtual tape library can have multiple parallel jobs.
- Disk or a virtual tape library always needs power and therefore operating costs are higher.
- Physical tape has lower operating costs.

**Tip:** Use disk and virtual tape libraries only where they are useful and have advantages over physical tape.

## 2.5 Backup tiers and architecture

As we have discussed, physical tape and disk offer different advantages, and also different disadvantages. One big disadvantage of disk system (and virtual tape systems) is the higher operating cost due to the higher electric power and cooling consumption. To get a backup/restore solution that meets all your requirements, but still has a low total cost of ownership (TCO), you must find the right combination of disk (virtual tape system) and physical tape.

A disk backup supports the backup process because it replaces the 1:1 relationship between the backup and the tape drive and can improve the tape drive bandwidth utilization, and thus can reduce the number of required tape drives. A disk backup also supports the restore process because the restoration of small files and large file systems is faster from disk than from tape, since disk does not have the long locate times that tape has.

Tape backup, however, reduces the TCO and is excellent for large files and fast backups.

Because each storage has advantages for different kinds of backup data and files and meets different restore requirements, a single backup architecture or just one backup tier does not meet all requirements. Therefore, several backup architectures or tiers are required. In addition, by using different tiers and architecture, you can lower your overall cost since different backups tiers have different costs and also different performance.

As a general overview, we can say that of the following tiers, the first one has the highest performance for backup and restore, but has also the highest cost:

- FlashCopy®
- LAN-free backup
- D2D2LowerCostDisk
- D2Tape and D2D2Tape

**Note:** D2D2LowerCostDisk means *disk-to-disk-to-lower cost disk*.

Next we discuss the different backup tiers.

## 2.5.1 Backup to tape

Direct backup to tape still makes sense for large files, such as databases, if the performance of the backup stream is high. You would not see any advantage from a disk backup or a disk restore because the streaming performance is at least as good on physical tape as on disk. Also, during the restore of those large files, you would not see any advantage because all data on tape are sequential and the physical tape drives do not need to locate. Of course, there is a small mechanical delay for the physical tape restore, because the cartridge needs to mounted on the physical tape drive. This delay is about 20 seconds. If you consider an 800 GB file where the transfer time is at least 38 minutes, the mount time is insignificant.

Backup directly to tape can be done in several ways:

- FlashCopy backup
- LAN-free backup
- Over the backup server

Next we discuss these backup methods.

### FlashCopy backup

With FlashCopy, you create a shadow of your original data volume on your disk subsystem (for instance, IBM DS8000™). See Figure 2-9. A creation of this volume, or at least the pointers, is done in just a few seconds. Your application will not see any big impact during this creation. This just-created flash volume can be also used for a fast restore, because it only needs to be *flashed back*. This flash volume is used for copying the data to tape. You can copy the data LAN-free to tape or over LAN to the backup server, and the backup server writes the data to tape.

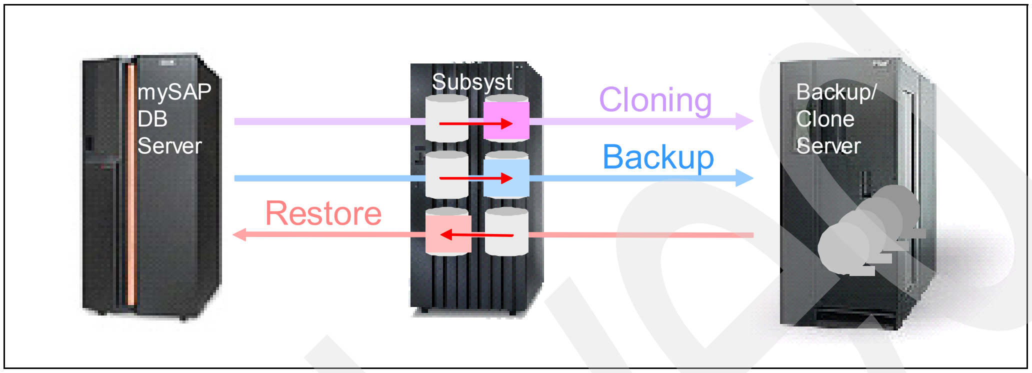



*Figure 2-9 FlashCopy backup*

The characteristics of *zero impact* backup (as indicated by the arrow titled Backup in Figure 2-9) are:

- No load on the production server, so no prescheduling is required.
- Short database backup window allows you to perform backup anytime.
- Usable for disk or tape media or both.
- Provides balancing of tape workload.

The arrow titled Restore in Figure 2-9 represents *flashback restore*, which provides:

- Restore from FlashCopy on disk
- Recovery that starts immediately after flashback restore
- A consistent process and user interface for tape or disk restore

*On Demand cloning* (see the arrow titled Cloning in Figure 2-9) is available as a service offering and:

- Does not require intermediate backup
- Only needs a short time to activate the clone
- Is automated and customizable

IBM provides this capability by Tivoli Storage Manager with automatic functions. These functions are included in Tivoli Storage Manager for Advanced Copy Services.

### LAN-free backup

LAN-free clients write the data over the SAN directly to the tape drives (Figure 2-10). The advantage of LAN-free is that the backup data does not go over the LAN and not through the backup server. This can free up resources on the backup server and bandwidth on the LAN. A restore would also go over the SAN.

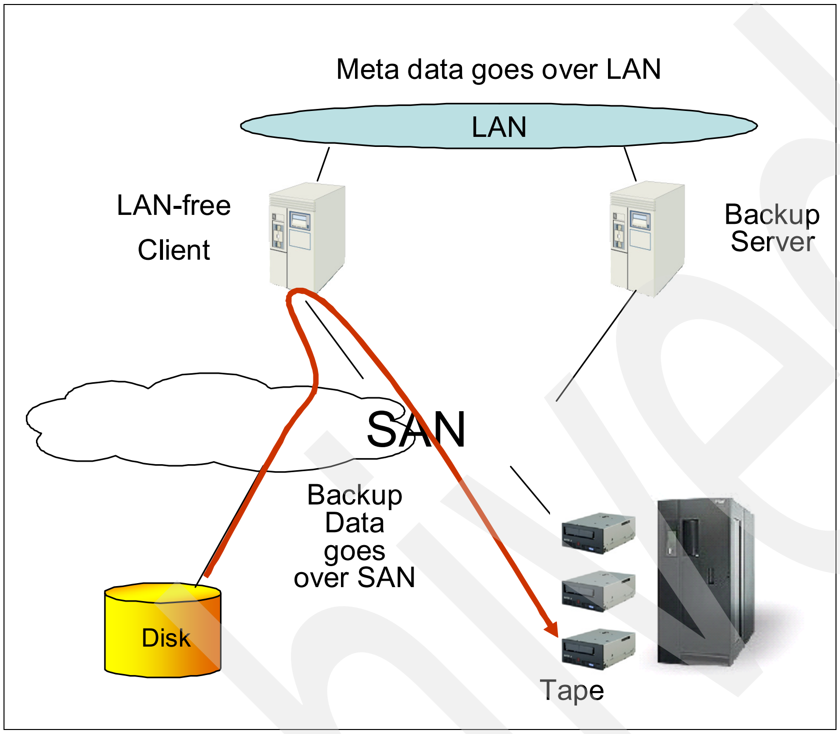



*Figure 2-10 LAN-free backup*

On the other hand, LAN-free means in general that you must have additional setup and administrative tasks. Also, for LAN-free backup, most backup applications require additional license costs not required for normal LAN-based backup.

LAN-free writes, in general, directly to tape. If you have many LAN-free backups, then you need many tape drives. Here the TS7500 provides a benefit because you can have as many virtual tape drives.

In general, we recommend using LAN-free backup only for large data sets and for backup clients that can deliver high performance for the backup because of the additional administrative tasks required for LAN-free.

## 2.5.2 Backup D2D2T

The combination of disk and tape in the backup environment gives the best TCO and also the best performance for backup and restore.

A disk buffer should be large enough to hold at least a daily backup, and all LAN-based backups should go to the disk buffer first. This frees up tape drives during the backup window, and the physical tape drives can now be used for backup directly to physical tape and for LAN-free backups (Figure 2-11).

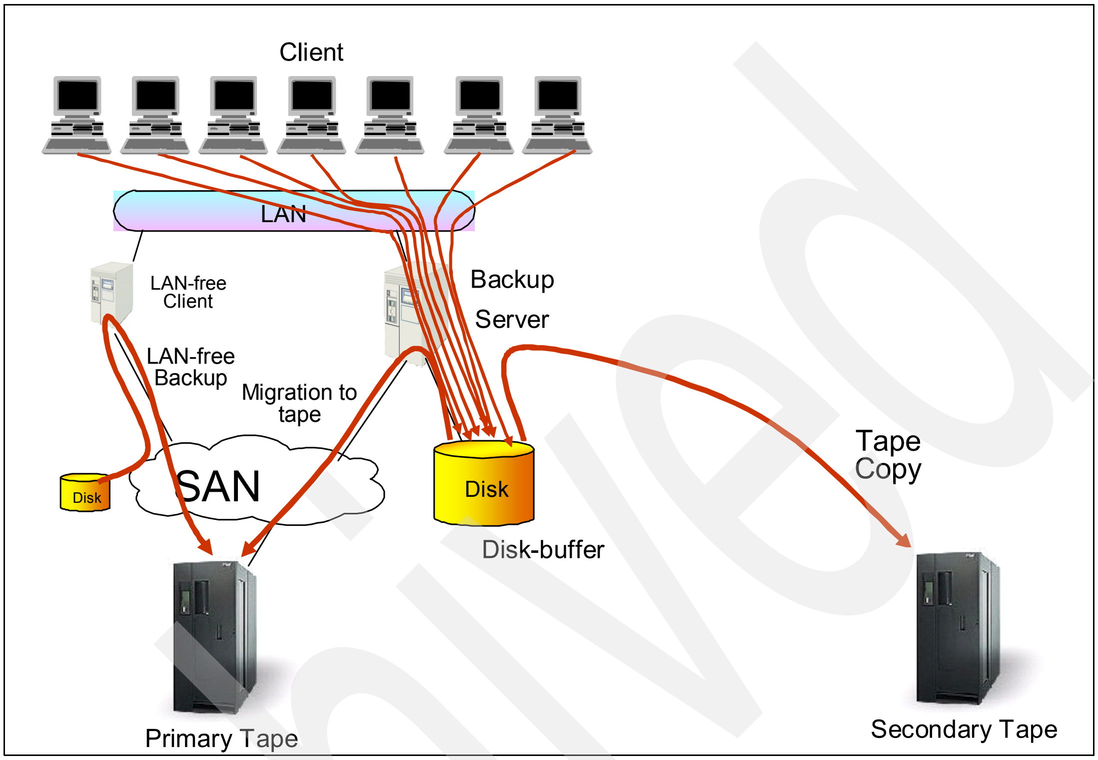



*Figure 2-11 D2D2T backup with tape copy to remote side*

If you want to create copies of the backup data on physical tape, perhaps to a remote site, we recommend that you create the initial physical tape copy first and then create the additional copy. This lowers the number of physical tape drives required during the creation of the tape copy. If you start the migration first, and then start the physical tape copy, then you would need two physical tape drives for this process because you are reading from a tape and writing to a tape.

The disk buffer should be a high-performance disk system, such as IBM DS4000 or IBM DS8000 with FC disk, to meet your backup requirements. We recommend that you use a separate disk system as a disk buffer so that you do not have any performance interference with other workloads. Additionally, it does not make sense to have production data and the backup data on the same disk system.

## 2.5.3 Backup D2D2LowerCostDisk

**Note:** D2D2LowerCostDisk means *disk-to-disk-to-lower cost disk*.

As discussed before, for small files and file systems, restoring from incremental backup data is faster from disk than from physical tape. Leaving the data on the disk buffer would increase your restore performance. The primary disk buffer is intended to be a high-performance system with Fibre Channel disk drives and, therefore, does not use lower-cost disk drives, such as S-ATA. If you want to keep small files, file systems, and this kind of data on disk longer to meet your restore requirements, then it makes sense to migrate it from a higher-performance and higher-cost system to a lower cost system. The TS7500 would fit here because it uses price-sensitive disk drives.

The process is:

1. Store your data on the primary disk buffer.
2. Create a physical tape copy, if desired, to a remote site.
3. Migrate the data from the disk pool to either physical tape (for large files) or to the TS7500 for smaller files and file systems (Figure 2-12).

If you use Tivoli Storage Manager, you can consider using the TS7500 as the active data pool. The active data pool in Tivoli Storage Manager 5.4 holds all active data versions in one pool and all inactive versions in a separate pool.

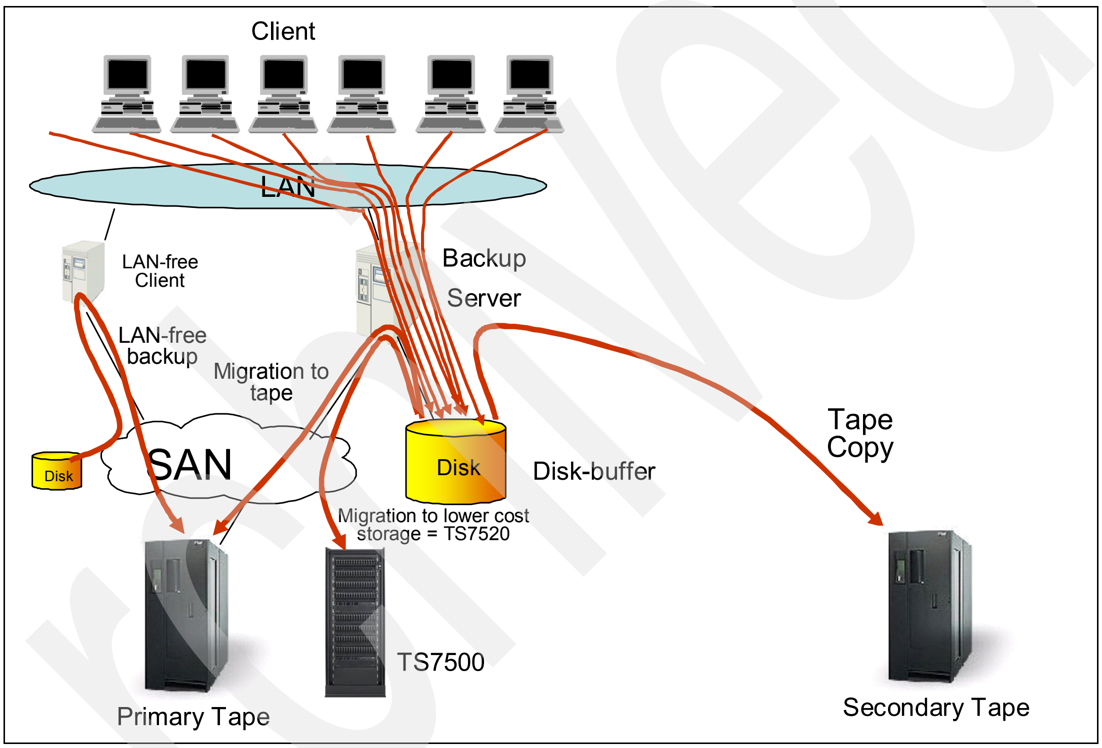



*Figure 2-12 D2D2T with TS7500 as lower-cost storage device for faster restore of file systems*

## 2.6 Tape virtualization

Virtualization, in general, brings an advantage if physical hardware resources are not fully utilized. Through virtualization, the hardware resources are virtually divided into several pieces, and those pieces can be used individually. Higher utilization will be expected.

Tape virtualization can be advantageous if:

- Tape cartridges are not filled totally.

  This occurs mainly on the z/OS® environment, but not on the Open Systems environments.

- Tape drive bandwidth is not fully utilized.

  If slow backups go directly to tape without using a disk buffer in front of the tape drives (D2D2T backup), the tape drive cannot write at its native speed.

- Tape library resources are poorly utilized.

  This might happen if each application or server uses its own library and the tape library is not shared.

IBM offers different layers of tape virtualization to try to provide the best benefit for the customer in each of the different virtualization layers. Tape virtualization might also provide a disadvantage if the virtualization is used where no need exists. For example, if you use a backup application (such as most Open Systems backup applications) that fills cartridges totally, and you use a tape virtualization solution that also tries to totally fill tape cartridges, then you might end up with more required tape cartridge space.

On the other hand, different virtualization layers do not exclude each other. Different layers can be complementary.

### 2.6.1 Tape library virtualization with Advance Library Management System

IBM TS3500 Tape Library offers with Advance Library Management System (ALMS) a tape cartridge slot and drive slot virtualization within the library. With this slot virtualization, you can easily share the library with several applications and servers, no matter where the physical resource is installed or stored on the library. Also, you can easily assign free resources to an application.

Find more information about ALMS at:

http://www-03.ibm.com/systems/storage/tape/pdf/whitepapers/advanced_library_management_system.pdf

### 2.6.2 Tape library virtualization with eRMM or IRMM

eRMM and IRMM virtualize one or more libraries and can share the libraries, tape drives, and cartridges with several applications and servers. eRMM supports the TS7500 through an request for price quotation (RPQ). For more information about IRMM and eRMM, see Appendix B, “IBM Integrated Removable Media Manager (IRMM) product overview” on page 501.

### 2.6.3 Disk staging backup

D2D2T backup is also a kind of tape drive virtualization because the disk buffer eliminates direct access to the tape drive during the backup. Tivoli Storage Manager uses a disk buffer to better utilize the tape drive, reduce the number of required tape drives during the backup window, and eliminate the requirement for direct access to the tape drives during the backup.

## 2.6.4 Tape Virtualization Engines TS7500 and TS7700

Virtual tape libraries are systems that emulate tape drives, tape libraries, and tape cartridges but write data on disk. The advantage of virtual tape libraries is that the application just sees tape. There is no need to make changes to the backup application, and the application gets advantages of disk backup functionality.

A virtual tape library does not require that any physical tape be connected to it. Some vendors also refer to virtual libraries as *disk libraries*.

IBM Virtualization Engine TS7500 is a virtual tape library and does not provide the function available with IBM Virtualization Engine TS7700 for z/OS. The TS7700 requires physical tape attachment and provides functions not available with the TS7500.

### IBM Virtualization Engine TS7500 for Open Systems

The first generation of the IBM Virtualization Engine TS7500 family, IBM TS7510, was a virtual tape library that offered mainly disk backup capabilities.

The second generation TS7520 offers additional function for attaching physical tape to improve the TS7520 integration as a D2T solution.

The third Generation TS7530 offers hardware-based compression of data and many features that help automate the data management.

### IBM Virtualization Engine TS7700 for z/OS

The TS7740 is the successor of the popular IBM Virtual Tape Systems (VTS) 3494-B16, 3494-B18, and 3494-B20. The VTS family for z/OS was developed to address the following problems in z/OS with native physical tape:

- Wasted space: Not all cartridges in z/OS are filled totally. In z/OS there might be just a few hundred MB on a tape cartridge.
- Poor tape drive bandwidth utilization due to long idle times on tape jobs.
- Lack of tape drives.

On IBM VTS and on IBM TS7740 there are always physical tape drives and libraries connected. The VTS/TS7740 acts as a kind of integrated D2T solution with an intelligent disk cache management. Migration from and to the disk cache is handled automatically from the VTS/TS7740.

In addition, the VTS/TS7740 offers recovery and failover capabilities that are optimized for z/OS.

Part 2

# TS7500 architecture and planning

In this part of the IBM Redbooks pubication we describe in detail IBM System Storage TS7530 and TS7520 Virtualization Engine models and their features and functions, and we provide you with all the information that you need to plan for a successful and seamless implementation of the TS7530.

3

# TS7530 components and features

In this chapter we examine the IBM Virtualization Engine TS7530's hardware components, model numbers, and functional aspects of the entire solution. We also map the software explained earlier on to the hardware that provides library emulation.

- Hardware components:
  - IBM Virtualization Engine TS7530 (3954-CV7)
  - IBM Virtualization Engine TS7500 Cache Controller (3955-SV6)
  - IBM Virtualization Engine TS7500 Cache Module (3955-SX6)
  - IBM 3952 Tape Frame (3952-F05)
- Software components: IBM Virtualization Engine TS7500 Software Version 3 Release 1

## 3.1 IBM Virtualization Engine TS7530

The TS7530 Virtualization Engine (VE) is a solution designed to help optimize backups in an organization through the implementation of tiered storage hierarchy. With the virtual tape library (VTL) we can use the benefits offered by tape technology for backing up data without the associated drawbacks like delays related to loading, unloading, seek, and so on. Deploying the TS7500 VTL can ensure smaller backup and restore windows, simultaneously reducing the management overhead related to backup.

### 3.1.1 TS7530 solution components

The TS7530 VE architecture consists of multiple hardware and software components to provide an integrated solution. The architectural components are:

- IBM Virtualization Engine TS7530 Model CV7 or TS7530 Virtualization Engine
- IBM Virtualization Engine TS7500 Model SV6 or TS7500 Cache Controller
- IBM Virtualization Engine TS7500 Model SX6 or TS7500 Cache Module
- IBM 3952 Tape Frame Model F05
- IBM Virtualization Engine TS7500 Software Version 3 Release 1 (5697-P19)

The IBM Virtualization Engine TS7530 solution is designed to offer tape virtualization for Open Systems servers connecting over Fibre Channel or Internet SCSI (iSCSI) connections. The TS7530 solution consists of:

- TS7500 Version 3 Release 1 (V3R1) software (5697-P19)
- One or two Base 3952 Tape Frames and up to 10 Expansion 3952 Tape Frames to contain the other components
- One, two, or four TS7530 Virtualization Engine servers (3954-CV7)
- Up to 24 TS7500 Cache Controllers (3955-SV6)
- Up to 112 TS7500 Cache Modules (3955-SX6)

The TS7530 solution is available in multiple configurations. Each TS7530 Virtualization Engine (3954-CV6) is called a single node. The TS7530 solution is available in a single-node configuration, in a dual-node high-availability (HA) configuration or a four-node configuration with two dual-node HA pairs.

The IBM Virtualization Engine TS7530 solution is designed to provide redundancy for critical hardware components and connections between components. Key functional features of the TS7530 solution are:

- Configuration of two TS7530 Virtualization Engine servers as an active/active cluster.
- Configuration of four TS7530 Virtualization Engine servers as two cooperating active/active clusters.
- Support for real-time compression of data, reducing disk storage requirements.
- On demand allocation of disk storage to help maximize storage utilization using virtual cartridges. (Static allocation is also supported for customized environments.)
- Support of import/export to IBM TotalStorage® 3494 Tape Library using an Ethernet interface to manage the library.
- Interaction in an HA configuration between the TS7530 nodes to perform transparent failover/failback within the solution in case of failure. The failure can be path failure, host bus adapter (HBA) failure, port failure, switch failure, or storage controller failure. The failover/failback minimize disruption to back up or restore activities.

- Integration of Ethernet and Fibre Channel switches for connectivity between base frames and expansion frames.
- Ability to scale processing and memory capacity for improved performance.

## 3.1.2 IBM TS7530 Virtualization Engine Controller (3955-CV7)

The TS7530 Virtualization Engine (3954-CV7) is based on System x server technology. The TS7530 provides a 64-bit framework for high-performance computing required in tape virtualization. The TS7530 Virtualization Engine is built for high speed. It eliminates system architecture bottlenecks through the use of separate, high-speed links between the processors, main memory, and I/O. The technologies available drive the system to deliver the performance, availability, and manageability needed for the next generation of high-performance virtualization engines that require low-latency and high-speed access to memory.

*Figure 3-1 Front view of the TS7530 Virtualization Engine*

This server is built on a modular design and can house up to four CPUmemory modules. The virtualization engine contains a combination of Peripheral Component Interface Extended (PCI-X) and Peripheral Component interface Express Slots (PCI-E). The TS7530 contains four PCI-E slots and two PCI-X slots. These slots can be used for connecting multi-port Fibre Channel HBAs, compression cards, and multi-port Gigabit Ethernet cards.

We will be referring to a slot numbering terminology where the PCI-E slots are numbered 1 to 4 and the PCI-X slots are numbered slot 5 and slot 6 throughout this chapter. Figure 3-2 graphically depicts the layout and the numbering of the internal PCI slots of the of the TS7530.

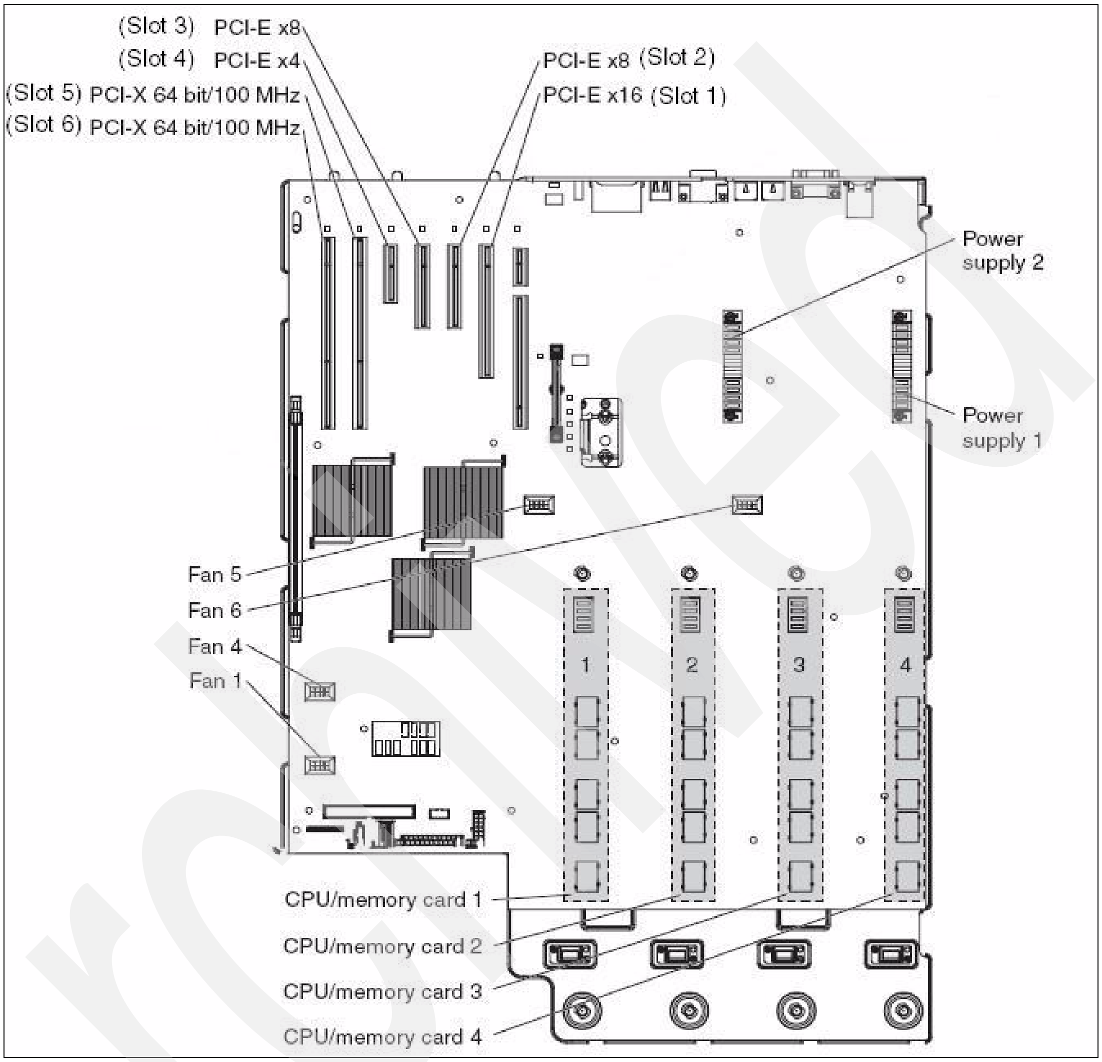



*Figure 3-2 Internal layout of the TS7530 Virtualization Engine*

The TS7530 Virtualization Engine comes pre-installed with a minimum of two quad-ported Fibre Channel adapters in PCI express slots 1 and 2, thus providing eight Fibre Channel ports operating at 4 Gbps each. However, four of these eight ports (upper two ports on each card) are used for internal connections to the cache controllers. These internal connections may be direct connections to the cache controller or via a Fibre Channel switch, depending on the number of cache controllers present in the TS7530 solution. The remaining four ports may be used for host connections or for connections to physical tape libraries or tape drives.

The Fibre Channel HBAs present on the TS7530 Virtualization Engine support multi-WWPN (worldwide port name). This feature is required in failover operations where the FC ports on the surviving engine spoofs the WWPN of the engine that has failed. If more Fibre Channel ports are required, there is a facility on the virtualization engine to add an additional Quad port Fibre Channel card in PCI-E slot 3 and up to two additional dual-port Fiber HBAs in PCI-X slot 5 and PCI-X slot 6.

**Attention:** If additional Fibre Channel cards are added to the TS7530 engine at a later date, the port numbering sequence for all the ports on the TS7530 changes. This change in port numbers has to be taken into account while configuring the system. Refer to 13.4.5, “Add or remove Fibre Channel cards” on page 448, for more details.

The TS7530 Virtualization Engine introduces support for hardware-based compression, thus reducing the impact of data compression on the virtualization engine’s performance. This hardware-based compression is provided via the hardware compression cards that can be placed in PCI-E slot 4 and the PCI-E slot 3. These compression cards are inserted onto the motherboard starting with slot 4.

Up to two quad-ported Intel® Pro/1000 GT 1 Gb/sec copper Ethernet host bus adapters can be used in the TS7530 to provide iSCSI connectivity, console connections, and network replication. The HBAs are inserted into the slots starting with slot 6. Ethernet port bonding is supported for all 4-port Ethernet cards and is user-configurable.

Figure 3-3 depicts the slot allocation for the various cards that can be connected to the TS7530.

| | **Slot 1 PCI-E** | **Slot 2 PCI-E** | **Slot 3 PCI-E** | **Slot 4 PCI-E** | **Slot 5 PCI-X** | **Slot 6 PCI-X** |
|---|---|---|---|---|---|---|
| Quad port Fiber Channel HBA | 1 | 2 | 3 | | | |
| Hardware Compression card | | | 2 | 1 | | |
| Dual port Fiber channel HBA | | | | | 1 | 2 |
| Quad port Gigabit Ethernet card | | | | | 2 | 1 |

Depicts the order in which cards have to be installed in the TS7530

*Figure 3-3 Using the various PCI slots in the TS7530*

The key features of the TS7530 Virtualization Engine are:

- Four PCI-E slots and two PCI-X slots
  - The four PCI-E slots can be used for either Quad Port FC HBAs or compression cards.
    - Slots 1 and 2 *must* have Quad Port FC HBA in them.
    - Slot 4 can take a compression card only.
    - Slot 3 can take either a FC card or a compression card.
  - The two PCI-X slots can be used for Fiber HBAs and Ethernet cards. They can contain one of the following:
    - Two quad-port Gig-E cards in slot 5 and slot 6
    - Two dual-port FC HBAs in slot 5 and slot 6
    - One quad-port Ethernet card in slot 6 and one dual-port FC HBA in slot 5
- A maximum of 16 x 4 Gb/s FC ports can be configured on the engine using three PCI-E slots containing Quad Port FC HBAs and two PCI-X slots containing Dual Port FC HBAs. Of these 16 ports four ports are reserved for connecting to cache controllers.
- TS7530 can hold two hardware compression cards in the PCI-E slots.
- Two quad-port 1Gb/sec Ethernet Adapters can be inserted in the PCI-X slots, providing eight additional ports for host connections.
- There are two 1 Gbps Ethernet Ports on the TS7530 Unit motherboard available for high availability and host connections.
- The TS7530 unit has an RSA Ethernet port on the motherboard for servicing the unit.
- The TS7530 can have up to three additional CPU cards. Each CPU card includes 4 GB memory and a 2.6 GHz, 2x1MB L2, AMD™ Opteron™ Dual Core processor (one card is included).
- For the dual-node and four-node configurations, the TS7530 Virtualization Engine supports failover capabilities via intelligent heartbeat monitoring.
- The memory modules on the TS7530 implement the *chipkill technology*. This technology enables the system to recover from memory chip failure or error by error checking and correction.

**Attention:** The server and disk components of IBM Virtualization Engine TS7530 have been modified and tuned to provide this integrated solution. IBM does not support any attempts to exchange the TS7530 components with other IBM model servers or IBM disk products. Such attempts will cause the configuration to fail.

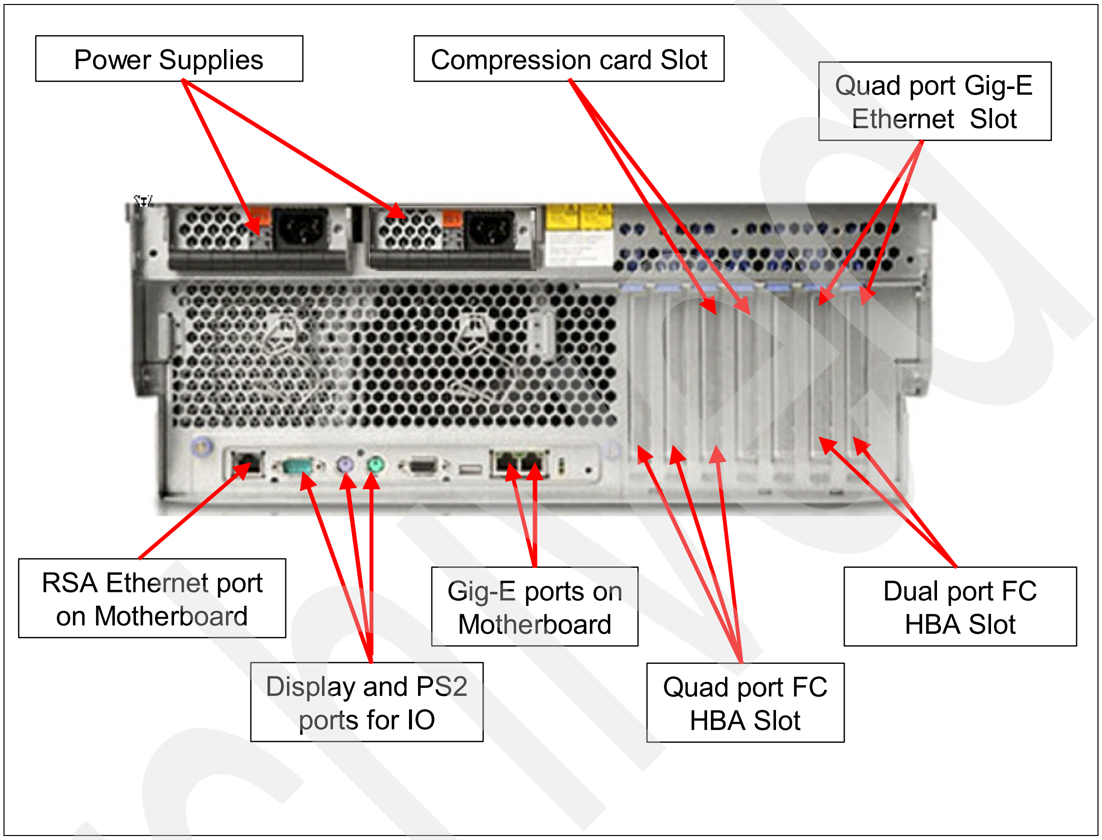



*Figure 3-4 Rear view of the TS7530 with depicting the ports*

The TS7530 Virtualization Engine (3954-CV7) can contain up to four processors to improve performance. Under the normal configuration the TS7530 ships with a single CPU and memory module and the processing power is sufficient for providing most of the tape virtualization functionalities. However, some the optional features on the TS7530 have significant computational needs, and for these situations we recommend adding an additional CPU and memory module. This prevents the virtualization engine node from being a bottleneck in the solution. Some of the scenarios where we recommend configuring an additional processor are:

- When hosted backup is configured on the TS7530 Virtualization Engine. Here the additional processor will cater to the processing needs of the backup application.
- When secure tape functionality is configured on the engine. Here it is advisable to add CPU and memory books depending on the number of libraries where secure tape is enabled to reduce the workload on the single CPU.
- When software-based compression is enabled on the virtualization engine the performance of the unit drops. Additional processors available for compression will improve the backup performance.

- When using network encryption an additional processor can be used to encrypt the data being transferred over the network, thus improving backup performance.
- When using network compression an additional processor can help share the computation load due to the operation and improve backup performance.

Every TS7530 Virtualization Engine solution configuration must contain at least one 3954-CV7 (also referred to as a single node). A second optional 3954-CV7 allows the TS7530 solution to operate in a dual-node high-availability configuration. When the TS7530 Virtualization Engine is configured in a dual-node HA configuration the two nodes share a heartbeat signal between them to ensure availability. In the dual-node configuration the two engines operate in an *active-active* mode. Hence, the performance delivered from the dual-node system is higher than the performance of a single node system.

To deliver the higher performance the dual-node configuration has double the number of available host ports. In the high-availability dual-node configuration the library can support up to 128,000 virtual cartridges, 2048 virtual drives, and 256 virtual libraries.

An HA configuration is ordered with the failover/failback feature to provide redundancy. However, there are some rules that must be followed to form a failover failback pair:

- The failover and failback between two TS7530 Virtualization Engines can occur only if the two nodes are in the same physical frame (3952-F05).
- The virtualization engine nodes forming the failover pair must have identical configurations.
- The failover/failback software feature must be ordered on both the virtualization engines forming the HA pair.
- Each of the virtualization engines in the failover pair must be allotted two separate static Ethernet IP addresses per server per port. One of these addressed will be dedicated for communicating the heartbeat signal between the two engines, while the other can be used as a regular service port.
- The ISV applications accessing the nodes might have to be restarted after the failover or failback has occurred. This might have to be done, as there will be a time of no response from the failed server before the failover is initiated and there will be an additional lag until the failover occurs.

In the four-node configuration for TS7530 the virtualization engine forms two failover pairs, with the third and fourth virtualization engines forming the second failover pair. In the four-node configuration the number of virtual libraries, drives, and cartridges is double that of the dual-node configuration. The performance is higher than the performance of the dual-node configuration. This performance is delivered via double the number of host connections found in the dual-node setup.

> **Note:** The number of nodes alone does not determine the performance of the units. The number of cache controllers and cache modules connecting to the unit at the backend also plays a major role in determining the performance of the system.

In the four-node configuration it becomes necessary to include two Fibre Channel switches in the two frames to connect them. These Fibre Channel switches are not available for the connection to the customer and are for internal use only.

# 3.2 IBM Virtualization Engine TS7530 disk architecture

The disk architecture of the TS7530 consists of IBM TS7500 Cache Controller (3955-SV6) and IBM TS7500 Cache Module (3955-SX6), both of which we describe in this section.

**Note:** In this chapter, references to cache capacity are native uncompressed capacity.

## 3.2.1 Disk technology

The disk technology used in the TS7500 Virtualization Engine is Serial Advanced Technology Attachment (SATA). IBM TS7500 Cache Controller 3955-SV6 and the IBM TS7500 Cache module 3955-SX6 have been designed to use 16 SATA drives in each unit to provide the storage capacity required by the TS7530 Virtualization Engine solution.

The Serial ATA specification was introduced in 2001 as an evolutionary replacement for Enhanced IDE (EIDE) or Parallel ATA (such as ATA-100). SATA products are 100% software compatible with the existing ATA protocol and current operating systems. Some of the salient features of SATA are:

- Point-to-point configuration eliminates bus sharing overhead.

  SATA uses point-to-point connectivity for performance and reliability. Because there is no sharing of the bus, the entire available interface bandwidth is dedicated to each device, enabling each added to deliver its maximum throughput.

- Lower power consumption.

  In the hard disk drive power is primarily consumed for disk rotation and drive-head management. The SATA drives have a rotational speed of 7200 rpm, which is lower than the rotational speed of the standard FC or SCSI drives, which operate at 10,000 rpm or 15,000 rpm. This slower speed of rotation saves considerable amounts of power.

- Lower power consumption for signaling.

  SATA operates at 250 millivolts signalling. This low voltage results in low power consumption, meaning lower cooling needs, making SATA attractive for multi-drive solutions.

- Higher capacity.

  SATA drives offer capacities far in excess of the capacities offered by conventional SCSI or FC drives. This coupled with the low power consumption provides the SATA technology with the lowest power consumption per GB ratio.

- Lower costs.

  The cost per GB of storage for SATA drives is far lower than any other form of hard disk drive, making them economically viable methods for large-scale storage.

- Additive device performance allows full bandwidth to each drive.

  SATA supports full duplex operation (support to send and receive data at the same time), giving it better performance than IDE, which supports half-duplex transmission.

- Hot-plug drives for quick and easy drive replacement.

  SATA supports hot-plugging, the ability to swap out a failed disk drive without having to power down the system or reboot. This capability contributes to both data availability and serviceability, without any associated downtime.

- Cyclical redundancy checking (CRC).

  CRC error detection is standard in SATA. This maintains strong data integrity. CRC provides error recovery capability on the drives.

Serial Advanced Technology Attachment disk drives are the physical disk drives housed within the IBM TS7530 Virtualization Engine solution. The SATA interface specification offers increased data rate performance, higher capacities, and lower power consumption.

To learn more about the SATA refer to the SATA Web site at:

http://www.serialata.org

### 3.2.2 Redundant Array of Independent Disks (RAID) configurations

The TS7530 Virtualization Engine uses Redundant Array of Independent Disks (RAID) for storing the data. RAID as a technology can be defined as:

> An arrangement consisting of a group of disks operating together to provide the users with fast data transfers and fault tolerance, through the use of techniques like data striping, mirroring and parity calculation.

Two other important definitions are:

**Striping** This is the process of taking a block of data and dividing it into equal portions (stripes), then writing each of these portions (stripes) onto a separate disk so that when the block needs to be accessed it can be simultaneously read from all the disks on which the portions have been written.

**Parity** This a stripe of data arrived at after performing mathematical and logical operations on the stripes forming a block of data, such that if one of the drives containing a stripe is lost, it can be recovered using the parity stripe.

RAID is a collection of techniques to be implemented in the disk subsystem. It is a strategy created to bridge the gap between computer input/output (I/O) requirements and the latency and throughput restrictions of single disk drives, while also allowing for greater degrees of fault tolerance.

The TS7530 supports two forms of RAID implementations:

- RAID 5
- RAID6

Each has its advantages and disadvantages.

## RAID 5

RAID5 includes data striping and parity calculation operations. RAID level 5 stripes data and parity across all drives in the array. RAID level 5 offers both data protection and increased throughput. When you assign RAID-5 to an array, the capacity of the array is reduced by the capacity of one drive (for data-parity storage). RAID-5 is best used in environments requiring high availability and fewer writes than reads. Figure 3-5 depicts the stripe organization on the disk incase of RAID 5.

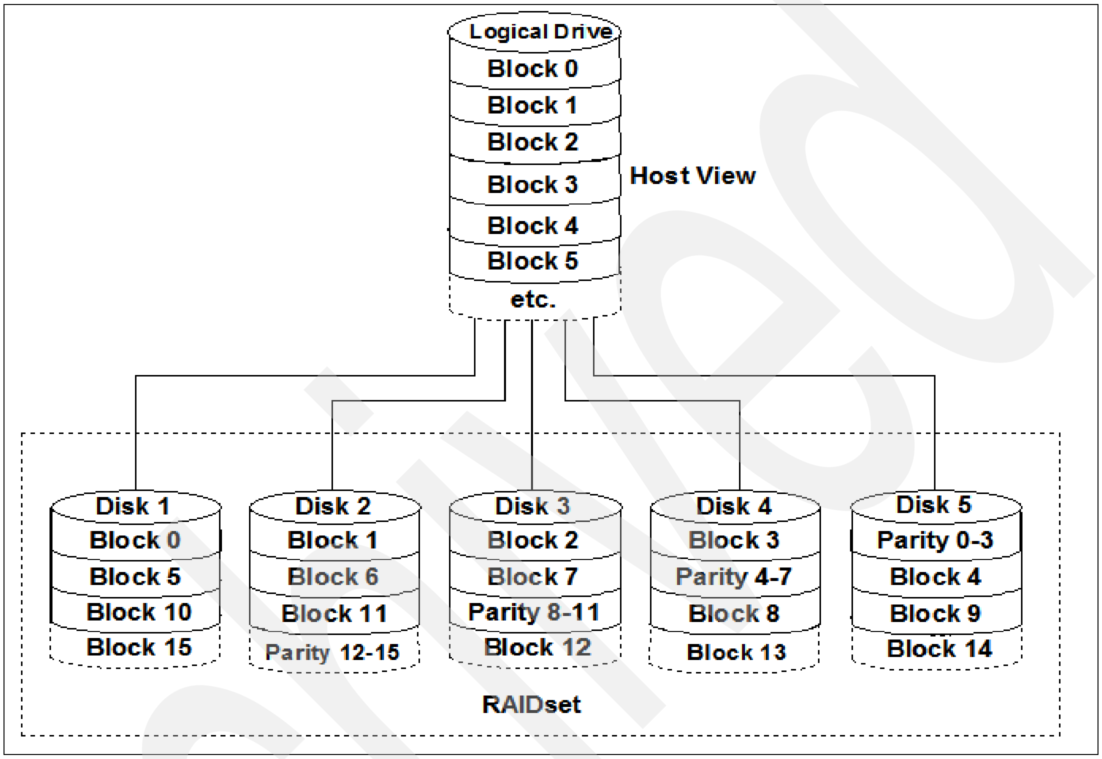



*Figure 3-5 RAID 5 Implementation*

When RAID 5 is configured on the TS7530 cache module or cache controller, the storage module (TS7500 Cache Controller 3955-SV6 or TS7500 cache module 3855-SX6) will be divided into two RAID groups. The first RAID group will be of eight disks and the second RAID group will be of seven disks. In each of the RAID 5 groups capacity equivalent to one of the disks will be used up for storing the parity stripe (P). The two RAID 5 groups inside each storage module can be defined as 7+P and 6+P. Thus, in each storage module with RAID 5 we have a usable capacity equivalent of 7+6 = 13 disk drives.

One drive will be kept aside in each storage module as a hot spare. The hot spare is an unformatted disk that is kept aside and is not used for any I/O operation. This hot spare can be used if there is a drive failure in one of the RAID groups. This RAID group may be present on any of the storage modules connected directly to a single cache controller (3955-SV6) unit. The availability of hot spare ensures that recovery from disk failure is not spare dependent. In case of failure RAID reconstruction can begin as soon as the failure is discovered using the hot spare available. Table 3-1 depicts the usable capacity in each storage module depending on the capacities of the individual SATA drives used in the module.

*Table 3-1 Usable capacities for storage modules based on drive size used*

| Drive capacity | Storage module's usable capacity |
|---|---|
| 500 GB SATA drives | 6.5 Terabytes |
| 750 GB SATA drives | 9.75 Terabytes |
| 1000 GB SATA drives | 13 Terabytes |

Figure 3-6 represents the disk allocation when RAID 5 is selected on the storage modules.

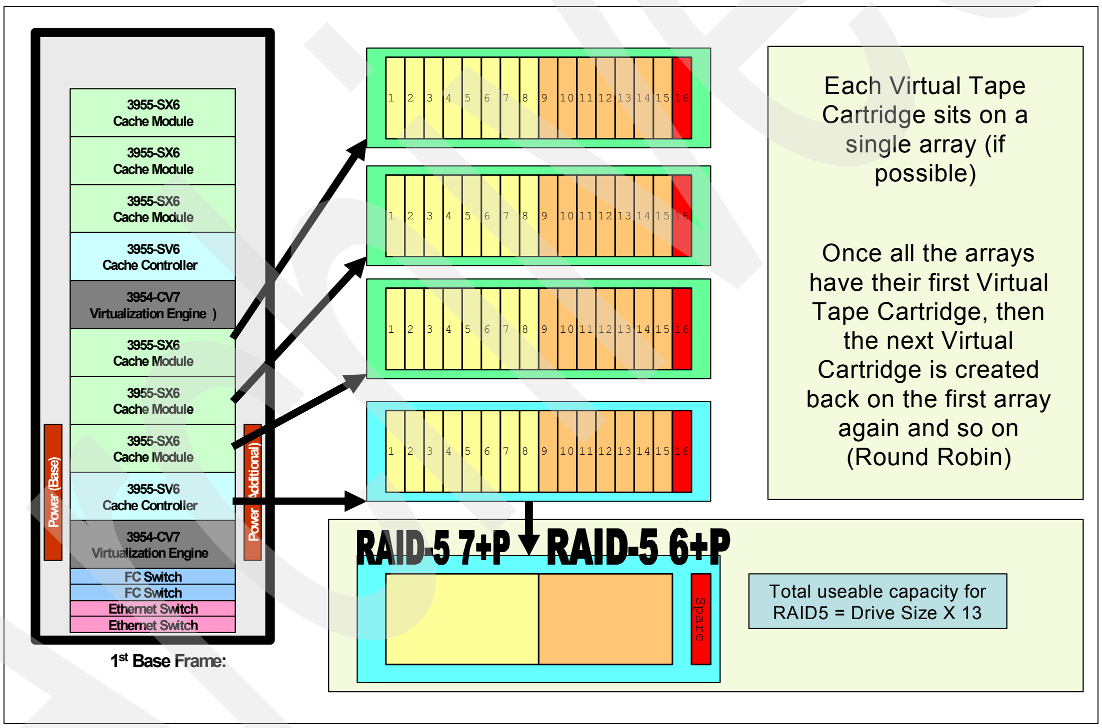



*Figure 3-6 RAID 5 disk allocation*

## RAID 6

This technology is designed to provide improved data protection against multiple disk drive failures. RAID 6 uses a double parity check implementation (designated as p + q). RAID 6 is a RAID level employing n+2 drives, which can survive the failure of any two drives. RAID 6 stripes blocks of data and parity across an array of drives and it calculates two sets of information for each block of data (p + q). For the purposes of RAID 6 p + q, they can be used to generate up to two missing values from a set of data. The key to this method is the q, which is a code word based upon Reed-Solomon error correction. As such, q is more like a CRC than parity.

The calculation of q is complex. In the case of the TS7500 SV6, this calculation is made by the hardware and thus is better performing than the software-based implementations. By storing two sets of distributed parities, RAID 6 is designed to tolerate two simultaneous disk failures. This is a good implementation for environments using SATA disks.

Due to the added overhead of more parity calculations, in terms of writing data, RAID 6 is slower than RAID 5 but may be faster in random reads thanks to the spreading of data over one more disks. See Figure 3-7.

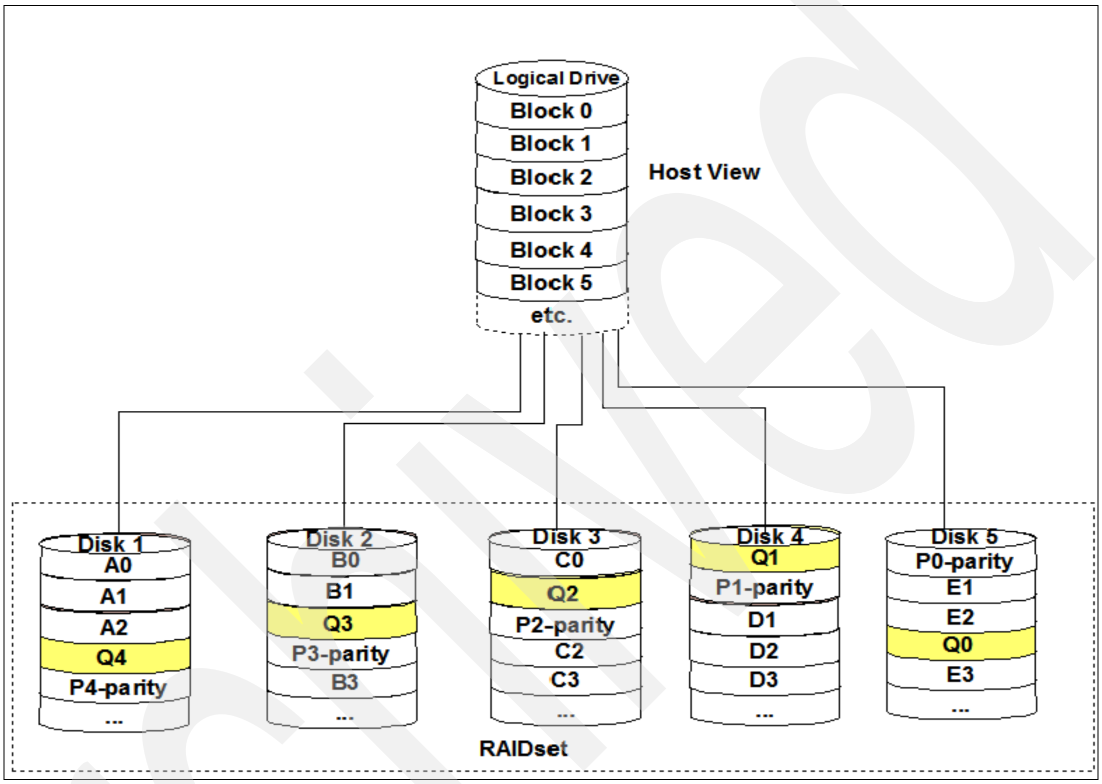



*Figure 3-7 RAID 6 implementation*

When RAID 6 is configured on the TS7530, the storage modules (TS7500 Cache Controller 3955-SV6 or TS7500 cache module 3855-SX6) are divided into two RAID groups. The first RAID group will be of eight disks and the second RAID group will be of seven disks. In each of the RAID 6 groups capacity equivalent to *two* of the disks will be used up for storing parity stripes P and Q. The two RAID 6 arrays inside each storage module can be defined as $6 + P + Q$ and $5 + P + Q$. Thus, in each storage module with RAID 5 we have a usable capacity equivalent of 6 + 5 = 11 disk drives.

Similar to the RAID 5 setup, one drive will be kept aside in each storage module as a hot spare. This hot spare can be used if there is a drive failure in one of the RAID groups, provided that the RAID groups is present on any one of the storage modules connected directly to a single cache controller 3955-SV6 unit. Table 3-2 depicts the usable capacity in each storage module depending on the capacities of the individual SATA drives used in the module in the RAID 6 setup

*Table 3-2 Usable capacities for storage modules based on drive size use*

| Drive capacity | Storage module’s usable capacity |
|---|---|
| 500 GB SATA drives | See note below. |
| 750 GB SATA drives | See note below. |
| 1000 GB SATA drives | 11 Terabytes. |

**Note:** RAID 6 is only available with 1 terabyte SATA drives and cannot be configured with the 500 GB or the 750 GB HDD. It should be noted that the usable capacity on the storage module when using RAID 6 is up to 15% lower when compared to the capacity of a configuration with RAID 5 groups.

Figure 3-8 represents the disk allocation when RAID 6 is selected on the storage modules.

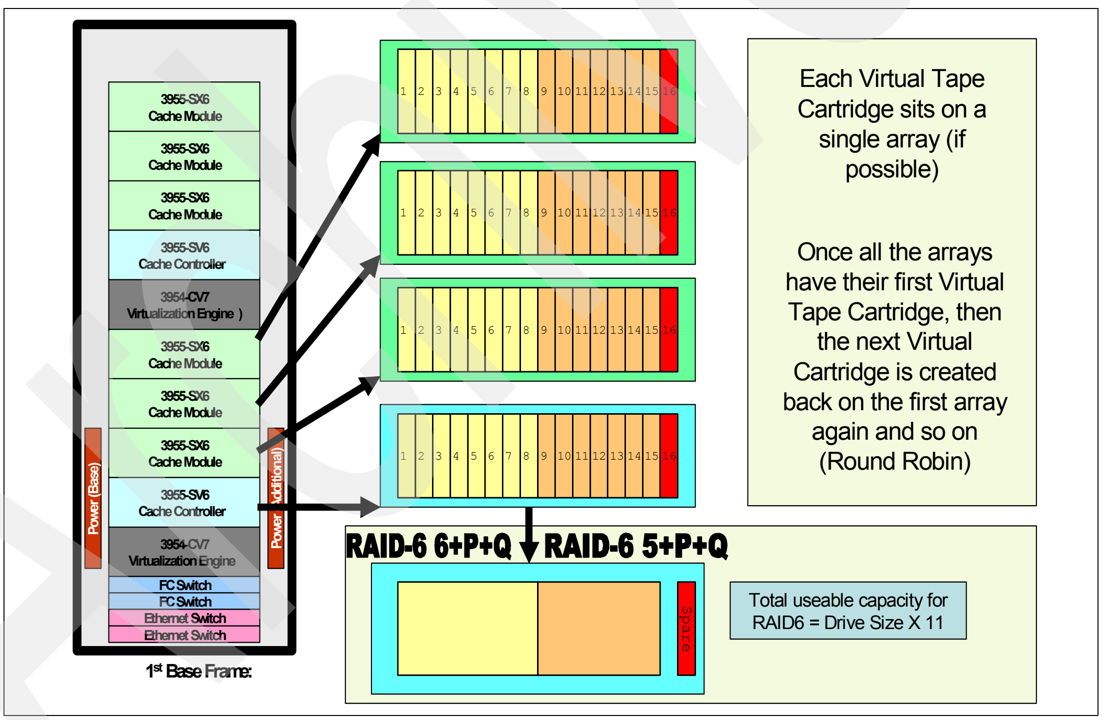



*Figure 3-8 RAID 6 disk allocation*

## RAID 5 versus RAID 6

Table 3-3 compares the two forms of RAID available on the TS7530 Virtualization Engine.

*Table 3-3 Comparison of RAID5 & RAID6 technology*

| Parameter | RAID 5 | RAID 6 |
|---|---|---|
| Failure tolerance | 1 drive failure | 2 drive failures |

| Parameter | RAID 5 | RAID 6 |
|---|---|---|
| Capacity lost for parity per RAID group | 1 drive equivalent | 2 drives equivalent |
| Speed of backups | Fast | Slow |
| Speed of restore | Slightly slower | Slightly faster |
| Maximum capacity per cache module | 13 TB | 11 TB |
| Drives supported | 500 GB SATA<br>750 GB SATA<br>1000 GB SATA | 1000 GB SATA |

Performance measurements have shown that RAID 5 arrays provided slightly better single virtual drive write and read data rates. See Figure 3-9 for the sustained host data rate for single virtual drive write throughput by blocksize and RAID type.

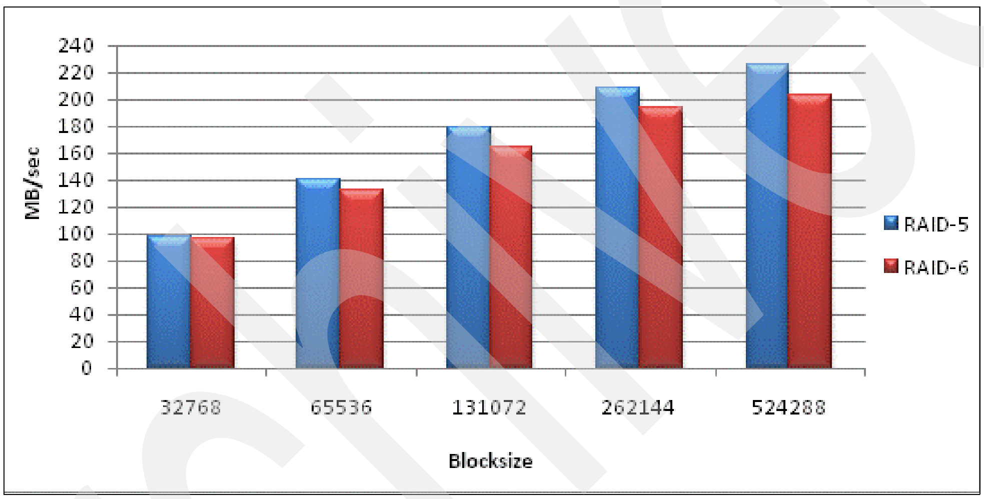



*Figure 3-9 TS7530 write MB/s by blocksize and RAID type*

All of the performance benchmarks were run on IBM System p Model 570 running AIX® 6.1 with 4 Gb FC LP11002-E (Emulex) adapters. The TS7530 was configured as listed below:

- One 3954 Model CV7
  - One dual-core processor package
  - Two hardware compression cards
  - Two quad-port Fibre Channel adapters
  - One dual-port Fibre Channel adapter
- Two 3955 Model SV6
- Six 3955 Model SX6

## 3.2.3 IBM TS7500 Virtualization Engine Cache Controller (3955-SV6)

The unit shown in Figure 3-11 on page 76 is the cache controller for the TS7530. The TS7500 Cache Controller system is a SATA-only system designed to be an economical alternative for storing virtualized backup data. The cache controller includes 16 disks and offers a fully switched drive-side architecture. The capacity offered by the cache controller is directly dependent on the capacity of the disks used in the controller. The maximum usable capacity for cache controller with 500 GB SATA drives is 6.5 TB, while the maximum usable capacity with 750 GB SATA drives is 9.75 TB, and the maximum usable capacity with 1000 GB SATA drives is 13 TB.

*Figure 3-10 Front view of the TS7500 Cache Controller 3955-SV6*

The 16 SATA drives available on the TS7500 Cache Controller are hot-swappable drives that allow us to remove and replace any hard disk drive without powering down the storage enclosure that contains the drives. Each drive in the cache controller has connection redundancy built into them with two connection paths available for every SATA drive in the unit. This redundant connection feature ensures that there is no impact of a connection failure on the operation of the solution. The TS7500 Cache Controller can only be ordered with all the 16 drives populated in the unit. This has been done to ensure consistency in the size of the RAID groups throughout the TS7530 Virtualization Engine solution.

The TS7500 Cache Controllers embrace the 4 Gb/s FC technology to ensure high throughput throughout the entire solution. To help convert the electronic signals needed for SATA drives to the high-speed optical signals used by the TS7500 Cache Controller, each SATA drive has a corresponding ATA translator card at the backend.

The TS7500 Cache Controllers come with multiple LED indicators that help communicate the state of the controller system at all times.

Figure 3-11 shows the rear view of the TS7500 Cache Controller. Here we can see that the cache controller is shipped with two RAID controllers, redundant power supplies, and redundant cooling fans on each controller. The cache controller also contains separate ports for connections to the TS7500 SX6 cache modules and the TS7530 Virtualization Engine node.

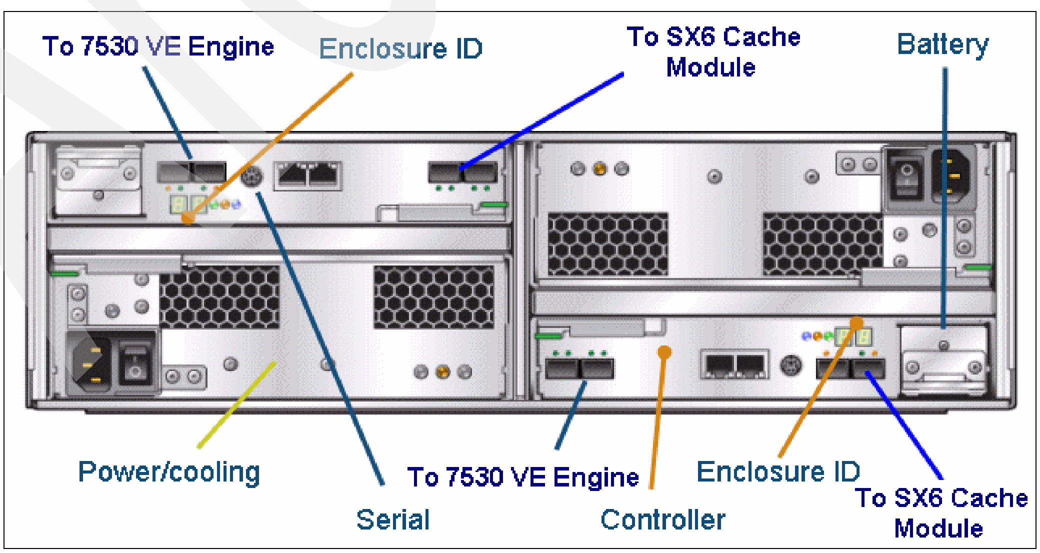



*Figure 3-11 Rear view of TS7500 Cache Controller*

The RAID controllers on the TS7500 Cache Controller (3955-SV6) operate in an *active-active* mode and contain 1 GB of cache each. These controllers are based on the XOR engine architecture designed to provide efficient RAID calculations. Each of the RAID controllers is equipped with its own cache battery, which is used to retain the data present in the cache in the scenario of power failure.

The key features of the TS7500 Cache Controller are:

- Compact, 3U rack-mountable enclosures containing dual high-performance intelligent RAID controllers, accommodating sixteen 500 GB or 750 GB or 1000 GB SATA drives for up to 16 TB raw internal physical storage capacity.
- The TS7500 Cache Controller (3955-SV6) provides end-to-end 4 Gbps support for high performance.
- Dual, redundant 4 Gbps RAID controllers with up to 2 GB of cache memory (1 GB per RAID controller).
- Lithium-ion battery backup protects data cache in each controller for at least 72 hours.
- Hot-swappable cache backup battery.
- Redundant, hot-swappable power supplies and fans.
- Supports RAID 5 and RAID 6.
- Switched loop architecture that supports two dual-redundant FC disk loops.
- Supports global hot spare.
- The cache controllers connecting to the TS7530 Virtualization Engine node can be either a Fibre Channel switched connection or a direct connection.
- Redundant drive-side connections designed to avoid any single-point-of-failure and maintain high availability.
- Supports connection to up to five TS7500 cache module 3955-SX6 in the expansion unit and up to three TS7500 cache module 3955-SX6s in the base unit.

Each 3955-SV6 has four 4 Gbit Fibre Channel ports redundantly attached to one or two 3954-CV7s. A TS7530 configuration contains a minimum of two TS7500 Cache Controllers.

The RAID configurations for the TS7500 SX6 module are defined in 3.2.2, “Redundant Array of Independent Disks (RAID) configurations” on page 70. It should be noted that the RAID structure remains the same for the storage unit irrespective of whether it is a cache controller or a cache module. The usable capacities for the TS7500 Cache Controller are tabulated in Table 3-4. Note the that the capacity of the cache controller is dependent on the RAID type implemented.

*Table 3-4 Tabulation of drive capacities and cache controller capacity*

| Drive capacity | Storage module’s usable capacity |
|---|---|
| 500 GB SATA drives | 6.5 Terabytes with RAID 5 |
| 750 GB SATA drives | 9.75 Terabytes with RAID 5 |
| 1000 GB SATA drives | 13 Terabytes with RAID 5 |
| 1000 GB SATA drives | 11 Terabyte with RAID 6 |

On the first RAID group of the first two TS7500 Cache Controllers there are three additional LUNs where the operating system, TS7500 V3 R1 software, and the metadata are stored. In a dual-node configuration the metadata LUNs are mirrored to the other TS7530 Cache Controller. These three LUNs occupy 24 GB of space.

Each TS7530 Cache Controller has two Fibre Channel ports to each TS7530 Virtualization Engine. With two TS7530 Virtualization Engines installed, operating in a dual-node high-availability configuration, both of the TS7530 Virtualization Engines have access to each TS7500 Cache Controller.

In a TS7530 HA configuration, with two TS7530 Virtualization Engine (3954-CV7) nodes, the storage on the TS7500 Cache Controllers and TS7500 Cache Modules is shared between the two TS7530 Virtualization Engine nodes. The architecture of the TS7530 solution has the storage physically shared between TS7530 Virtualization Engine nodes to help provide redundancy and failover. The capacity is not logically shared and is assigned to each TS7530 Virtualization Engine (3954-CV7) equally or balanced in a dual-node system. In a four-node dual TS7530 HA configuration storage is also physically shared between the TS7530 nodes to help provide redundancy within an HA pair inside a frame. As in the dual-node configuration, the capacity is not logically shared and is assigned to each TS7530 Virtualization Engine (3954-CV7) node.

In normal operation, a dual-node TS7530 is two systems and a four-node TS7530 is four systems, each with its own cache. Usable capacity is defined separately from raw capacity and accounts for RAID 5 or RAID 6 overhead and hot spares. The minimum configuration for the TS7530 solution is with 13 TB usable space with two cache controllers populated with 500 GB SATA hard drives.

### 3.2.4 IBM TS7500 Cache Module (3955-SX6)

The TS7500 Cache Module is the disk expansion drawer associated with the TS7500 Cache Controller. The TS7500 Cache module for the TS7530 Virtualization Engine is designed to work with theTS7500 Cache Controller to provide users with increased capability for 4 Gbps Fibre Channel operation and 16-bay disk capacity. Designed for a maximum storage density, the fully populated unit with 1,000 GB 7200 rpm SATA Disk Drives offers 16 TB of RAW capacity and 13 TB of usable capacity using RAID 5 and 1000 GB disk drives.

The disk drives in the TS7500 Cache Controller and the TS7500 Cache module are exclusive with the drives in other storage systems. They are not interchangeable with the disk module from any other another storage subsystem.

TheTS7500 Cache module is rack-mountable, occupies 3U rack space, and comes standard with two 4 Gbps shortwave Small Form Factor Pluggable (SFP) fiber optic transceivers for connection to TS7500 Cache Controller.

The SX6 module comes by default with dual redundant power supplies and dual redundant enhanced switching modules. The enhanced switching modules are the components that provide switched point-to-point connections to all the hard disk drives in the enclosure.

The TS7500 Cache Module connects to an existing TS7500 Cache Controller or to another TS7500 Cache Module. The connections for the TS7500 Cache Module are shown in Figure 3-12.

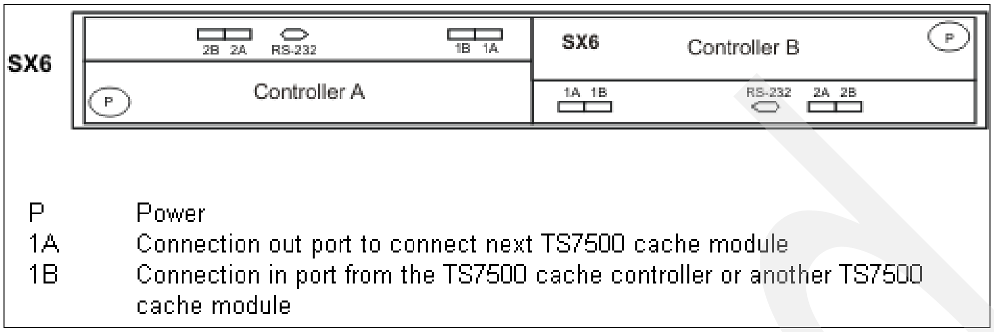



*Figure 3-12 TS7500 Cache Module (3955-SX6)*

The RAID configurations for the TS7500 SX6 module are defined in the section 3.2.2, “Redundant Array of Independent Disks (RAID) configurations” on page 70. It should be noted that the RAID structure remains the same for the storage unit irrespective of whether its a cache controller or a cache module.

A base unit or a secondary base unit 3952 Frame Model F05 can contain up to six TS7500 Cache Modules (3955-SX6). The expansion unit 3952 Frame Model F05 can contain up to 10 additional TS7500 Cache Modules. The cache module is not a compulsory component to have in a TS7530 solution.

Up to three TS7500 Cache Modules can be attached to each TS7500 Cache Controller in a base unit. Up to five TS7500 Cache Modules can be attached to each TS7500 Cache Controller in an expansion unit.

Each TS7500 Cache Module contains 16 SATA disks of 500 GB, 750 GB, or 1000 GB, for a total raw capacity of 8 TB, 12 TB, and 16 TB, respectively. Each TS7500 Cache Module contains one hot spare disk to help provide RAID reliability. The usable capacities for the TS7500 cache module are shown in Table 3-5. Note the that the capacity of the cache module is dependent on the RAID type implemented.

*Table 3-5 Tabulation of drive capacities and cache module capacity*

| Drive capacity | Storage module’s usable capacity |
|---|---|
| 500 GB SATA drives | 6.5 Terabytes with RAID-5 |
| 750 GB SATA drives | 9.75 Terabytes with RAID-5 |
| 1000 GB SATA drives | 13 Terabytes with RAID-5 |
| 1000 GB SATA drives | 11 Terabyte with RAID-6 |

The amount of disk cache for the TS7500 solution must be large enough to support the business need for the environment in which the TS7500 is installed. For more information about TS7500 Virtualization Engine performance and sizing see Chapter 5, “Configuration and planning” on page 129.

### 3.2.5 LUN configuration for IBM Virtualization Engine

The LUN configurations presented in the following sections are for IBM Virtualization Engine TS7530 software and database repositories. The LUNs are preconfigured by IBM Service Support Representatives (SSRs), so there is no need to change them.

The primary TS7530 Virtualization Engine server on disk has the following LUN allocations:

- Boot LUN (20 GB)

  Boot LUN0 is a FC drive connected to port FC11 and the partitions will be as follows:

  – 4 GB for swap
  – 4 GB for ve
  – 5 GB for /var/log
  – 7 GB for OS (boot; root)

  To isolate log files and configuration files we create two more partitions, one for /var/log and another for VE.

- Repositories LUNs (2 GB)

  The FC LUNs 1 and 2 are used for the repository (LUN1) and mirror of repository (LUN2).

- Data LUNs

  The LUN 31, 32, and 53 (application LUN) are not used for data. The other FC LUNs are virtualized and used for data.

- Application LUN53

  This LUN is formatted and mounted to the /application directory. This LUN can be used for installing applications onto the TS7530 line the ISV backup application.

In an HA configuration DATA LUNs are split into the two controllers for the upper and lower servers. To have more security for repositories the repository is created in one of the controllers and the mirror of the repository in the other controller.

**Note:** In each case, all LUNs are initialized and ready for use upon system installation.

## 3.3 IBM 3952 Tape Frame Model F05

IBM 3952 Tape Frame Model F05 is the 19-inch rack in which all of the TS7530 components reside and is required for the configuration. The rack comes standard with one Power Control Assembly (PCA) for power distribution within the rack. We recommend the second redundant PCA on all Enterprise Edition racks.

The IBM Virtualization Engine TS7530 solution requires a base 3952 Tape Frame Model F05 containing one or two TS7530 Virtualization Engine servers (3954-CV7) and two TS7500 Cache Controllers (3955-SV6). An optional second base frame containing an additional two TS7530 Virtualization Engines, two TS7500 Cache Controllers (3955-SV6), and up to six optional TS7500 Cache Modules (3955-SX6) is available. An optional expansion frame containing up to two TS7500 Cache Controllers and up to 10 TS7500 Cache Modules is also available.

The TS7530 solution can have up to twelve 3952 Tape Frames Model F05:

- An primary base frame
- An optional secondary base frame
- Up to 10 expansion frames

The 3952 Tape Frame Model F05 is a frame that can be used to house the components of the TS7530 solution. Up to twelve 3952 Tape Frames Model F0s5 can be attached in a TS7530 configuration. The base unit 3952 Tape Frame Model F05 can accommodate:

- One or two TS7530 Virtualization Engine (3954-CV7) servers
  - A single TS7530 Virtualization Engine (3954-CV7) supports up to 10 expansion frames (1664 TB usable capacity, 2048 TB raw capacity).
  - Two TS7530 Virtualization Engines (3954-CV7) can be configured in a dual-node HA configuration for twice the virtual drives and virtual volumes. This configuration supports up to 10 expansion frames (1664 TB usable capacity, 2048 TB raw capacity).
- Attaching to a second base frame for a total of 4 TS7530 Virtualization Engine servers

  Four TS7530 Virtualization Engines (3954-CV7) can be configured in a four-node dual HA pair configuration for four times the virtual drives and virtual volumes of a single-node configuration. This configuration supports up to 1768 TB of usable capacity (2176 TB of raw capacity with 10 expansion frames).
- Two TS7500 Cache Controllers (3955 Model SV6)

  These each provide 6.5 TB or 9.75 TB or 11 TB or 13 TB of usable capacity (depending on the capacity of the drives and the RAID type used) that can be added in one base frame.
- Up to six TS7500 Cache Modules (3955 Model SX6)

  These each provide 6.5 TB or 9.75 TB or 11 TB or 13 TB of usable capacity (depending on the capacity of the drives and the RAID type used) that can be added in one base frame.

An optional 3952 Tape Frame Model F05, called the expansion unit, can accommodate up to 10 TS7500 Cache Modules and up to two TS7500 Cache Controllers, for a maximum of 153 TB of usable cache capacity (192 TB raw) in a TS7500 solution.

## 3.4 TS7530 Virtualization Engine management console

A management console is used for configuration, management, and service support for the TS7500 Virtualization Engine. This console can either be supplied by the customer or optionally ordered from IBM. If you order a management console, you must place it as a separate order from the TS7530 solution.

The management software for the TS7500 has to be installed on a system (console) that has access to the TS7530 Virtualization Engines management ports via the LAN. Using the management console the administrator can configure the TS7500 Virtualization Engine solution and perform maintenance activities (Figure 3-13 on page 82). Using the console the administrator can create virtual libraries, virtual drives, and virtual volumes. He can also choose to enable compression, encryption, enhanced caching, and other enhanced features on any of the virtual library selected. The console is the medium using the additional features that can be added to the TS7500 Virtualization Engine solution via their respective license keys. The functionalities and use of the console are described in depth later in this IBM Redbooks pubication when appropriate for the tasks described.

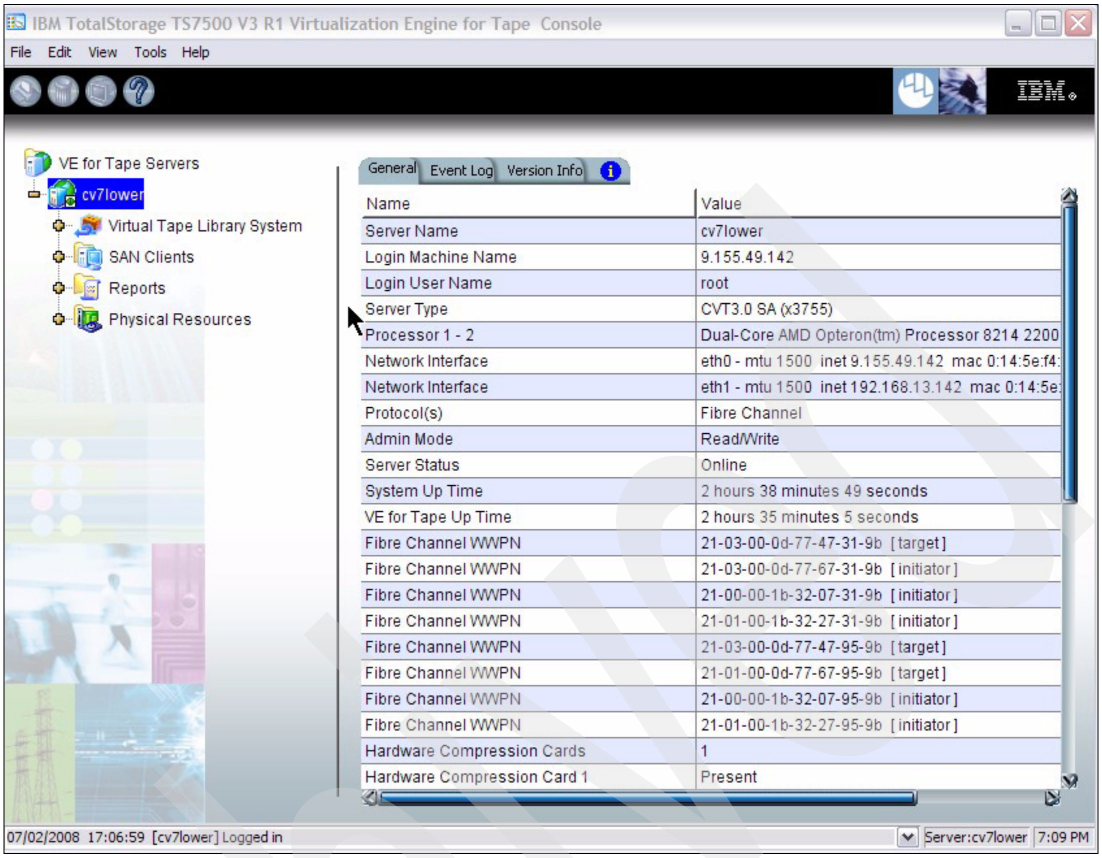



*Figure 3-13 TS7500 V3 R1 Virtualization Engine Tape Console*

## 3.4.1 Hardware requirements

The minimum hardware requirements for the console on which the console software will run are:

- x86 (Pentium® or higher) microprocessor
- 1 GB memory
- 175 MB of disk space for Virtualization Engine for Tape Console Function and Capacity Support
- Keyboard, mouse, and CD-ROM drive
- Super VGA monitor with the screen resolution set to at least 800x600, small fonts setting, and 256 colors
- One Ethernet port for attachment to the TS7500 management network
- One additional Ethernet port recommended for Internet access
- A Web browser and Java™-2 JRE™ installed

## 3.4.2 Operating system support

The TS7500 VE Console software requires one of the following platforms for installation:

- Windows 2000 with Service Pack 4 (SP4)
- Windows 2000 Server SP4
- Windows 2000 Advanced Server SP4

- Windows 2000 Datacenter Server SP4
- Windows 2003 Server Enterprise Edition
- Windows 2003 Datacenter Edition
- Windows XP SP2
- Windows Vista®

# 3.5 TS7530 configurations

The TS7530 Virtualization Engine Enterprise Edition configuration consists of:

- One, two, or four TS7530 Virtualization Engines (3954-CV7)
- Up to 24 TS7500 Cache Controllers (3955-SV6)
- Up to 112 TS7500 Cache Modules (3955-SX6)
- Up to 12 IBM 3952-F05 Tape Frames
- One, two, or four copies of the TS7500 Virtualization Engine Software V3R1 Enterprise Edition (5697-N65)
- A TS7500 Management Console

The maximum capacity of a TS7530 configuration is 1768 TB of usable capacity (2176 TB of raw capacity with 10 expansion frames).

## 3.5.1 Single node configuration

The single node configuration has the characteristics described below.

### Components

The TS7530 Virtualization Engine single node configuration consists of:

- One TS7530 Virtualization Engines (3954-CV7).
- Up to 11 IBM 3952-F05 Tape Frames. One base frame and 10 expansion frames.
- Up to 22 TS7500 Cache Controllers (3955-SV6). Up to two TS7500 Cache Controllers (3955-SV6) per frame. The base frame must have two cache controllers.
- Up to 106 TS7500 Cache Modules (3955-SX6). Up to six cache modules in the base frame and up to 10 cache modules in the expansion frames.
- One FC switch pair in the base frame to connect to expansion frames.
- One copy of TS7500 Virtualization Engine Software V3R1 Enterprise Edition (5697-P19).
- A TS7500 Management Console.

The maximum capacity of a TS7530 configuration is 1664 TB of usable capacity (2048 TB of raw capacity with ten expansion frames).

### Connectivity

The single node configuration provides up to 16 Fibre Channel connections on the node using quad-port and dual-port Fibre Channel cards. The engine can have up to three Quad Port FC HBAs and two dual-port FC HBAs. The port details are covered in 13.4, “Hardware upgrades” on page 443.

Out of the 16 Fibre Channel connections four are used for connecting to the virtualization engine to the cache controllers. These ports can be identified as the upper two ports on the first two Quad Port FC HBAs. The remaining 12 ports can be used as host connect ports.

The single engine can also accept up to two hardware compression cards for providing hardware-based compression on the TS7530 Virtualization Engine. You can also use the quad-ported Ethernet cards in slots 5 and 6. Any number of available Ethernet ports can be used for network replication on the TS7530.

### Functions and scalability

The functions defined here are the functional capabilities of the TS7530 solution. The functions labeled basic function are available by default while the functions labeled enhanced function are paid functions and additional licenses need to be purchased before they can be used.

- Tape virtualization: Tape drive, tape library, and tape virtualization (basic function)

  This functionality helps the TS7530 system portray the disk drives as tape libraries, tape drives, and cartridges. This forms the core functionality of the system.

- Exporting to and importing from physical tape (basic function)

  This functionality manages the movement of backup data from the physical tape to the virtualization engine and vice versa.

- Enhanced caching (basic function)

  This functionality automates the movement of data from the virtualization engine to the physical tape libraries based on user-defined policies.

- Hosted backup (enhanced function)

  This functionality enables the user to have the backup application run on the same hardware on which the virtualization solution is running.

- Network Data Management Protocol (NDMP) support (enhanced function)

  This functionality enables the virtualization solution to support backup for NAS-based solutions.

- Internet SCSI (iSCSI) protocol support (enhanced function)

  This functionality enables the TS7530 to perform data transfers over the regular IP medium like LAN or WAN.

- Tape encryption (basic function)

  This functionality enables the TS7530 to support Library-Managed Encryption offered by the latest generation of physical tape drives and libraries.

- Secure tape (enhanced function)

  With this functionality the TS7530 encrypts all the data residing inside it using the software before it is sent to the physical tape.

- Control path failover (CPF) and data path failover (DPF) (enhanced function)

  With this functionality the TS7530 can continue its operations seamlessly even if one of the connection paths to the system is lost.

- Hardware-based data compression (basic function)

  This functionality uses the on board hardware compression cards to compress the data while it resides on the virtualization engine.

- Software-based data compression (basic function)

  This functionality uses the software to compress the data while it resides on the TS7530 virtualization engine.
- Local replication (enhanced function)

  This functionality provides the system with capabilities to replicate data within the same system but onto a different cache controller.
- Network replication (enhanced function)

  With this functionality the system can maintain duplicate copy of the data on a different system that may be in any geographic location.
- Network encryption (enhanced function)

  This functionality helps the TS7530 encrypt the data that is being sent over the network during network replication.
- Network compression (enhanced function)

  This functionality helps the TS7530 compress the data that is being sent over the network during network replication.
- Data shredding (basic function)

  This functionality enables the TS7530 to erase the contents of the physical tape in a manner such that the data can never be recovered.
- Tape duplication (enhanced function, available via request for price quotation)

  This functionality enables the TS7530 to make duplicate copies of all the tapes being written on the physical library.

The maximum possible configuration of the single node setup includes 11 frames with 22 SV6 units and 106 SX6 units. The maximum possible configuration has a RAW capacity of 2048 TB or 2 PetaBytes. However, due to RAID and hot spares we get a final usable capacity of 1664 TB.

## 3.5.2 Dual-node configuration

The dual-node configuration has the characteristics described below.

### Components

The TS7530 Virtualization Engine dual-node configuration consists of:

- Two TS7530 Virtualization Engines (3954-CV6).
- Up to 11 IBM 3952-F05 Tape Frames. One base frame and 10 expansion frames.
- Up to 22 TS7500 Cache Controllers (3955-SV6). Up to two TS7500 Cache Controllers (3955-SV6) per frame. The base frame must have two cache controllers.
- Up to 106 TS7500 Cache Modules (3955-SX6). Up to six cache modules in the base frame and up to 10 cache modules in the expansion frames.
- One FC switch pair in the base frame to connect to expansion frames. The switches are optional and only needed if expansion frames are attached.
- Two copies of TS7500 Virtualization Engine Software V3R1 Enterprise Edition (5697-P19).
- A TS7500 Management Console.

The maximum capacity of a TS7530 configuration is 1664 TB of usable capacity (2048 TB of raw capacity with ten expansion frames).

### Connectivity

The dual-node configuration provides up to 32 Fibre Channel connections on the two nodes using quad-port and dual-port Fibre Channel cards. Each engine can have up to three Quad Port FC HBAs and two dual-port FC HBAs. See 13.4, “Hardware upgrades” on page 443, for more details.

Out of the 32 Fibre Channel connections eight are used for connecting to the virtualization engine to the cache controllers. These ports can be identified as the upper two ports on the first two Quad Port FC HBAs on each of the nodes. The remaining 24 ports can be used as host or physical tape library connect ports.

In the dual-node configuration each engine can accept up to two hardware compression cards for providing hardware-based compression on the TS7530 Virtualization Engine system.

You can also use the quad ported Ethernet cards in slots 5 and 6. Any number of available Ethernet ports can be used for network replication on the TS7530. The TS7530 base frame also contains an Ethernet switches that are required to connect the Ethernet ports of the two engines. The customer’s network is attached to both Ethernet switches for console service (RSA port).

### Functions and scalability

With the dual-node configuration in addition to the functionalities available on the single node configuration we have additional enhanced functions available: Failover/failback (enhanced function). With this functionality the TS7530 system can continue to function even if one of the virtualization engines fails.

However, there are some features that are mutually exclusive with the failover and failback feature needed in the dual-node configuration. The mutually exclusive features are:

- Hosted backup (enhanced function)

  This functionality enables the user to have the backup application run on the same hardware on which the virtualization solution is running.

- Network Data Management Protocol (NDMP) support (enhanced function)

  This functionality enables the virtualization solution to support backup for NAS-based solutions.

The maximum possible configuration of the dual-node setup includes 11 frames with 22 SV6 units and 106 SX6 units. The maximum possible configuration has a RAW capacity of 2048 TB or 2 PetaBytes. However, due to RAID and hot spares we get a final usable capacity of 1664 TB.

## 3.5.3 Four-node configuration

The four-node configuration has the characteristics described below.

### Components

The TS7530 Virtualization Engine four-node configuration consists of:

- Four TS7530 Virtualization Engines (3954-CV6)
- Up to 12 IBM 3952-F05 Tape Frames (two base frames and 10 expansion frames)

- Up to 24 TS7500 Cache Controllers (3955-SV6). Up to two TS7500 Cache Controllers (3955-SV6) per frame. The base frame must have two cache controllers
- Up to 112 TS7500 Cache Modules (3955-SX6). Up to six cache modules in each base frame and up to 10 cache modules in the expansion frames
- One FC switch pair in the base frames to connect to expansion frames
- Four copies of TS7500 Virtualization Engine Software V3R1 Enterprise Edition (5697-P19)
- A TS7500 Management Console

The maximum capacity of a TS7530 configuration is 1768 TB of usable capacity (2176 TB of raw capacity with ten expansion frames and to base frames).

### Connectivity

The four-node configuration provides up to 64 Fibre Channel connections on the two nodes using quad-port and dual-port Fibre Channel cards. Each engine can have up to three Quad Port FC HBAs and two dual-port FC HBAs. See 13.4, “Hardware upgrades” on page 443, for more information.

Out of the 64 Fibre Channel connections 16 are used for connecting the virtualization engine to the cache controllers. These ports can be identified as the upper two ports on the first two Quad Port FC HBs on each of the nodes. The remaining 48 ports can be used as host connect ports.

in the four-node configuration each engine can accept up to two hardware compression cards for providing hardware-based compression on the TS7530 Virtualization Engine system.

You can also use the quad ported Ethernet cards in slots 5 and 6. Any number of available Ethernet ports can be used for network replication on the TS7530. The TS7530 base frame also contains Ethernet switches, which are required to connect the Ethernet ports of the two engines. The customer’s network is attached to both Ethernet switches for console, service (RSA port), and optionally iSCSI and NDMP connections.

### Functions and scalability

With the dual-node configuration in addition to the functionalities available on the single node configuration we have additional enhanced functions available: Failover/failback (enhanced function). With this functionality the TS7530 system can continue to function even if one of the engine nodes fails. Remember that there are two failover pairs in the four-node configuration. The two nodes in each base frame form a failover pair.

However, there are some features that are mutually exclusive with the failover and failback feature needed in the dual-node configuration. The mutually exclusive features are:

- Hosted backup (enhanced function)

  This functionality enables the user to have the backup application run on the same hardware on which the virtualization solution is running.
- Network Data Management Protocol (NDMP) support (enhanced function)

  This functionality enables the virtualization solution to support backup for NAS-based solutions.

The maximum possible configuration of the four-node setup includes 12 frames with 24 SV6 units and 112 SX6 units. The maximum possible configuration has a RAW capacity of 2176 TB or 2.1 PetaBytes. However, due to RAID and hot spares we get a final usable capacity of 1768 TB.

## 3.6 TS7500 Virtualization Engine V3R1 software compatibility

The TS7500 Virtualization Engine software is compatible with a variety of systems and platforms to ensure ease of use. This helps organizations move towards backup infrastructure consolidation. There are many aspects related to the compatibility of the software running on the virtualization engine nodes;

- Compatibility with host systems.
- Virtualization support for the libraries
- Compatibility with physical libraries
- Compatibility with backup applications
- Compatibility of console software with console operating system

### 3.6.1 Supported host systems

The TS7500 Virtualization Engine attaches to the following platforms and host operating systems:

- IBM System p
  - AIX 5L™ Version 5.1
  - AIX 5L Version 5.2
  - AIX 5L Version 5.3
  - AIX 6L Version 6.1
- IBM System i
  - Version 5 Release 3 of i5/OS®
  - Version 5 Release 4 of i5/OS
- Sun SPARC-based Servers
  - Sun Solaris™ 8
  - Sun Solaris 9
  - Sun Solaris 10
- Microsoft Windows + x86 platform-based servers
  - Microsoft Windows 2003 (build 3790 or greater)
  - Microsoft Windows 2008
- Linux + x86 platform-based Servers
  - SUSE® linux Enterprise Server (SLES) 10.1
  - SUSE linux Enterprise Server (SLES) 9 with SP4
  - Red Hat Enterprise Linux (RHEL)4.6
  - Linux Asianux 2.0
- HP PA-RISC and Itanium®
  - HP-UX (64-bit) 11i Version 1
  - HP-UX (64-bit) 11i Version 2
  - HP-UX (64-bit) 11i Version 3
- Linux on System z
  - System z servers with RHEL 4.5
  - System z servers with SLES 9 and SP3
  - System z9® with RHEL 4.5
  - System z9 with SLES 9 and SP3

For further information about the support and interoperabiity of various platforms and operating systems visit:

http://www.ibm.com/systems/support/storage/config/ssic/index.jsp

## 3.6.2 Supported virtual libraries

The following virtual libraries are supported with the TS7530 Virtualization Engine:

- IBM TS3500 Tape Library with TS1120 Tape Drives or IBM 3592 Model J1A Tape Drives or IBM Ultrium 2, 3, or 4 Tape Drives
- IBM TS3400 Tape Library with TS1120 Tape Drives
- IBM TS3100 Tape Library with Ultrium 3 or 4 Tape Drives
- IBM TS3200 Tape Library with Ultrium 3 or 4 Tape Drives
- IBM TS7530 Tape Library with TS1120 tape drives or IBM 3592 model J1A tape drives or IBM Ultrium 2, 3, or 4 Tape Drives
- IBM TS7520 Tape Library with TS1120 Tape Drives or IBM 3592 Model J1A Tape Drives or IBM Ultrium 2, 3, or 4 Tape Drives
- IBM TS7510 Tape Library with IBM 3592 Model J1A or Ultrium 2 or 3 Tape Drives
- IBM TS3310 Tape Library with IBM Ultrium 3 or 4 Tape Drives
- IBM 3582 Tape Library with IBM Ultrium 2 or 3 Tape Drives
- IBM 3583 Tape Library with IBM Ultrium 2 or 3 Tape Drives

During virtual library creation you can select a virtual library type of TS7530, TS7520, or TS7510. These options emulate IBM TS3500 library models appropriate for the virtual tape drive technology selected. TS7530, TS7520, or TS7510 are only used if your backup application vendor requires them. Check with your backup application vendor about the specific changes required to support virtual tape solutions.

## 3.6.3 Supported physical libraries

The following physical libraries can be used with a TS7530 Virtualization Engine:

- IBM TS3500 Tape Library with TS1120 Tape Drives or IBM 3592 Model J1A Tape Drives or IBM Ultrium 2, 3, or 4 Tape Drives
- IBM TS3400 Tape Library with TS1120 Tape Drives
- IBM TS3100 Tape Library with Ultrium 3 or 4 Tape Drives
- IBM TS3200 Tape Library with Ultrium 3 or 4 Tape Drives
- IBM TS3310 Tape Library with IBM Ultrium 3 or 4 Tape Drives
- IBM 3582 Tape Library with IBM Ultrium 2 or 3 Tape Drives
- IBM 3583 Tape Library with IBM Ultrium 2 or 3 Tape Drives
- IBM 3494 Tape Library with TS1120 Tape Drives or IBM 3592 Model J1A tape drives

## 3.6.4 Backup applications

Support is planned for the following list of backup applications. Each backup application must complete a certification process before it is supported:

- Symantec NetBackup Version 6.0 and Version 6.5
  - Enablement on AIX
  - Enablement on Windows 32-bit and x64
  - Enablement on RHEL
  - Enablement on SLES
  - Enablement on Solaris (SPARC)

- Enablement on HP-UX (PA-RISC

- EMC Networker Version 7.3 and Version 7.4
  - Enablement on AIX
  - Enablement on Windows 32-bit and x64
  - Enablement on RH AS 4.0 x86
  - Enablement on SuSe 10 x64 and SuSe 9 x86
  - Enablement on Solaris (SPARC)
  - Enablement on HP-UX (PA-RISC)
- CA BrightStor ARCserve Backup Version 11.5 and Version 11.1
  - Enablement on AIX
  - Enablement on Windows
  - Enablement on Red Hat
  - Enablement on Solaris
  - Enablement on NetWare 11.1
  - Enablement on HP-UX
- HP Data Protector Version 5.x and Version 6.0
  - Enablement on HP-UX
  - Enablement on Windows 2003
  - Enablement on Solaris
- Tivoli
  - Enablement on AIX
  - Enablement on Windows
  - Enablement on Solaris
  - Enablement on Linux
  - Enablement on HP-UX
- CommVault Galaxy Version 5.9 and Version 6.1
  - Enablement on AIX 5.1, 5.2, 5.3
  - Enablement on HP-UX 11, 11.i
  - Enablement on RHEL 3 and 4
  - Enablement on SuSe 9, 10
  - Enablement on NetWare 6.5
  - Enablement on Tru64 5.1, 5.2
  - Enablement on Windows 2000, 2003 (32/64)
  - Enablement on Solaris 7, 8, 9 (32/64 on Intel)

To determine the status of TS7530 Virtualization Engine support for a backup application and for any pertinent configuration information, always check the support matrix at:

http://www-01.ibm.com/systems/support/storage/config/ssic/index.jsp

## 3.7 TS7530 Virtualization Engine feature configuration options

This section provides information about TS7530 Virtualization Engine features, options, prerequisites, and co-requisites.

### 3.7.1 TS7530 Virtualization Engine server (3954-CV7)

An IBM 3952 Tape Frame Model F05 provides the frame that contains the various components of the TS7530 solution. When configuring a TS7530 solution, one or two TS7530

Virtualization Engine servers (3954-CV7) can be installed in a base unit 3952 Tape Frame using the following features:

- FC1682 (Path Failover): Enables automatic control path failover to a preconfigured redundant path without aborting the current job in progress. It also provides failover for multiple redundant paths in a SAN environment by automatically providing error recovery to retry the current operation using an alternate, preconfigured path without aborting the current job in progress. This can provide flexibility in SAN configuration, availability, and management. An associated feature is required on the TS7500 EE V3R1 software.
- FC3450 (Dual 4 Gb/s FC Port Card): Provides a Fibre Channel adapter card with two ports rated for transfer speeds up to 4 Gb per second.
- FC3451 (Quad 1 Gb/s Ethernet Port Card): Provides an Ethernet adapter card with four ports rated for transfer speeds up to 1Gb per second.
- FC3453 (4 Gb/s Quad Port FC Card): Provides a Fibre Channel adapter card with four ports rated for transfer speeds up to 4 Gb per second.
- FC3454 (Dual Core AMD Opteron Processor): Provides a dual-core AMD Opteron Processor card and 4 GB RAM.
- FC3455 (Data Compression Card): Provides a data compression card for hardware-assisted compression of data received by the TS7500.
- FC6025 (25m LC/LC Fibre Cable): Provides a 25-meter (82.5-foot) 50.0/125-micrometer short wavelength multimode fiber-optic cable with LC Duplex connectors on both ends. These Fibre Channel cables are for host server and tape library attachment. Customer-supplied cables may be used. Feature FC9700 (No Factory Cables) must be installed if feature FC6025 is not ordered.
- FC7420 (Failover/Failback): Enables hardware connections between two installed servers in the same 3952 Tape Frame. The servers must be the same model, either 3954 Model CV7 or Model CV6. Both servers in the failover pair must have the same installed features, except the cable features FC6025 (25 m LC/LC Fiber Cable) and FC9700 (No Factory Cables) may be different. This feature also enables high availability for TS7500 operations. If one server in the failover pair fails, the surviving server takes over its identity. The worldwide node names and IP addresses associated with the failed server are transferred to the surviving server. The failback occurs when the surviving server determines that the restored server has recovered and can resume its responsibilities. An associated feature is required on the TS7500 EE V3R1 software.

  The FC7420 (Failover/Failback) feature is mutually exclusive from the FC7425 (Hosted Backup) and FC7426 (NDMP).
- FC7421 (Network Replication): Enables the TS7500 solution to support the network replication function in the TS7500 EE V3R1 software. An associated feature is required on the software.
- FC7422 (Network Encryption): Enables the TS7530 solution to support the network encryption function in the TS7500 EE V3R1 software. Both the local and target servers must have feature FC7421 (Network Replication) and FC7422 (Network Encryption) enabled for network encryption to operate. An associated feature is required on the TS7500 EE V3R1 software.
- FC7423 (Network Compression): Enables the TS7500 solution to support the network compression function in the TS7500 EE V3R1 software. Both the local and target servers must have feature FC7421 (Network Replication) and FC7423 (Network Compression) enabled for network compression to operate. An associated feature is required on the TS7500 EE V3R1 software.
- FC7425 (Hosted Backup): Enables backup application to be installed on the TS7500 solution, eliminating the need for a dedicated backup server. An associated feature is

required on the TS7500 EE V3R1 software. This feature is not compatible with Failover/Failback (FC7420). A list of compatible software is available from your IBM representative and at:

http://www.ibm.com/systems/storage/tape/library.html

- FC7426 (NDMP): Enables backup applications and NAS devices to perform backup and restore using the NDMP Version 4 protocol over an IP network. With this enabled, the TS7500 solution acts as an NDMP server, centralizing management, while eliminating locally attached tape devices from each NAS device. When a backup occurs, data is moved from a NAS device directly to the virtual library. An associated feature is required on the TS7500 EE V3R1 software. This feature is not compatible with Failover/Failback (FC7420). A list of compatible software is available from your IBM representative or at:

  http://www.ibm.com/systems/storage/tape/library.html

- FC7427 (Secure Tape): Enables encryption with one or more keys for data exported to physical tape and decryption when it is imported back to virtual tapes. The data on the tape cannot be read or be decrypted without using the appropriate key. An associated feature is required on the TS7500 V3R1 software.
- FC7428 (iSCSI): Enables SCSI commands to be used over an IP network and allows hosts to connect via the Ethernet instead of requiring Fibre Channel. An associated feature is required on the TS7500 EE V3R1 software.
- FC7429 (Local Replication): Enables making a copy of a a complete virtual volume in the same TS7500 server. This functions just like network replication except the target and source servers are the same. An associated feature is required on the TS7500 EE V3R1 software.
- FC9305 (Four-node Indicator): Indicates that this server will be installed in a four-node configuration, as supported by the required TS7500 Enterprise Edition software. It must be included with all the servers ordered on the two base frames in a four-node system.
- FC9307 (Enterprise Edition Preload: AAS (5697-P19)): Directs the factory to preload TS7500 Enterprise Edition V3R1 software (5697-P19) on the TS7530 Server. A separate order is required for the TS7500 software.
- FC9326 (Plant Install in F05): Directs this server to be installed in the factory in a new 3952 Tape Frame Model F05.
- FC9327 (Field Merge in F05): Directs this server to be shipped to a customer location for installation into an existing 3952 Tape Frame Model F05.
- FC9700 (No Factory Cables): Should be specified if the Fibre Channel cable feature (FC6025) is not ordered, and customer-supplied cables will be used.

### 3.7.2 TS7530 Cache Controller (3955-SV6)

A minimum of two TS7500 Cache Controllers must be installed in the base unit 3952 Tape Frame with the following features:

- FC9328 (Plant Install a 3955 Model SV6): Directs the factory to install one TS7500 Model SV6 Cache Controller into a new 3952 Tape Frame shipping from the plant. Two TS7500 Model SV6 Cache Controllers must be installed in the 3952 Tape designated as a base unit (FC7317, FC7320). Two corresponding feature numbers 5738 (plant install a 3955 Model SV6) must be ordered on the 3952 Tape Frame, one for each TS7500 Model SV6 Cache Controller.
- FC9329 (Field Install a 3955 Model SV6): To add an additional TS7500 Model SV6 Cache Controller into a 3952 Tape Frame installed in the field. Two corresponding feature

numbers 5739 (field install a 3955 Model SV6) must be ordered on the 3952 Tape Frame, one for each TS7500 Model SV6 Cache Controller.

The following features provide disk cache storage for the TS7500 Cache Controller:

- FC7111 (8 TB SATA Storage): Provides 8 TB of unformatted storage capacity using 16 of the 500 GB 7200 rpm SATA drives.
- FC7112 (12 TB SATA Storage): Provides 12 TB of unformatted storage capacity using 16 of the 750 GB 7200 rpm SATA drives
- FC7113 (16 TB SATA Storage): Provides 16 TB of unformatted storage capacity using 16 of the 1000 GB 7200 rpm SATA drives

Each base frame for the TS7530 solution has to contain two cache controllers, while the expansion module can contain up to two cache controllers. Thus, there can be a maximum of 24 cache controllers in a TS7530 solution—four in the base frames (two in each base frame) and up to 20 in the expansion modules (up to 10 expansion modules).In the base frame each cache controller can be attached to three cache modules, while in the expansion frame each cache controller attaches to five cache modules to provide capacity.

### 3.7.3 TS7530 Cache Module (3955-SX6)

IBM 3952 Tape Frame Model F05 provides the frame that contains the various components of the TS7500 solution. Up to six TS7500 Cache Modules (3955-SX6) can be installed in a base unit 3952 Tape Frame (three per 3955-SV6 installed). Up to 10 additional TS7500 Cache Modules can be installed in an expansion unit 3952 Tape Frame (up to five per 3955-SV6 installed) to provide additional cache storage capacity.

The TS7500 Cache Modules are added by ordering the following features:

- FC9330 (Plant Install a 3955 Model SX6)

  To have the factory install the TS7500 Cache Module into a new 3952 Tape Frame (either base unit or expansion unit) shipping from the plant. One corresponding FC5748 (Plant Install a 3955 Model SX6) must be ordered on the 3952 Tape Frame for each TS7500 Cache Module being installed by the plant. Two TS7500 Cache Controllers must be installed prior to TS7500 Cache Modules being installed in an expansion unit.

- FC9331 (Field Merge a 3955 Model SX6)

  To ship a TS7500 Cache Module for field installation into an installed 3952 Tape Frame (either base unit or expansion unit) a corresponding FC5749 (Field Install a 3955 Model SX6) must be ordered on the 3952 Tape Frame.

The following features provide disk cache storage for the TS7500 Cache Module:

- FC7111 (8 TB SATA Storage): Provides 8 TB of unformatted storage capacity using 16 numbers of 500 GB 7200 rpm SATA drives.
- FC7112 (12 TB SATA Storage): Provides 12 TB of unformatted storage capacity using 16 numbers of 750 GB 7200 rpm SATA drives
- FC7113 (16 TB SATA Storage): Provides 16 TB of unformatted storage capacity using 16 numbers of 1000 GB 7200 rpm SATA drives

Up to six TS7500 Model SX6 Cache Modules can be installed in the base unit 3952 Tape Frame (three per 3955 Model SV6 installed). Additional (up to 10) TS7500 Model SX6 Cache Modules can be installed in an expansion unit 3952 Tape Frame to provide additional cache storage capacity (five per each 3955 Model SV6 installed).

### 3.7.4 IBM 3952 Tape Frame Model F05 (3952-F05)

IBM 3952 Tape Frame Model F05 provides the frame that contains the various components of the TS7530 solution. The TS7530 solution can consist of one to twelve 3952 Tape Frames that are specified with the following features:

- FC1903 (Dual AC Power)

  This feature provides one additional power distribution unit to allow connection to independent branch power circuits. If this feature is ordered, two power cords are provided.

- FC1906 (Ethernet Switch Kit)

  Includes one 16-port Ethernet switch. Recommended for each 3954-CV7 (up to a maximum of two). This feature also includes Ethernet cables to connect the TS7530 Virtualization Engines (3954-CV7) in the base frame to the integrated switch, and to connect the Ethernet switch to the Fibre Channel switches in the base frame.

- FC1910 (Fibre Channel Switch Kit)

  Includes two 32-port Fibre Channel switches with 16 ports enabled per switch. This feature is only valid for 3952-F05 in a TS7530 configuration with FC7317 (TS7530 Series Base Unit). This feature is required when FC7320 (TS7500 Series Secondary Base Unit) or FC7318 (TS7500 Series Expansion Unit) is ordered for the first time in a system configuration. Features 1903 (Dual AC Power) and 1906 (Ethernet Switch Kit) are required.

- FC1911 (Eight Port Switch Expansion)

  Enables an additional eight ports for each of the Fibre Channel switches added with FC1910 (Fibre Channel Switch Kit). Up to two FC1911s are allowed to enable the complete 32 ports. These features are required for large configurations including more than three expansion frames (for the first) and seven expansion frames (for the second).

- FC4747 (Remove a 3954-CV6)

  Provides the instructions to remove a TS7520 Server from an installed 3952 Tape Frame. One or two features are required for upgrading from one or two TS7520 servers to TS7530 Servers. One FC5732 is required for every FC4747 ordered. One FC5728 or FC5729 must be removed from the Model F05 for every FC4747 ordered.

- FC7317 (TS7500 Series Base Unit)

  Identifies this frame as the base unit frame that contains one or two TS7500 Virtualization Engine servers, two TS7500 Cache Controllers, and up to six TS7500 Cache Modules.

- FC7318 (TS7500 Series Expansion Unit)

  Identifies this frame as the expansion unit frame that contains up to two TS7500 Cache Controllers and up to 10 additional TS7500 Cache Modules.

- FC7320 (TS7500 Series Secondary Base Unit)

  Identifies this frame as the secondary base unit frame that contains two TS7500 Virtualization Engine servers, two TS7500 Cache Controllers, and up to six TS7500 Cache Modules. This feature is required in four-node configuration.

One or two TS7530 Virtualization Engines (3954-CV7) can be installed in the base unit frame with the following features:

- FC5731 (Plant Install a 3954 Model CV7)

  Instructs the factory to install one TS7530 Virtualization Engine (3954-CV7) into a new 3952 Tape Frame shipping from the plant. A minimum of one must be installed in the 3952 Tape Frame designated as the base unit (FC7317 - TS7500 Series Base Unit). A minimum of two must be installed in the tape frame designated as the secondary base unit (FC7320 - TS7500 Series secondary Base Unit).

A corresponding FC9326 (Plant Install a 3954 Model CV7) must be ordered on the TS7530 Virtualization Engine (3954-CV7).

- FC5732 (Field Install a 3954 Model CV7)

  To ship a second TS7530 Virtualization Engine for field installation into an installed 3952 Tape Frame designated as the base unit (FC7317 - TS7500 Series Base Unit). A corresponding FC9327 (Field Merge a 3954 Model CV7) must be ordered on the TS7530 Virtualization Engine (3954-CV7).

  This feature must also be ordered when replacing a Model CV6 with a Model CV7. In case of this model upgrade, the following features are also required:

  **On the 3954-CV6** FC9380: Discontinuance support.
  **On the 3952-F05** FC4747: Remove 3954-CV6.

  In addition, it is especially important for planning that the CV6 servers have enough memory (4 GB) to have the TS7530 code installed on the CV6 so that the system is ready for the CV7 MES. If you have two CV6s installed both must be replaced at the same time.

  See 13.1, “Upgrade and migration considerations” on page 436, for more information about the MES upgrade.

Two TS7500 Cache Controllers must be installed in the base unit frame with the following features:

- FC5738 (Plant Install a 3955 Model SV6)

  To have the factory install one TS7500 Cache Controller (3955-SV6) into a new 3952 Tape Frame shipping from the plant. Two of these features must be installed in the 3952 Tape Frame designated as the base unit (FC7317 - TS7500 Series Base Unit). A corresponding FC9322 (Plant Install a 3955 Model SV6) must be ordered on the TS7500 Cache Controller (3955-SV6).

- FC5739 (Field Install a 3955 Model SV6)

  To ship an additional TS7500 Cache Controller into a new 3952 Tape Frame installed in the field. Two of these features must be installed in the 3952 Tape Frame designated as the base unit (FC7317 - TS7500 Series Base Unit). A corresponding FC9329 (Field Install a 3955 Model SV6) must be ordered on the TS7500 Cache Controller (3955-SV6).

The TS7500 Cache Module provides additional disk cache storage and is installed in the 3952 Tape Frame with the following features:

- FC5748 (Plant Install a 3955 Model SX6)

  To have the factory install one TS7500 Cache Module into a new 3952 Tape Frame shipping from the plant.

- FC5749 (Field Install a 3955 Model SX6)

  To ship an additional TS7500 Cache Module (3955-SX6) for field installation into an installed 3952 Tape Frame. A maximum of six of these features can be installed in the 3952 Tape Frame designated as a base unit or two in a limited edition base unit. An additional 10 features can be installed in the 3952 Tape Frame designated as the expansion unit.

The appropriate power cord must be specified. The Dual AC Power feature (FC1903) must be ordered if connection to two independent branch power circuits is required. If this feature is ordered, two power cords are provided.

### 3.7.5 IBM Virtualization Engine TS7500 Software Version 3 Release 1

IBM Virtualization Engine TS7500 Enterprise Edition V3.1 software supports additional hardware compression as an option in the IBM Virtualization Engine TS7530 Server (3954 Model CV7).

Additionally, support is added for extended online storage capacity via the IBM 3955 model SV6 and SX6 1 TB disk drives in either RAID 5 or RAID 6 format.

All prior functions supported by Enterprise Addition V2.1 are also supported in V3.1, with exception of support for the execution of functions on IBM TS7510 hardware components.

The following functions are supported in the Virtualization Engine TS7500 solution with IBM Virtualization Engine TS7500 Enterprise Edition V3.1 software:

- Network replication: Copies a complete virtual volume from one TS7500 Virtualization Engine to another across an IP network. At prescribed intervals, when the tape is not in use, changed data from the primary virtual tape is transmitted to the replica resource on the target Model CV7 Virtualization Engine so that they are synchronized. The target Model CV7 Virtualization Engine is usually located at a remote location. Under normal operation, backup clients do not have access to the replica resource on the target server. If a disaster occurs and the replica is needed, the administrator can promote the replica to become the primary virtual tape so that clients can access it.
- Network compression: Uses software compression on data that is transferred across an IP network during a network replication. Network compression improves overall bandwidth between two TS7500 Virtualization Engines that are replicating virtual volumes, because the data will be compressed before being sent over the IP network.
- Network encryption: Secures data transmission over the network during replication. Initial key distribution is accomplished using the authenticated Diffie-Hellman exchange protocol. Subsequent session keys are derived from the master shared secret, making it very secure.
- Failover and failback: Failover supports high availability for TS7500 solution operations and can help eliminate the down time that can occur should a TS7500 Virtualization Engine fail. In the TS7500 solution failover design, a TS7500 Virtualization Engine is configured to monitor another TS7500 Virtualization Engine. In the event that the virtualization engine being monitored fails to fulfill its responsibilities to the SAN clients it is serving, the monitoring TS7500 Virtualization Engine will take over its identity. When this happens, the worldwide node names and IP addresses associated with the failed TS7500 Virtualization Engine are transferred to the surviving TS7500 Virtualization Engine. The failback occurs when the system has recovered.
- Secure tape: Implements the Advanced Encryption Standard (AES) algorithm published by the National Institute of Standards and Technology, an agency of the U.S. government. With this option, you can create one or more keys that can be used to encrypt the data when it is exported to physical tape and decrypt when it is imported back to virtual tapes. Encryption helps make the data on the tape unreadable, unless the appropriate key is used.
- Local replication: Copies a complete virtual volume in the same TS7500 Virtualization Engine. Local replication is the same as network replication, except the target and source servers are the same.
- NDMP backup: Enables backup applications and NAS devices to perform backup and restore using the Network Data Management Protocol V4 protocol over an IP network. The TS7500 solution acts as an NDMP server, centralizing management while reducing or eliminating locally attached tape devices from each NAS device. When a backup occurs,

data is moved from an NAS device directly to the virtual library. Note that NDMP backup is mutually exclusive with failover/failback.

- iSCSI: Enables SCSI commands to be used over an IP network and hosts to connect via Ethernet instead of Fibre Channel.
- Hosted backup: Makes virtual tape libraries and drives available to local systems by allowing backup applications to be installed directly onto the TS7500 Virtualization Engine, reducing or eliminating the need for a dedicated backup server. Note that hosted backup is mutually exclusive of failover/failback.
- Control path failover and data path failover: Enables automatic control path failover to a pre-configured redundant path without aborting the current job in progress. It also provides failover for multiple redundant paths in a SAN environment by automatically providing error recovery to retry the current operation using alternate, preconfigured paths without aborting the current job in progress. This can provide flexibility in SAN configuration, availability, and management.
- Console and capacity support: Management console and capacity support is offered on a tiered, per-TB basis for customers ordering the Enterprise Edition. It includes the IBM Virtualization Engine TS7500 Management Console program, as well as entitlement to use the available disk capacity. The quantity of management console and capacity support required for every TS7500 Cache Controller and TS7500 Cache Module allocated to the TS7530 Virtualization Engine is dependent on the capacity feature selected on each cache unit.

# 4

# TS7520 architecture

In this chapter we examine IBM Virtualization Engine TS7520 (TS7520) hardware components, model numbers, and functional aspects of the entire solution. We also cover the virtualization engine software that provides library emulation.

- Hardware components:
  - IBM Virtualization Engine TS7520 (3954-CV6)
  - IBM Virtualization Engine TS7520 Cache Controller (3955-SV6)
  - IBM Virtualization Engine TS7520 Cache Module (3955-SX6)
  - IBM 3952 Tape Frame (3952-F05)
- Software components: IBM Virtualization Engine TS7500 Software Version 3 Release 1 (5697-P19)

## 4.1 IBM Virtualization Engine TS7520

The IBM Virtualization Engine TS7520 solution (TS7520) is a virtual tape solution designed to help optimize tape processing. Through the implementation of an integrated, tiered storage hierarchy of disk and tape, the benefits of both technologies can be leveraged to enhance performance and provide additional capacity for tape processing requirements. Deploying this subsystem can help reduce batch processing time and management overhead.

### 4.1.1 TS7520 components

The TS7520 architecture consists of multiple hardware and software components to provide an integrated solution. The architectural components are:

- The IBM Virtualization Engine TS7520 Model CV6 or TS7520 Virtualization Engine
- The IBM Virtualization Engine TS7520 Model SV6 or TS7520 Cache Controller
- The IBM Virtualization Engine TS7520 Model SX6 or TS7520 Cache Module
- IBM 3952 Tape Frame Model F05
- IBM Virtualization Engine TS7500 Software Version 2, Release 1 program (5697-N65 or 5697-N66)

The IBM Virtualization Engine TS7520 solution is designed to offer tape virtualization for Open Systems servers connecting over Fibre Channel or iSCSI connections. The TS7520 solution consists of:

- TS7500 V2R1 Software (5697-N65 or 5697-N66)
- One or two Base 3952 Tape Frames and up to 10 Expansion 3952 Tape Frames to contain the other components
- One, two, or four TS7520 Virtualization Engine servers (3954-CV6)
- Up to 24 TS7520 Cache Controllers (3955-SV6)
- Up to 112 TS7520 Cache Modules (3955-SX6)

The TS7520 solution is available in multiple configurations. One TS7520 Virtualization Engine (3954-CV6) is termed as a single node. The TS7520 solution is available in a single-node configuration, a dual-node high-availability (HA) configuration, or a four-node configuration with two dual-node HA pairs.

The IBM Virtualization Engine TS7520 solution is designed to provide redundancy for critical hardware components and connections between components. Key functional features of the TS7520 solution are:

- Configuration of two TS7520 Virtualization Engine servers as an active cluster
- Configuration of four TS7520 Virtualization Engine servers as two cooperating active clusters
- Support for real-time compression of data, reducing disk storage requirements
- On demand allocation of disk storage to help maximize storage utilization using virtual cartridges (Static allocation is also supported for customized environments)
- Support of import/export to an IBM TotalStorage 3494 Tape Library using an Ethernet interface to manage the library

- Interaction in an HA configuration with the TS7520 Cache Controllers to perform transparent fail-over/fail-back within the TS7520 solution from path (HBA, port, switch, channel) or storage controller failure to minimize disruption to backup or restore activities
- Integration of Ethernet and Fibre Channel Switches for connectivity between base frames and expansion frames
- Ability to scale processing and memory capacity for improved performance

> **Attention:** Since the introduction of TS7530 it is no longer possible to add CPUs to the TS7520 Virtualization Engine. However, memory upgrades have been permitted to support the latest version of the virtualization software.

### 4.1.2 IBM TS7520 Virtualization Engine Controller (3955-CV6)

The TS7520 Virtualization Engine (3954-CV6) is based on a System x server. The Peripheral Component Interconnect (PCI) slots 1 through 6, shown in Figure 4-1 on page 102, contain the dual ported Qlogic (QLA2462) Fibre Channel (FC) adapters with Lucent Connectors (LC). The 3954-CV6 has the following features:

- Six PCI-X slots
- Up to six Dual port, 4 Gbps FC HBAs:
  - Cache connections:
    - One HBA and two ports required for Limited Edition[1] (LE)
    - Two HBAs and four ports required for Enterprise Edition (EE)
  - Up to four HBAs or eight ports to use as:
    - Up to eight host connections: Number of physical connections
    - Up to four physical tape connections
- Up to four Quad Port 1 Gbps Ethernet Adapters: 16 ports maximum
- Two 1 Gbps Ethernet Ports on the Planar
- One RSA 1 Gbps Ethernet port for service
- Up to three additional 2.67 GHz Xeon Dual Core processors

  The feature to add additional CPU cards has been withdrawn.
- Up to seven additional 2 GB memory increments (2 GB are included)

1 Limited edition TS7520 Virtualization Engine has been discontinued and ordering of the same is not supported

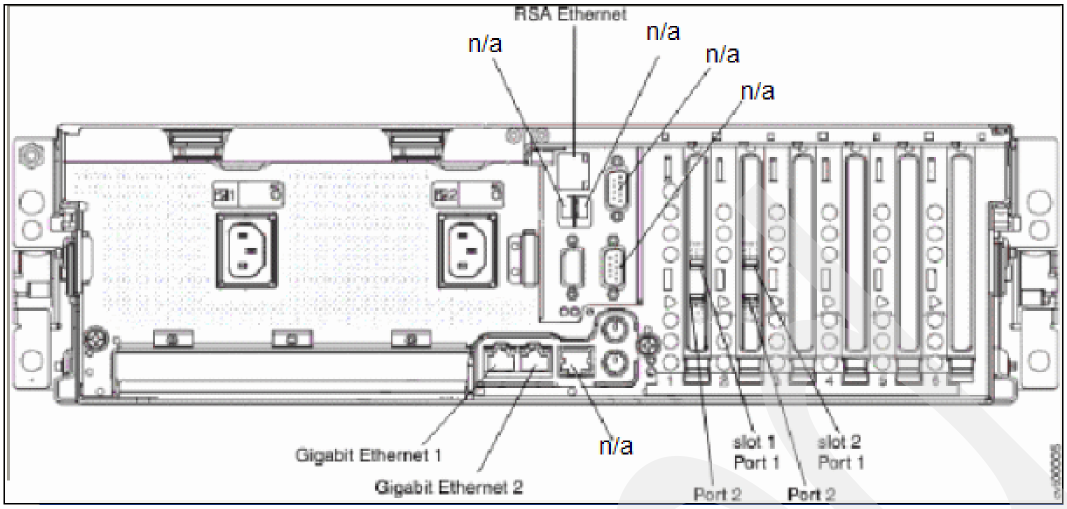


*Figure 4-1 TS7520 Virtualization Engine (3954-CV6)*

> **Attention:** The server and disk components of the IBM Virtualization Engine TS7520 have been modified and tuned to provide this integrated solution. IBM does not support any attempts to exchange the TS7520 components with other IBM model servers or IBM disk products. Such attempts will cause the configuration to fail.

The TS7520 Virtualization Engine (3954-CV6) can contain up to four processors to improve performance and accelerate compression of the backup data. Every TS7520 solution configuration must contain at least one 3954-CV6 (also referred to as a single node). A second optional 3954-CV6 allows the TS7520 solution to operate in a dual-node High Availability (HA) configuration.

A TS7520 HA configuration can have more virtual cartridges, virtual volumes, and interface ports. An HA configuration is ordered with feature code 7420 Failover/Failback to provide the failover/failback redundancy. The third and fourth optional TS7520 Virtualization Engines (3954-CV6) enable the TS7520 solution to operate in two dual-node HA configurations and allows more virtual cartridges, virtual volumes, and interface ports. To provide HA for four TS7520 Virtualization Engine servers, you must order feature code (FC) 7420 Failover/Failback for each TS7520 Virtualization Engine (3954-CV6).

Each 3954-CV6 comes with up to 12 Fibre Channel connections. In a Limited Edition[2] configuration two of the Fibre Channel ports are connected to the single TS7520 Cache Controller and up to 10 Fibre Channel ports are available for host server or tape attachment. In an Enterprise Edition configuration, four of the Fibre Channel ports are connected to the TS7520 Cache Controllers and up to eight Fibre Channel ports are available for host server or tape attachment (4 maximum for tape). In a dual-node system, there are 16 Fibre Channel ports available for the host server for tape attachment (eight maximum for tape).

Two Fibre Channel switches can be integrated into only the first base frame for an additional 32 ports each. These switches are required to add additional expansion enclosures to a base frame or if a second base frame is added to the configuration. The Fibre Channel switches are for internal connections only and are not available for customer use.

[2] The limited edition TS7520 Virtualization Engine has been discontinued and ordering of the same is not supported.

**Note:** If the TS7500 Software Version 3 Release 1 has to be run on the TS7520 Virtualization Engine, you must ensure that the system being upgraded has a minimum of 4 GB RAM memory in the TS7520 Node. If sufficient memory is not available on the node a memory upgrade must be performed on the node.

## 4.2 IBM Virtualization Engine TS7520 disk architecture

The disk architecture of the TS7520 consists of the IBM TS7520 Cache Controller (3955-SV6) and the IBM TS7520 Cache Module (3955-SX6), both of which we describe in this section.

**Note:** In this chapter, references to cache capacity are native uncompressed capacity.

### 4.2.1 Disk technology

Serial Advanced Technology Attachment (SATA) disk drives are the physical disk drives housed within the IBM Virtualization Engine TS7520. The SATA interface specification offers increased data rate performance over Parallel Advanced Technology Attachment (PATA). Developed by a group of leading technology vendors, SATA was designed to overcome the performance barriers of PATA technologies, while maintaining the benefits and cost efficiency of PATA technology. The SATA Working Group introduced the first SATA specification, Serial ATA 1.0, in 2001. There are three capacities of SATA drives supported on the TS7520 Virtualization Engine solution.

- 500 GB 7200 rpm SATA drives
- 750 GB 7200 rpm SATA drives
- 1000 GB 7200rpm SATA drives (only supported with software Version 3 Release 1)

For additional information about Serial ATA refer to the Web site at:

http://www.serialata.org

### 4.2.2 Redundant Array of Independent Disks

The TS7520 Virtualization Engine solution uses Redundant Array of Independent Disks (RAID) for storing the data. RAID as a technology can be defined as:

> An arrangement consisting of a group of disks operating together to provide the users with fast data transfers and fault tolerance, through the use of techniques like data striping, mirroring and parity calculation.

**Striping** This is the process of taking a block of data and dividing it into equal portions (stripes), then writing each of these portions (stripes) onto a separate disk so that when the block needs to be accessed it can be simultaneously read from all the disks on which the portions have been written.

**Parity** This is a stripe of data arrived at after performing mathematical and logical operations on the stripes forming a block of data, such that if one of the drives containing a stripe is lost, it can be recovered using the parity stripe.

RAID is a collection of techniques to be implemented in the disk subsystem. It is a strategy created to bridge the gap between computer input/output (I/O) requirements and the latency and throughput restrictions of single disk drives, while also allowing for greater degrees of fault tolerance.

The TS7520 supports RAID 5 implementations only.

RAID5 includes data striping and parity calculation operations. RAID level 5 stripes data and parity across all drives in the array. RAID level 5 offers both data protection and increased throughput. When you assign RAID 5 to an array, the capacity of the array is reduced by the capacity equivalent of one drive (for data-parity storage). RAID 5 is best used in environments requiring high availability and fewer writes than reads. Figure 4-2 depicts the stripe organization on the disk in case of RAID 5.

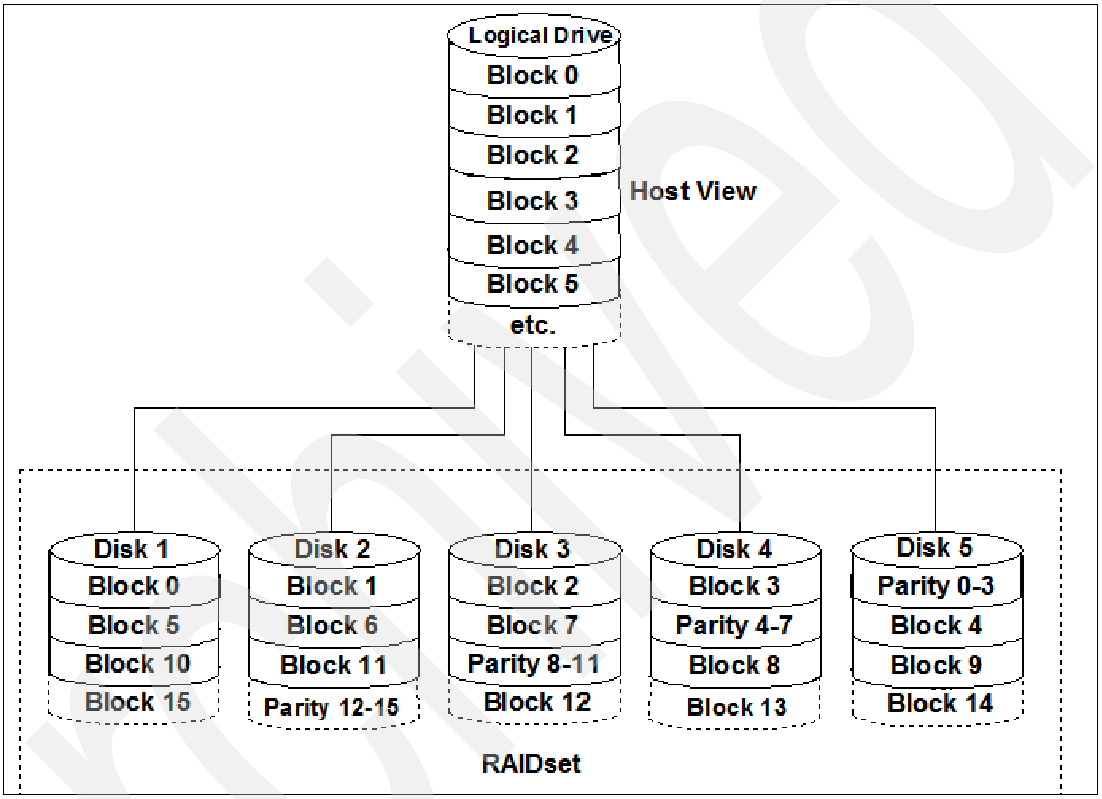



*Figure 4-2 RAID 5 data striping and parity arrangement*

When RAID 5 is configured on the TS7520 cache module or cache controller, the storage module (TS7500 Cache Controller 3955-SV6 or TS7500 Cache Module 3855-SX6) will be divided into two RAID arrays. The first RAID group will be of eight disks and the second RAID group will be of seven disks. In each of the RAID 5 groups capacity equivalent to one of the disks will be used up for storing the parity stripe. The two RAID 5 groups inside each storage module can be defined as 7+P and 6+P. Thus, in each storage module with RAID 5 we have a usable capacity equivalent to 7+6 = 13 disk drives.

One drive will be kept aside in each storage module as a hot spare. The hot spare is an unformatted disk that is kept aside and is not used for any I/O operation. This hot spare can be used if there is a drive failure in one of the RAID groups. This RAID group may be present on any of the storage modules connected directly to a single cache controller (3955-SV6) unit. The availability of hot spare ensures that recovery from disk failure is not spare dependent. In case of failure RAID reconstruction can begin as soon as the failure is discovered using the hot spare available. Table 4-1 depicts the usable capacity in each storage module depending on the capacities of the individual SATA drives used in the module.

*Table 4-1 Usable capacities for storage modules based on drive size used*

| Drive capacity | Storage module's usable capacity |
|---|---|
| 500 GB SATA drives | 6.5 Terabytes |
| 750 GB SATA drives | 9.75 Terabytes |
| 1000 GB SATA drives[a] | 13 Terabytes |

a. The 1,000 GB drives are supported only on TS7500 Software Version 3 Release 1.

Figure 4-3 represents the disk allocation when RAID 5 is selected on the storage modules.

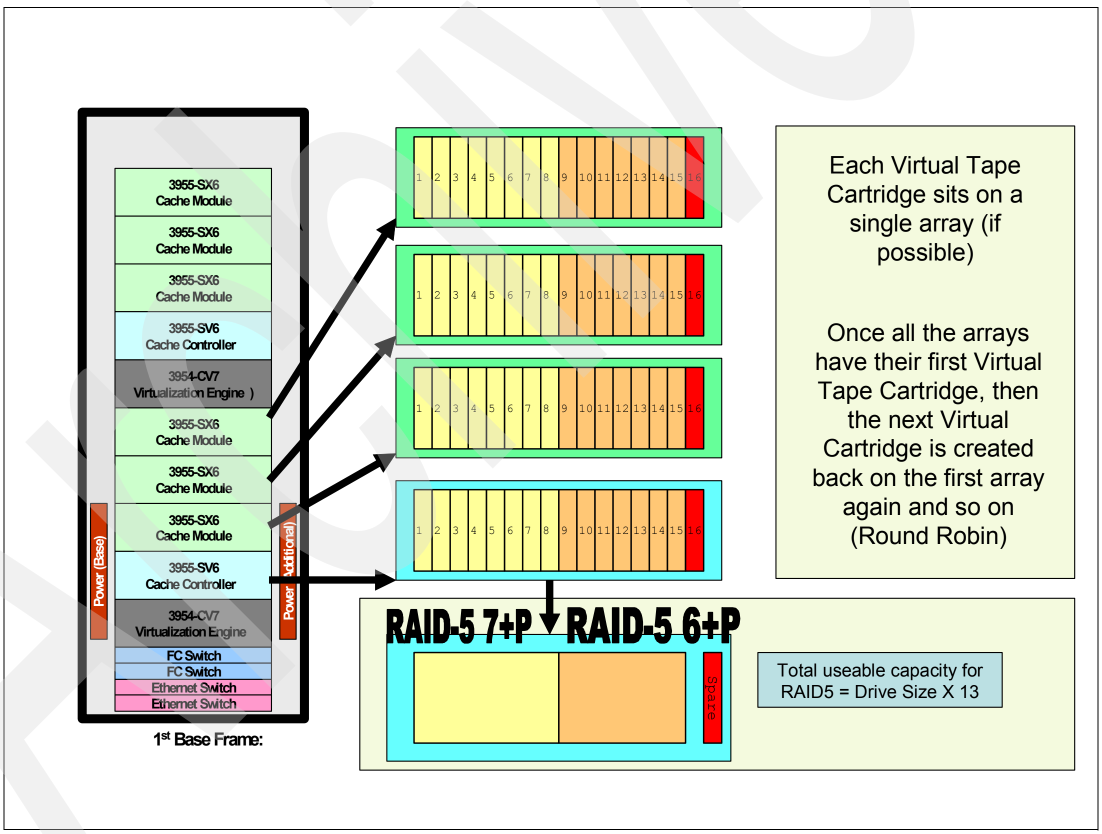



*Figure 4-3 RAID 5 disk allocation*

## 4.2.3 IBM TS7500 Virtualization Engine Cache Controller (3955-SV6)

The TS7500 Cache Controller (3955-SV6), shown in Figure 4-4, is the cache controller for the TS7500. Each 3955-SV6 contains 16 disk drives and two redundant controllers. The maximum usable capacity for cache controller with 500 GB SATA drives is 6.5 TB, while the maximum usable capacity with 750 GB SATA drives is 9.75 TB and the maximum usable capacity with 1,000 GB SATA drives is 13 TB.

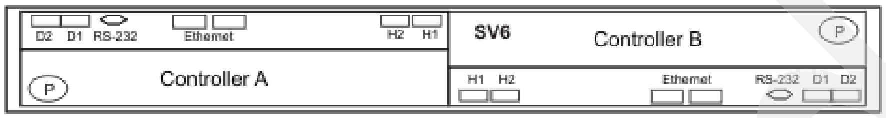



*Figure 4-4 TS7520 Cache Controller (3955-SV6)*

Each 3955-SV6 has four 4 Gbit Fibre Channel ports redundantly attached to one or two 3954-CV6s. A TS7520 Enterprise Edition configuration contains a minimum of two TS7520 Cache Controllers. A TS7520 Limited Edition[3] configuration contains one TS7520 Cache Controller.

The TS7520 Cache Controller (3955-SV6), shown in Figure 4-4, consists of the following components:

- Sixteen SATA HDDs
- Dual array controllers
- Dual AC power supplies
- Fibre Channel expansion ports connected to TS7520 Cache Modules
- Fibre Channel host ports H1 and H2 connected to TS7520 Virtualization Engine (3954-CV6)

The TS7520 Cache Controller provides two RAID-5 arrays, one with *seven data plus one parity* (7+P) and the second with *six data plus one parity* (6+P). Each 3955-SV6 contains one hot spare drive. Each RAID array, with the exception of the first RAID array on the first two TS7520 Cache Controllers, contains two data LUNs on which the data, or virtual volumes, are stored. Two drives in each TS7520 Cache Controller are used for parity.

On the first RAID array of the first two TS7520 Cache Controllers there are three additional LUNs where the operating system, TS7500 software, and metadata are stored. The metadata LUNs are mirrored to the TS7520 Cache Controller. These three LUNs occupy 24 GB.

The TS7520 Cache Controller and TS7520 Cache Module provide the disk storage for the IBM Virtualization Engine TS7520 solution. The TS7520 Virtualization Engine enables tape virtualization for Open Systems servers connecting over Fibre Channel or iSCSI physical connections.

Two TS7520 Cache Controllers are required in each Enterprise Edition TS7520 system. Limited Edition[4] configurations require one. Controllers reside in the 3952 Frame Model F05.

Each TS7520 Cache Controller has two Fibre Channel ports to each TS7520 Virtualization Engine. With two TS7520 Virtualization Engines installed, operating in a dual-node high-availability (HA) configuration, both of the TS7520 Virtualization Engines have access to each TS7520 Cache Controller.

[3] Limited edition TS7520 Virtualization Engine has been discontinued and ordering of the same is not supported.
[4] Limited edition TS7520 Virtualization Engine has been discontinued and ordering of the same is not supported.

In a TS7520 HA configuration, with two TS7520 Virtualization Engine (3954-CV6) nodes, the storage on the TS7520 Cache Controllers and TS7520 Cache Modules is shared between the two TS7520 Virtualization Engine nodes. The architecture of the TS7520 solution has the storage physically shared between TS7520 Virtualization Engine nodes to help provide redundancy and failover. The capacity is not logically shared and is assigned to each TS7520 Virtualization Engine (3954-CV6) equally or balanced in a dual-node system. In a four-node dual TS7520 HA configuration, storage is also physically shared between the TS7520 nodes to help provide redundancy within an HA pair inside a frame. As in the dual-node configuration, the capacity is not logically shared and is assigned to each TS7520 Virtualization Engine (3954-CV6) node.

In normal operation, a dual-node TS7520 is two systems and a four-node TS7520 with four systems, each with its own cache. Useable capacity is defined separately from raw capacity and accounts for RAID5 overhead, and hot spares. The useable capacity of each TS7520 Cache Controller is defined in Table 4-2. In a Limited Edition[4] configuration the minimum configuration is 6.5 TB.

*Table 4-2 Usable capacity*

| Drive capacity | Usable capacity per controller | Usable capacity for minimum Enterprise configuration |
|---|---|---|
| 500 GB SATA drives | 6.5 TB per controller | Minimum 13 TB in the solution |
| 750 GB SATA drives | 9.75 TB per controller | Minimum 19.5 TB in the solution |
| 1000GB SATA drives | 13 TB per controller | Minimum 26 TB in the solution |

## 4.2.4 IBM TS7500 Cache Module (3955-SX6)

The TS7500 Cache Module (3955-SX6) is the disk expansion drawer associated with the TS7500 Cache Controller.

The TS7500 Cache Module is a rack-mountable enclosure configured with 16 SATA disk drive modules, offering up to 16 terabytes (TB) of raw capacity per enclosure. The usable capacity for a cache module with 500 GB SATA drives is 6.5 TB, while the usable capacity with 750 GB SATA drives is 9.75 TB, and the maximum usable capacity with 1,000 GB SATA drives is 13 TB. The TS7500 Cache Module consists of the following components:

- Sixteen SATA HDDs
- Dual Enclosure Service Modules
- Dual AC power

The TS7500 Cache Module connects to an existing TS7500 Cache Controller or TS7500 Cache Module. The connections for the TS7500 Cache Module are shown in Figure 4-5.

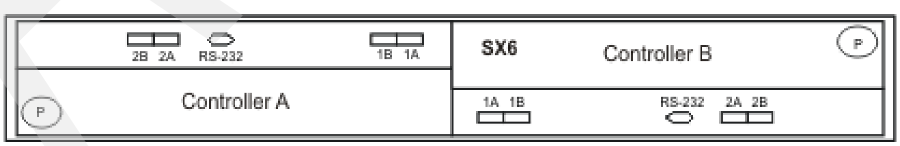



*Figure 4-5 TS7520 Cache Module (3955-SX6)*

The 3955-SX6 provides two RAID-5 LUNs, comprised of eight disks (7+P) and seven disks (6+P). For RAID 5 arrays, one disk's worth of parity is spread across all disks in the array. One disk in each TS7500 Cache Module is designated as a spare. The spare can service any of the RAID 5 arrays attached to the same 3955-SV6 Cache Controller.

Each TS7500 Cache Module (3955-SX6) is an expansion drawer of additional disk cache storage for extra capacity in a TS7500 solution. A base unit or a secondary base unit 3952 Frame Model F05 contains up to six TS7500 Cache Modules (3955-SX6). The expansion unit 3952 Frame Model F05 contains up to 10 additional TS7500 Cache Modules. A minimum configuration contains no TS7500 Cache Modules.

Up to three TS7500 Cache Modules can be attached to each TS7500 Cache Controller in a base unit. Up to five TS7500 Cache Modules can be attached to each TS7500 Cache Controller in an expansion unit.

Each TS7500 Cache Module contains 16 SATA disks of 500 GB, 750 GB, or 1000 GB, for a total raw capacity of 8 TB, 12 TB, or 16 TB, respectively. Useable capacity is up to 6.5 TB for each 3955-SX6 installed in a base frame or an expansion frame with 500 GB SATA drives, 9.75 TB for 750 GB drives, and 13 TB for 1000 GB drives. Each TS7520 Cache Module contains one hot spare disk to help provide RAID reliability.

The amount of disk cache for the TS7520 solution must be large enough to support the business need and for the environment in which the TS7520 is installed. For more information about TS7520 Virtualization Engine performance and sizing, see Chapter 5, “Configuration and planning” on page 129.

### 4.2.5 LUN configuration for IBM Virtualization Engine

The LUN configurations presented in the following sections are for the IBM Virtualization Engine TS7500 Software and database repositories. The LUNs are preconfigured by IBM Service Support Representatives (SSRs), so there is no need to change them.

The primary TS7520 Virtualization Engine server on disk has the following LUN allocations:

- LUN 0:
  - Boot LUN – 20 GB LUN 0 connected to Port 0
  - 4 GB for swap, 4 GB for ve, 5 GB for /var/log, 7 GB for operating system (boot, root)
- LUN 1: Repository LUN – FC LUNs 2 GB
- LUN 2: Mirror of repository – FC LUNs 2 GB
- All others LUNS except LUN 31: Data LUNs – All Other FC LUNs are virtualized and used for data.
- LUN 31: Reserved

In a high availability dual-node TS7520 configuration, the secondary TS7520 Virtualization Engine server on disk has the same LUN allocations as the primary TS7520 Virtualization Engine server on disk.

> **Note:** In each case, all LUNs are initialized and ready for use upon system installation.

## 4.3 IBM 3952 Tape Frame Model F05

The IBM 3952 Tape Frame Model F05 is the 19-inch rack in which all of the TS7520 components reside, and is required for the configuration. The rack comes standard with one Power Control Assembly (PCA) for power distribution within the rack. The second redundant PCA is required on all Enterprise Edition racks but is optional for the Limited Edition[5] rack.

[5] The limited edition TS7520 Virtualization Engine has been discontinued and ordering of the same is not supported.

The IBM Virtualization Engine TS7520 solution requires a base 3952 Tape Frame Model F05 containing one or two TS7520 Virtualization Engine servers (3954-CV6) and two TS7520 Cache Controllers (3955-SV6). An optional second base frame containing an additional two TS7520 Virtualization Engines, two TS7520 Cache Controllers (3955-SV6), and up to six optional TS7520 Cache Modules (3955-SX6) is available. An optional expansion frame containing up to two TS7520 Cache Controllers and up to ten TS7520 Cache Modules is also available.

The TS7520 solution can have up to twelve 3952 Tape Frames Model F05:

- An Enterprise Edition primary base frame or Limited Edition[5] base frame
- An optional secondary base frame (for Enterprise Edition configurations)
- Up to ten expansion frames (for Enterprise Edition configurations).

The 3952 Tape Frame Model F05 is a frame that can be used to house the components of the TS7520 solution. Up to twelve 3952 Tape Frames Model F05 can be attached in a TS7520 configuration. The base unit 3952 Tape Frame Model F05 can accommodate:

- One or two TS7520 Virtualization Engine (3954-CV6) servers
  - A single TS7520 Virtualization Engine (3954-CV6) supports up to 10 expansion frames (1664 TB usable capacity, 2048 TB raw) and an effective data throughput rate of up to 1100 MB/s.
  - Two TS7520 Virtualization Engines (3954-CV6) can be configured in a dual-node HA configuration for twice the virtual drives and virtual volumes. This configuration supports up to 10 expansion frames (1664 TB usable capacity, 2048 raw capacity) and an effective data throughput rate of up to 2400 MB/s.
- Attaching to a second base frame for a total of four TS7520 Virtualization Engine servers

  Four TS7520 Virtualization Engines (3954-CV6) can be configured in a four-node dual HA pair configuration for four times the virtual drives and virtual volumes of a single-node configuration. This configuration supports up to 1768 TB of usable capacity (2176 TB of raw capacity with 10 expansion frames) and an effective data throughput rate of up to 4800 MB/s.
- Two TS7520 Cache Controllers (3955 Model SV6) that each provide 6.5 TB, 9.75 TB, or 13 TB of usable capacity per base frame
- Up to six TS7520 Cache Modules (3955 Model SX6) that each provide 6.5 TB, 9.75 TB, or 13 TB of usable capacity

An optional 3952 Tape Frame Model F05, called the expansion unit, can accommodate up to 10 TS7520 Cache Modules and up to two TS7520 Cache Controllers, for a maximum of 156 TB of usable cache capacity (192 TB raw) in a TS7520 solution.

**Tip:** *IBM Virtualization Engine TS7520 Introduction and Planning Guide*, GC27-2067, is a good place to find information about all of the physical site planning for the TS7520.

## 4.4 TS7520 Virtualization Engine management console

A management console is used for configuration, management, and service support for the TS7500 Virtualization Engine. This console can either be supplied by the customer or optionally ordered from IBM. If you order a management console, you must place it as a separate order from the TS7520 solution.

The management software for the TS7500 has to be installed on a system (console) that has access to the TS7520 Virtualization Engines management ports via the LAN. Using the management console the administrator can configure the TS7500 Virtualization Engine solution and perform maintenance activities. Using the console the administrator can create virtual libraries, virtual drives, and virtual volumes. He can also choose to enable compression, encryption, enhanced caching, and other enhanced features on any of the virtual libraries selected. The console is the medium to which additional features can be added to the TS7500 Virtualization Engine solution via their respective license keys. The functionalities and use of the console are described in depth in Chapter 6, “Initial setup” on page 181, through Chapter 12, “Operation” on page 377, of this book whenever appropriator.

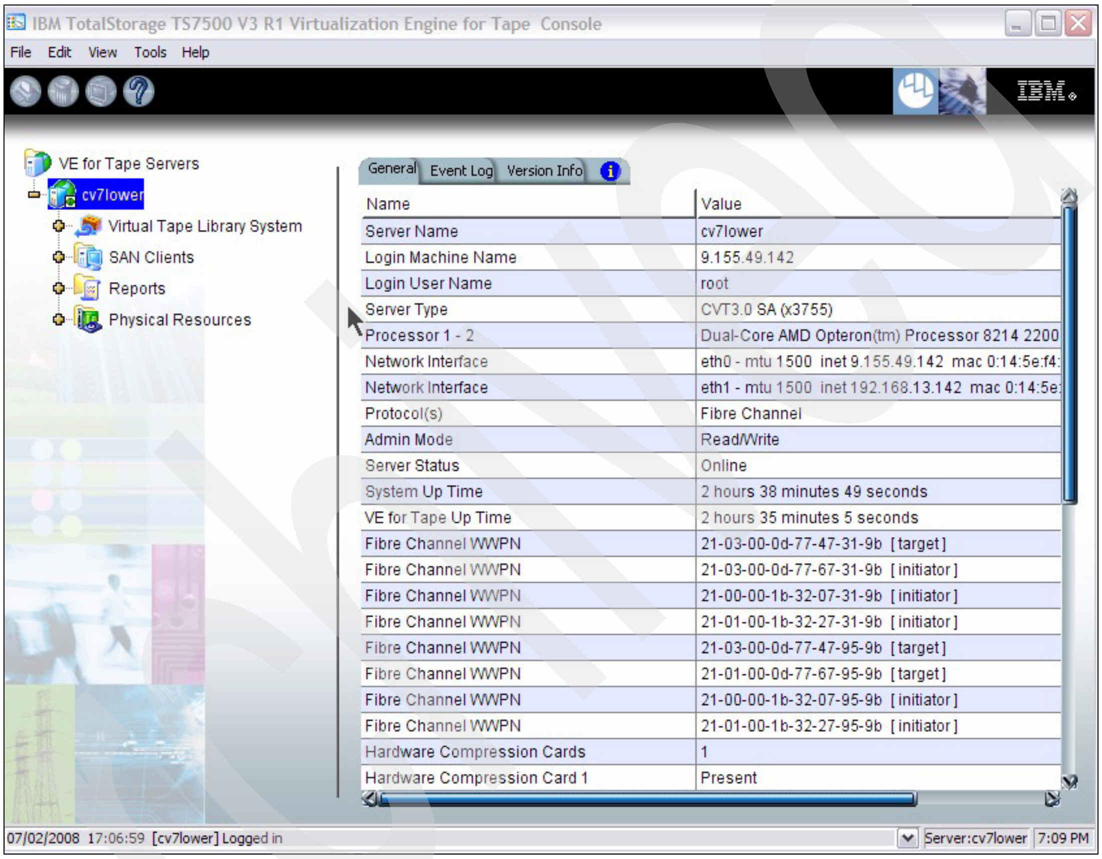



*Figure 4-6 TS7500 V3 R1 Virtualization Engine Tape Console*

The minimum hardware requirements for the console on which the console software will run are:

- x86 (Pentium or higher) microprocessor
- 1 GB memory
- 175 MB of disk space for Virtualization Engine for Tape Console Function and Capacity Support
- Keyboard, mouse, and CD-ROM drive
- Super VGA monitor with the screen resolution set to at least 800x600, small fonts setting, and 256 colors
- One Ethernet port for attachment to the TS7500 management network

- One additional Ethernet port recommended for Internet access
- A Web browser and Java-2 JRE installed

# 4.5 TS7520 configurations

The TS7520 Virtualization Engine is available in an Enterprise Edition configuration and in a Limited Edition[6] configuration.

**Attention:** The TS7520 Limited Edition configuration of the virtualization was withdrawn from marketing and is no longer available for ordering.

## 4.5.1 TS7520 Enterprise Edition configuration

The TS7520 Virtualization Engine Enterprise Edition configuration consists of:

- One, two, or four TS7520 Virtualization Engines (3954-CV6)
- Up to 24 TS7520 Cache Controllers (3955-SV6)
- Up to 112 TS7520 Cache Modules (3955-SX6)
- Up to 12 IBM 3952-F05 Tape Frames
- One, two, or four copies of the TS7500 Virtualization Engine Software V3R1 Enterprise Edition (5697-P19)
- A TS7520 Management Console

The maximum capacity of a TS7520 Enterprise Edition configuration is 1768 TB configured (usable) or 2176 TBs raw.

**Attention:** To have the TS7520 Virtualization Engine work with the TS7500 Version 3 Release 1 software the memory present on the virtualization engine must be upgraded to 4 GB, which is the minimum that is requirement for the software.

### Functions and scalability

The TS7520 Enterprise Edition configuration license provides these functions. The functions tagged basic functions are available by default, while the functions tagged enhanced functions are optional functions that must be paid for:

- Tape virtualization: Tape drive, tape library, and tape virtualization (basic function)

  This functionality helps the TS7520 system portray the disk drives as tape libraries, tape drives, and cartridges. This forms the core functionality of the system.

- Exporting to and importing from physical tape (basic function)

  This functionality manages the movement of backup data from the physical tape to the virtualization engine and vice versa.

- Enhanced caching (basic function)

  This functionality automates the movement of data from the virtualization engine to the physical tape libraries based on user-defined policies.

[6] The limited edition TS7520 Virtualization Engine has been discontinued and ordering of the same is not supported.

- Hosted backup (enhanced function)

  This functionality enables the user to have the backup application run on the same hardware on which the virtualization solution is running.

- Network Data Management Protocol support (enhanced function)

  This functionality enables the virtualization solution to support backup for NAS-based solutions.

- Internet SCSI (iSCSI) protocol support (enhanced function)

  This functionality enables the TS7520 to perform data transfers over the regular IP medium like LAN or WAN.

- Tape encryption (basic function)

  This functionality enables the TS7520 to support Library-Managed Encryption offered by the latest generation of physical tape drives and libraries.

- Secure tape (enhanced function)

  With this functionality the TS7520 encrypts all the data residing inside it using the software before it is sent to the physical tape.

- Control path failover (CPF) and data path failover (DPF) (enhanced function)

  With this functionality the TS7520 can continue its operations seamlessly even if one of the connection paths to the system is lost.

- Software-based data compression (basic function)

  This functionality uses the software to compress the data while it resides on the TS7520 Virtualization Engine.

- Local replication (enhanced function)

  This functionality provides the system with capabilities to replicate data within the same system but onto a different cache controller.

- Network replication (enhanced function)

  With this functionality the system can maintain a duplicate copy of the data on a different system that may be in any geographic location.

- Network encryption (enhanced function)

  This functionality helps the TS7520 encrypt the data that is being sent over the network during network replication.

- Network compression (enhanced function)

  This functionality helps the TS7520 compress the data that is being sent over the network during network replication.

The maximum possible configuration of the single node setup includes 11 frames with 22 SV6 units and 106 SX6 units. The maximum possible configuration has a RAW capacity of 2048 TB or 2 PetaBytes. However, due to RAID and hot spares we get a final usable capacity of 1664 TB.

The maximum possible configuration of the dual-node setup is similar to that of a dual-node setup that includes 11 frames with 22 SV6 units and 106 SX6 units. The maximum possible configuration has a RAW capacity of 2048 TB or 2 PetaBytes. However, due to RAID and hot spares we get a final usable capacity of 1664 TB.

The maximum possible configuration of the four-node setup includes 12 frames with 24 SV6 units and 112 SX6 units. The maximum possible configuration has a RAW capacity of

2176 TB or 2.1 PetaBytes. However, due to RAID and hot spares we get a final usable capacity of 1768 TB.

### Connectivity

The Enterprise Edition configuration provides up to 12 Fibre Channel connections per TS7520 Virtualization Engine or node using dual-port Fibre Channel cards.

With Fibre Channel connections, initiator ports are used to attach to the TS7520 Cache Controllers or physical tape libraries. Target ports are used to attach servers on which backup applications are run. When you use only Fibre Channel connections, the Fibre Channel port assignments are:

- Ports 0 through 3: Initiator ports connected to the TS7520 Cache Controllers (slots 1 and 2)
- Port 4: Target port (slot 3)
- Port 5: Initiator port (slot 3)
- Ports 6 through 11: Alternates between target port and initiator port (slots 4–6)

Port 5 can be reconfigured as a target port and ports 6 through 11 can be configured as either target or initiator ports. You can dedicate up to four Fibre Channel ports to physical tape connection.

You can also use the quad-ported Ethernet cards in slots 3 through 6. The Fibre Channel cards can be used in any combination with the Ethernet cards. Any number of available Ethernet ports can be used for network replication.

You must order two redundant FC1906 Ethernet Switch Kits. This feature is required on the first base frame for an Enterprise Edition configuration. Each kit includes one 16-port Ethernet switch. Internal Ethernet cables connect the TS7520 Virtualization Engines in the first and second base frames to the internal Ethernet switches. Internal Ethernet cables attach the optional Fibre Channel switches in the base frame to the internal Ethernet switches. The customer’s network is attached to both Ethernet switches for console, service (RSA port), and optionally iSCSI and NDMP connections.

A high-availability TS7520 configuration, with two or four TS7520 Virtualization Engines (3954-CV6) or nodes and dual AC power on the 3952 Tape Frames, provides redundancy for nodes, disks, power, and tape/host connectivity. Increasing the number of nodes also increases the maximum supported cache for a TS7520 solution.

## 4.5.2 TS7520 Limited Edition[7] configuration

The TS7520 Virtualization Engine Limited Edition[7] configuration is a small configuration with reduced virtualization functions. After the announcement of TS7530 Virtualization Engine solution the limited edition[7] TS7520 Virtualization Engine solution was withdrawn. The limited edition[7] configuration consists of:

- One TS7520 Virtualization Engine (3954-CV6)
- One TS7520 Cache Controller (3955-SV6)
- Up to two TS7520 Cache Modules (3955-SX6)
- One copy of the TS7500 Virtualization Engine Software V2R1 Limited Edition[7] (5697-N66)
- A TS7520 Management Console

[7] The limited edition TS7520 Virtualization Engine was discontinued and ordering of the same is not supported.

The maximum capacity of a TS7520 Limited Edition[7] configuration is 19.5 TBs configured (usable) or 24 TBs raw. You cannot upgrade from a TS7520 Limited Edition[7] configuration to a TS7520 Enterprise Edition configuration.

## Functions

The TS7520 Enterprise Edition configuration license provides these functions. The functions tagged basic functions are available by default, while the functions tagged enhanced functions are optional functions that have to be paid for.

- Tape virtualization: Tape drive, tape library, and tape virtualization (basic function)

  This functionality helps the TS7520 system portray the disk drives as tape libraries, tape drives, and cartridges. This forms the core functionality of the system.

- Exporting to and importing from physical tape (basic function)

  This functionality manages the movement of backup data from the physical tape to the virtualization engine and vice versa.

- Enhanced caching (enhanced function)

  This functionality automates the movement of data from the virtualization engine to the physical tape libraries based on user-defined policies.

- Hosted backup (enhanced function)

  This functionality enables the user to have the backup application run on the same hardware on which the virtualization solution is running.

- 3494 support (enhanced function)

  This function enables the TS7520 limited edition[8] to work with the TS3494 library that is physically connected to it.

- Network Data Management Protocol support (enhanced function)

  This functionality enables the virtualization solution to support backup for NAS-based solutions.

- Internet SCSI (iSCSI) protocol support (enhanced function)

  This functionality enables the TS7520 to perform data transfers over the regular IP medium like LAN or WAN.

- Tape encryption (basic function)

  This functionality enables the TS7520 to support Library-Managed Encryption offered by the latest generation of physical tape drives and libraries.

- Secure tape (enhanced function)

  With this functionality the TS7520 encrypts all the data residing inside it using the software before it is sent to the physical tape.

- Control path failover and data path failover (DPF) (enhanced function)

  With this functionality the TS7520 can continue its operations seamlessly even if one of the connection paths to the system is lost.

- Software-based data compression (basic function)

  This functionality uses the software to compress the data while it resides on the TS7520 Virtualization Engine.

[8] The limited edition TS7520 Virtualization Engine was discontinued and ordering of the same is not supported.

- Network replication (enhanced function)

  With this functionality the system can maintain a duplicate copy of the data on a different system that may be in any geographic location.
- Network encryption (enhanced function)

  This functionality helps the TS7520 encrypt the data that is being sent over the network during network replication.
- Network compression (enhanced function)

  This functionality helps the TS7520 compress the data that is being sent over the network during network replication.

### Connectivity

The limited edition[8] configuration provides up to 12 Fibre Channel connections. Initiator ports are used to attach to the TS7520 Cache Controller or physical tape libraries. Target ports are used to attach servers on which backup applications are run. The Fibre Channel port assignments are:

- Ports 0 and 1: Initiator ports connected to the TS7520 Cache Controller (slot 1)
- Port 2: Target port (slot 2)
- Port 3: Initiator port (slot 2)
- Ports 4 through 11 target ports (slots 3–6)

Ports 4 through 11 can be reconfigured as initiator ports.

You can also use the quad-ported Ethernet cards in slots 3 through 6. The Fibre Channel cards can be used in any combination with the Ethernet cards. Any number of available Ethernet ports can be used for network replication.

The TS7520 Limited Edition[9] configuration has only one TS7520 Virtualization Engine (3954-CV6) and one TS7520 Cache Controller (3955-SV6). Both Cache Controller Fibre Channel connections are attached to the same dual-ported card in the virtualization engine. The TS7520 Limited Edition[9] configuration is not recommended for environments requiring high availability.

You can order one or two FC1906 Ethernet Switch Kits. Each kit includes one 16-port Ethernet switch. This feature is optional, but at least one is recommended for a limited edition[9] configuration. Internal Ethernet cables connect the TS7520 Virtualization Engine in the base frame to the internal Ethernet switch. The customer's network is attached to the Ethernet switches for console, service (RSA port), and optionally iSCSI and NDMP connections.

## 4.6 TS7500 Virtualization Engine software compatibility

The TS7500 Virtualization Engine software is compatible with a variety of systems and platforms to ensure ease of use. This helps organizations move towards backup infrastructure consolidation. There are many aspects related to the compatibility of the software running on the virtualization engine nodes, such as:

- Compatibility with host systems
- Virtualization support for the libraries
- Compatibility with physical libraries
- Compatibility with backup applications
- Compatibility of console software with console operating system

## 4.6.1 Supported host systems

The TS7500 Virtualization Engine attaches to the following platforms and host operating systems:

- IBM System p
  - AIX 5L Version 5.1
  - AIX 5L Version 5.2
  - AIX 5L Version 5.3
  - AIX 6L Version 6.1[9]
- IBM System i
  - Version 5 Release 3 of i5/OS[9]
  - Version 5 Release 4 of i5/OS[9]
- Sun SPARC-based servers
  - Sun Solaris 8
  - Sun Solaris 9
  - Sun Solaris 10
- Microsoft Windows + x86 platform-based servers
  - Microsoft Windows 2003 (build 3790 or greater)
  - Microsoft Windows 2008[9]
- Linux + x86 platform-based Servers
  - SUSE Linux Enterprise Server (SLES) 10.1
  - SUSE Linux Enterprise Server (SLES) Version 9 with SP4[9] or Version 9 with SP3[9]
  - Red Hat Enterprise Linux (RHEL) Version 4.6[10], Version 4.4[10], or Version 3.8 [10]
  - Linux Asianux 2.0
- HP PA-RISC and Itanium
  - HP-UX (64-bit) 11i Version 1
  - HP-UX (64-bit) 11i Version 2
  - HP-UX (64-bit) 11i Version 3[10]
- Linux on System z
  - System z servers with RHEL 4.5[10]
  - System z servers with SLES 9 and SP3[10]
  - System z9 with RHEL 4.5[10]
  - System z9 with SLES 9 and SP3[10]

For further information about the support and interoperabiity of various platforms and operating systems visit:

http://www.ibm.com/systems/support/storage/config/ssic/index.jsp

## 4.6.2 Supported virtual libraries

The following virtual libraries are supported with the TS7520 Virtualization Engine:

- IBM TS3500 Tape Library with TS1120 Tape Drives or IBM 3592 Model J1A Tape Drives or IBM Ultrium 2, 3, or 4 Tape Drives
- IBM TS3400 Tape Library with TS1120 Tape Drives
- IBM TS3100 Tape Library with Ultrium 3 or 4 Tape Drives
- IBM TS3200 Tape Library with Ultrium 3 or 4 Tape Drives
- IBM TS7520 Tape Library with TS1120 Tape Drives or IBM 3592 model J1A Tape Drives or IBM Ultrium 2, 3, or 4 Tape Drives

[9] No support when using the TS7500 Software Version 2 Release 1
[10] No support when using the TS7500 Software Version 3 Release 1

- IBM TS7510 Tape Library with IBM 3592 Model J1A or Ultrium 2 or 3 Tape Drives
- IBM TS3310 Tape Library with IBM Ultrium 3 or 4 Tape Drives
- IBM 3582 Tape Library with IBM Ultrium 2 or 3 Tape Drives
- IBM 3583 Tape Library with IBM Ultrium 2 or 3 Tape Drives

During virtual library creation you can select a virtual library type of TS7530, TS7520, or TS7510. These options emulate IBM TS3500 library models appropriate for the virtual tape drive technology selected. TS7530, TS7520, or TS7510 are only used if your backup application vendor requires them. Check with your backup application vendor about the specific changes required to support virtual tape solutions.

### 4.6.3 Supported physical libraries

The following physical libraries can be used with a TS7520 Virtualization Engine:

- IBM TS3500 Tape Library with TS1120 Tape Drives or IBM 3592 model J1A Tape Drives or IBM Ultrium 2, 3, or 4 Tape Drives
- IBM TS3400 Tape Library with TS1120 Tape Drives
- IBM TS3100 Tape Library with Ultrium 3 or 4 Tape Drives
- IBM TS3200 Tape Library with Ultrium 3 or 4 Tape Drives
- IBM TS3310 Tape Library with IBM Ultrium 3 or 4 Tape Drives
- IBM 3582 Tape Library with IBM Ultrium 2 or 3 Tape Drives
- IBM 3583 Tape Library with IBM Ultrium 2 or 3 Tape Drives
- IBM 3494 Tape Library with TS1120 Tape Drives or IBM 3592 Model J1A Tape Drives

### 4.6.4 Backup applications

Support is planned for the following backup applications. Each backup application must complete a certification process before it is supported.

- Symantec NetBackup Version 6.0 and Version 6.5
  - Enablement on AIX
  - Enablement on Windows 32-bit and x64
  - Enablement on RHEL
  - Enablement on SLES
  - Enablement on Solaris (SPARC)
  - Enablement on HP-UX (PA-RISC
- EMC Networker Version 7.3 and Version 7.4
  - Enablement on AIX
  - Enablement on Windows 32-bit and x64
  - Enablement on RH AS 4.0 x86
  - Enablement on SuSe 10 x64 and SuSe 9 x86
  - Enablement on Solaris (SPARC)
  - Enablement on HP-UX (PA-RISC)

- CA BrightStor ARCserve Backup Version 11.5 and Version 11.1
  - Enablement on AIX
  - Enablement on Windows
  - Enablement on Red Hat
  - Enablement on Solaris
  - Enablement on NetWare 11.1
  - Enablement on HP-UX
- HP Data Protector Version 5.x and Version 6.0
  - Enablement on HP-UX
  - Enablement on Windows 2003
  - Enablement on Solaris
- Tivoli
  - Enablement on AIX
  - Enablement on Windows
  - Enablement on Solaris
  - Enablement on Linux
  - Enablement on HP-UX
- CommVault Galaxy Version 5.9 and Version 6.1
  - Enablement on AIX 5.1, 5.2, 5.3
  - Enablement on HP-UX 11, 11.i
  - Enablement on RHEL 3 and 4
  - Enablement on SuSe 9 and 10
  - Enablement on NetWare 6.5
  - Enablement on Tru64 5.1, 5.2
  - Enablement on Windows 2000, 2003 (32/64)
  - Enablement on Solaris 7, 8, and 9 (32/64 on Intel)

To determine the status of TS7520 Virtualization Engine support for a backup application and for any pertinent configuration information, always check the support matrix at:

http://www-01.ibm.com/systems/support/storage/config/ssic/index.jsp

### 4.6.5 Operating system support for console software

The TS7500 Console software requires one of the following platforms for installation:

- Windows 2000 with Service Pack 4 (SP4)
- Windows 2000 Server SP4
- Windows 2000 Advanced Server SP4
- Windows 2000 Datacenter Server SP4
- Windows 2003 Server Enterprise Edition
- Windows 2003 Datacenter Edition
- Windows XP SP2
- Windows Vista

## 4.7 TS7520 Virtualization Engine feature configuration options

The following sections provide information about TS7520 Virtualization Engine features, options, prerequisites and co-requisites.

## 4.7.1 TS7520 Virtualization Engine server (3954-CV6)

An IBM 3952 Tape Frame Model F05 provides the frame that contains the various components of the TS7520 solution. When configuring a TS7520 solution, one or two TS7520 Virtualization Engine servers (3954-CV6) can be installed in a base unit 3952 Tape Frame using the following features:

- FC9326 (Plant Install a 3954 Model CV6): To have the factory install one 3955-CV6 into a new 3952 Tape Frame shipping from the plant. A minimum of one must be installed in the 3952 Tape Frame designated as the base unit. A corresponding FC5728 (Plant Install a 3954 Model CV6) must be ordered on the 3952 Tape Frame.
- FC9327 (Field Merge a 3954 Model CV6): To ship a second TS7520 Virtualization Engine (3954-CV6) for field installation into an installed 3952 Tape Frame designated as the base unit. A corresponding FC5729 (Field Install a 3954 Model CV6) must be ordered on the 3952 Tape Frame.

  When field installing a Model CV6, no additional storage is required. Whenever a second server is added, there need to be available LUNs for the new server to enlist. If all the originally installed capacity was enlisted to the original server, then additional storage needs to be installed when the second server is installed. So, additional storage might not be required, but might be needed. The additional storage can be Cache Modules (3955-SX6) added to the base frame if space exists in the frame, or it can be provided by adding an Expansion Frame to the configuration.

  Alternatively, you can *discharge* a LUN from one server and then *enlist* it to another. You do this by using the Console. On the left side, first select **Physical Resources** → **Storage Devices** → **Fibre Channel Devices**, right-click and choose **discharge**. Enlisting works similarly.

The following features preload the TS7520 V2R1 software on the TS7520 Virtualization Engine. One must be ordered.

- FC9302 (Enterprise Edition VE Preload - AAS): To have the factory install the 5697-N65 program
- FC9303 (Limited Edition[11] VE Preload - AAS): To have the factory install the 5697-N66 program

The following optional features are available on the TS7520 Virtualization Engine:

- FC1682 (Path Failover): Enables automatic control and data path failover to a pre-configured redundant path without aborting the current job in progress.
- FC7420 (Failover/Failback): Enables hardware connections between two installed TS7520 Virtualization Engines in the same 3952 Tape Frame. This feature must be ordered on each 3954-CV6 in a two or four-node configuration.

  Both 3954-CV6s in the failover pair must have the same installed features from Table 4-3.

*Table 4-3 Identical features required on both TS7520s in a failover pair*

| Feature name | Feature code |
|---|---|
| Path Failover | 1682 |
| Network Replication | 7421 |
| Network Encryption | 7422 |
| Network Compression | 7423 |

[11] The limited edition TS7520 Virtualization Engine was discontinued and ordering of the same is not supported.

| Feature name | Feature code |
|---|---|
| Hosted Backup | 7425 |
| NDMP | 7426 |
| Secure Tape | 7427 |
| iSCSI Enable | 7428 |
| Local Replication | 7429 |

- FC7421 (Network Replication): Enables the TS7520 solution to support the Network Replication function in the TS7500 V2R1 Software.
- FC7422 (Network Encryption): Enables the TS7520 solution to support the Network Encryption function in the TS7500 V2R1 Software. Both the local and target TS7520 Virtualization Engine servers must have features 7421 and 7422 enabled for Network Encryption to operate.
- FC7423 (Network Compression): Enables the TS7520 solution to support the Network Compression function in the TS7500 V2R1 Software. Both the local and target TS7520 Virtualization Engine servers must have features 7421 and 7423 enabled for Network Compression to operate.
- FC7424 (3494 Support): Enables attachment of a physical 3494 library to a TS7520 Limited Edition[12] configuration. This function is included in a TS7520 Enterprise Edition configuration.
- FC7425 (Hosted Backup): Enables backup applications to be installed on the TS7520 solution eliminating the need for a dedicated backup server. A list of compatible software is available from your IBM representative or at:

  http://www.ibm.com/systems/storage/tape/library.html

  Note that Hosted Backup applications will not be failed over in an HA environment.
- FC7426 (NDMP): Enables backup applications and NAS devices to perform backup and restore using the NDMP version 4 protocol over an IP network. This feature requires FC7425 (Hosted Backup). Note that NDMP applications will not be failed over in an HA environment.
- FC7427 (Secure Tape): Enables encryption with one or more keys for data exported to physical tape and decryption when it is imported back to virtual tapes.
- FC7428 (iSCSI): Enables SCSI commands to be used over an IP network and allows hosts to connect via Ethernet instead of requiring Fibre Channel.
- FC7429 (Local Replication): Enables making a copy of a complete virtual volume in the same TS7520 server. This acts the same as network replication except the target and source servers are the same.
- FC7430 (Enhanced Tape Caching): Enhances the functionality of the TS7520 solution by acting as a cache to a physical tape library, providing transparent access to data regardless of its location. This function must be ordered for the Limited Edition[11] configuration and is included in an Enterprise Edition configuration.
- FC9305 (Four-node indicator): Indicates that this CV6 will be installed in a four-node configuration, as supported by the required TS7500 V2R1 Enterprise Edition Software (5697-N65). It must be included with each TS7520 Virtualization Engine ordered on the primary base frame in a four-node system.

[12] Limited edition TS7520 Virtualization Engine has been discontinued and ordering of the same is not supported.

### 4.7.2 TS7520 Cache Controller (3955-SV6)

A minimum two TS7500 Cache Controllers must be installed on the base unit 3952 Tape Frame with the following features:

- FC9328 (Plant Install a 3955 Model SV6): Directs the factory to install one TS7500 Model SV6 Cache Controller into a new 3952 Tape Frame shipping from the plant. Two TS7500 Model SV6 Cache Controllers must be installed in the 3952 Tape designated as a base unit (FC7317, FC7320). Two corresponding feature numbers 5738 (Plant Install a 3955 Model SV6) must be ordered on the 3952 Tape Frame, one for each TS7500 Model SV6 Cache Controller.
- FC9329 (Field Install a 3955 Model SV6): To add an additional TS7500 Model SV6 Cache Controller into a 3952 Tape Frame installed in the field. Two corresponding feature numbers 5739 (Field Install a 3955 Model SV6) must be ordered on the 3952 Tape Frame, one for each TS7500 Model SV6 Cache Controller.

The following features provide disk cache storage for the TS7500 Cache Controller:

- FC7111 (8 TB SATA Storage): Provides 8 TB of unformatted storage capacity using 16 numbers of 500 GB 7200 rpm SATA drives
- FC7112 (12 TB SATA Storage): Provides 12 TB of unformatted storage capacity using 16 numbers of 750 GB 7200 rpm SATA drives
- FC7113 (16 TB SATA Storage): Provides 16 TB of unformatted storage capacity using 16 numbers of 1000 GB 7200 rpm SATA drives

Each base frame for the TS7520 solution has to contain two cache controllers, while the expansion module can contain up to two cache controllers. Thus, there can be a maximum of 24 cache controllers in a TS7520 solution—four in the base frames (two in each base frame) and up to 20 in the expansion modules (up to 10 expansion modules). In the base frame each cache controller can be attached to three cache modules, while in the expansion frame each cache controller attaches to five cache modules to provide capacity.

### 4.7.3 TS7520 Cache Module (3955-SX6)

IBM 3952 Tape Frame Model F05 provides the frame that contains the various components of the TS7500 solution. Up to six TS7500 Cache Modules (3955-SX6) can be installed in a base unit 3952 Tape Frame (three per 3955-SV6 installed). Up to 10 additional TS7500 Cache Modules can be installed in an expansion unit 3952 Tape Frame (up to five per 3955-SV6 installed) to provide additional cache storage capacity.

The TS7500 Cache Modules are added by ordering the following features:

- FC9330 (Plant Install a 3955 Model SX6)

  To have the factory install the TS7500 Cache Module into a new 3952 Tape Frame (either base unit or expansion unit) shipping from the plant one corresponding FC5748 (Plant Install a 3955 Model SX6) must be ordered on the 3952 Tape Frame for each TS7500 Cache Module being installed by the plant. Two TS7500 Cache Controllers must be installed prior to TS7500 Cache Modules being installed in an expansion unit.
- FC9331 (Field Merge a 3955 Model SX6)

  To ship a TS7500 Cache Module for field installation into an installed 3952 Tape Frame (either base unit or expansion unit) a corresponding FC5749 (Field Install a 3955 Model SX6) must be ordered on the 3952 Tape Frame.

The following features provide disk cache storage for the TS7500 Cache Module:

- FC7111 (8 TB SATA Storage): Provides 8 TB of unformatted storage capacity using 16 numbers of 500 GB 7200 rpm SATA drives
- FC7112 (12TB SATA Storage): Provides 12 TB of unformatted storage capacity using 16 numbers of 750 GB 7200 rpm SATA drives
- FC7113 (16TB SATA Storage): Provides 16 TB of unformatted storage capacity using 16 numbers of 1000 GB 7200 rpm SATA drives

Up to six TS7500 Model SX6 Cache Modules can be installed on the base unit 3952 Tape Frame (three per 3955 Model SV6 installed). Up to 10 additional TS7500 Model SX6 Cache Modules can be installed in an expansion unit 3952 Tape Frame to provide additional cache storage capacity (five per 3955 Model SV6 installed).

## 4.7.4 IBM 3952 Tape Frame Model F05 (3952-F05)

The IBM 3952 Tape Frame Model F05 provides the frame that contains the various components of the TS7520 solution. The TS7520 solution can consist of one to twelve 3952 Tape Frames that are specified with the following features:

- FC1903 (Dual AC Power)

  This feature provides one additional Power Distribution Unit to allow connection to independent branch power circuits. If this feature is ordered, two power cords are provided.

- FC1906 (Ethernet Switch Kit)

  Includes one 16-port Ethernet switch. Recommended for each 3954-CV6 (up to a maximum of 2). This feature also includes Ethernet cables to connect the TS7520 Virtualization Engines (3954-CV6) in the base frame to the integrated switch, and to connect the Ethernet switch to the Fibre Channel switches in the base frame. Required for FC7317 (TS75200 Series Base Unit) and is optional for FC7319 (TS7520 Series Limited Edition[13] Base Unit).

- FC1907 (Fibre Channel Switch Kit)

  Includes two 32-port Fibre Channel switches with 16 ports enabled per switch. This feature is only valid for 3952-F05 in a TS7520 configuration with FC7317 (TS75200 Series Base Unit). This feature is required when FC7320 (TS7520 Series Secondary Base Unit) or FC7318 (TS7500 Series Expansion Unit) is ordered for the first time in a system configuration. Features 1903 (Dual AC Power) and 1906 (Ethernet Switch Kit) are required.

- FC1908 (Eight Port Switch Expansion)

  Enables an additional eight ports for each of the Fibre Channel switches added with FC1907 (Fibre Channel Switch Kit). Up to two FC1908 are allowed to enable the complete 32 ports. These features are required for large configurations including more than three expansion frames (for the first) and seven expansion frames (for the second).

- FC7317 (TS75200 Series Base Unit)

  Identifies this frame as the base unit frame which contains one or two TS7520 Virtualization Engine servers, two TS7520 Cache Controllers, and up to six TS7520 Cache Modules.

[13] The limited edition TS7520 Virtualization Engine was discontinued and ordering of the same is not supported.

- FC7318 (TS7500 Series Expansion Unit)

  Identifies this frame as the expansion unit frame which contains up to two TS7520 Cache Controllers, and up to ten additional TS7520 Cache Modules.

- FC7319 (TS7520 Series Limited Edition[13] Base Unit)

  Identifies this frame as a Limited Edition[13] base unit frame which contains one TS7520 Virtualization Engine server, one TS7520 Cache Controller, and up to two TS7520 Cache Modules.

- FC7320 (TS7520 Series Secondary Base Unit)

  Identifies this frame as the secondary base unit frame which contains two TS7520 Virtualization Engine servers, two TS7520 Cache Controllers, and up to six TS7520 Cache Modules.

One or two TS7520 Virtualization Engines (3954-CV6) can be installed in the base unit frame with the following features:

- FC5728 (Plant Install a 3954 Model CV6)

  To have the factory install one TS7520 Virtualization Engine (3954-CV6) into a new 3952 Tape Frame shipping from the plant. A minimum of one must be installed in the 3952 Tape Frame designated as the base unit (FC7317 - TS75200 Series Base Unit). A corresponding FC9326 (Plant Install a 3954 Model CV6) must be ordered on the TS7520 Virtualization Engine (3954-CV6).

- FC5729 (Field Install a 3954 Model CV6)

  To ship a second TS7520 Virtualization Engine for field installation into an installed 3952 Tape Frame designated as the base unit (#7317 - TS75200 Series Base Unit). A corresponding FC9327 (Field Merge a 3954 Model CV6) must be ordered on the TS7520 Virtualization Engine (3954-CV6).

Two TS7520 Cache Controllers must be installed in the base unit frame with the following feature:

- FC5738 (Plant Install a 3955 Model SV6)

  To have the factory install one TS7520 Cache Controller (3955-SV6) into a new 3952 Tape Frame shipping from the plant. Two of these features must be installed in the 3952 Tape Frame designated as the base unit (FC7317 - TS75200 Series Base Unit). A corresponding FC9322 (Plant Install a 3955 Model SV6) must be ordered on the TS7520 Cache Controller (3955-SV6).

- FC5739 (Field Install a 3955 Model SV6)

  To ship an additional TS7520 Cache Controller into a new 3952 Tape Frame installed in the field. Two of these features must be installed in the 3952 Tape Frame designated as the base unit (FC7317 - TS75200 Series Base Unit). A corresponding FC9329 (Field Install a 3955 Model SV6) must be ordered on the TS7520 Cache Controller (3955-SV6).

The TS7520 Cache Module provides additional disk cache storage and is installed in the 3952 Tape Frame with the following feature:

- FC5748 (Plant Install a 3955 Model SX6)

  To have the factory install one TS7520 Cache Module into a new 3952 Tape Frame shipping from the plant.

- FC5749 (Field Install a 3955 Model SX6)

  To ship an additional TS7520 Cache Module (3955-SX6) for field installation into an installed 3952 Tape Frame. A maximum of six of these features can be installed in the 3952 Tape Frame designated as a base unit or two in a limited edition[14] base unit. An additional ten features can be installed in the 3952 Tape Frame designated as the expansion unit.

The appropriate power cord must be specified. The Dual AC Power feature (FC1903) must be ordered if connection to two independent branch power circuits is required. If this feature is ordered, two power cords are provided. This feature is optional for Limited Edition[14] configurations.

The available power cord feature are:

- FC9954 (NEMA L6-30 Power Cord)

  This feature provides a NEMA L6-30 non-watertight 4.3 meter (14 foot) power cord, 200-208, 240 Vac, 24 Amps, used in U.S., Canada, Latin America, and Japan.

- FC9955 (RS 3750 DP Power Cord)

  This feature provides a Russellstoll 3750DP Watertight 4.3 meter (14 foot) power cord, 200-208, 240 Vac, 24 Amps, used in U.S, Chicago, Canada, LA, and Japan.

- FC9956 (IEC 309 Power Cord)

  This feature provides a IEC 309, p+n+g, 32A, 4.3 meter (14 foot) power cord, 230 Vac, 24 Amps, used in EMEA.

- FC9957 (PDL 4.3 Power Cord)

  This feature provides a PDL 4.3 meter (14 foot) power cord, 230-240 Vac, 23 Amps, used in Australia and New Zealand.

- FC9958 (Korean 4.3m Power Cord)

  This feature provides a NEMA L6-30 non-watertight 4.3 meter (14 foot) power cord, 200-208, 240 Vac, 24 Amps, with a Korean plug, used in North and South Korea.

- FC9959 (Unterminated Power Cord)

  This feature provides an unterminated, non-watertight 4.3 meter (14 foot) power cord, 200-208, 240 Vac, 24 Amps power cord with IRAM and BSMI agency certifications. This is the recommended cord for Argentina and Taiwan.

- FC9966 (China Unterminated Power Cord)

  This feature provides an unterminated, non-watertight 4.3 meter (14 foot) power cord, 200-208, 240 Vac, 24 Amps power cord with CCC agency certification. This is the recommended power cord for China.

### 4.7.5 IBM Virtualization Engine TS7500 Software Version 2 Release 1

The software features available with the TS7520 Virtualization Engine include optional functions and capacity support. The feature code numbers are different for the Enterprise Edition (5697-N65) and the limited edition[15] (5697-N65) and also vary by geographic location and maintenance period (one or three years, original order or extension). For a list of the feature code numbers, please see Appendix C, “Feature codes” on page 507.

- Network Replication: Copies a complete virtual volume from one TS7520 Virtualization Engine to another across an IP network. At prescribed intervals, when the tape is not in use, changed data from the primary virtual tape is transmitted to the replica resource on the target TS7520 Virtualization Engine so that they are synchronized.
- Network Compression: Uses software compression on data that is transferred across an IP network during a network replication. Network Compression improves overall

[14] The limited edition TS7520 Virtualization Engine was discontinued and ordering of the same is not supported.
[15] The limited edition TS7520 Virtualization Engine was discontinued and ordering of the same is not supported.

bandwidth between two TS7520 Virtualization Engines that are replicating virtual volumes, because the data will be compressed before being sent over the IP network.

- Network Encryption: Secures data transmission over the network during replication. Initial key distribution is accomplished using the authenticated Diffie-Hellman exchange protocol. Subsequent session keys are derived from the master shared secret, making it secure.
- Failover/Failback: Supports high availability for TS7520 solution operations, and can reduce the down time that can occur, if a TS7520 Virtualization Engine fails.
- Secure Tape: Uses the Advanced Encryption Standard (AES) algorithm published by the National Institute of Standards and Technology, an agency of the U.S. government. With this option, you can create one or more keys that can be used to encrypt the data when it is exported to physical tape and decrypt when it is read or appended by the TS7520.
- Local Replication: Copies a complete virtual volume in the same TS7500 Virtualization Engine. Local replication is the same as network replication, except the target and source servers are the same.
- NDMP: Enables backup applications and NAS devices to perform backup and restore using the NDMP V4 protocol over an IP network. The TS7500 solution acts as an NDMP server, centralizing management while eliminating locally attached tape devices from each NAS device. When a backup occurs, data is moved from an NAS device directly to the virtual library. NDMP requires Hosted Backup.
- iSCSI: Enables SCSI commands to be used over an IP network and hosts to connect via Ethernet instead of Fibre Channel.
- Hosted Backup: Makes virtual tape libraries and drives available to local systems by allowing backup applications to be installed directly onto the TS7500 Virtualization Engine, eliminating the need for a dedicated backup server.
- Path Failover: Enables automatic control and data path failover to a pre-configured redundant path without aborting the current job in progress. It also provides failover for multiple redundant paths in a SAN environment by automatically providing error recovery to retry the current operation using an alternate, preconfigured paths without aborting the current job in progress.
- Console and Capacity Support: Management console and capacity support is offered on a tiered, per TB basis for customers ordering the Enterprise Edition. It includes the IBM Virtualization Engine TS7520 Management Console program as well as entitlement to use the available disk capacity.

  Approximately 6.5 TB of management console and capacity support are required for every TS7520 Cache Controller and TS7520 Cache Module allocated to the TS7520 Virtualization Engine applicable to each 5697-N65 or 5697-N66 license.

### 4.7.6 IBM Virtualization Engine TS7500 Software Version 3 Release 1

IBM Virtualization Engine TS7500 Enterprise Edition V3.1 software supports additional hardware compression as an option in the IBM Virtualization Engine TS7520 Server (3954 Model CV7). Additionally, support is added for extended online storage capacity via IBM 3955 Model SV6 and SX6 1 TB disk drives in either RAID 5 or RAID 6 format.

All prior functions supported by Enterprise Addition V2.1 are also supported in V3.1, with the exception of support for the execution of functions on IBM TS7510 hardware components.

The following functions are supported in the TS7500 Virtualization Engine solution with IBM Virtualization Engine TS7500 Enterprise Edition V3.1 software:

- Network replication: Copies a complete virtual volume from one TS7500 Virtualization Engine to another across an IP network. At prescribed intervals, when the tape is not in use, changed data from the primary virtual tape is transmitted to the replica resource on the target Model CV7 Virtualization Engine so that they are synchronized. The target Model CV7 Virtualization Engine is usually located at a remote location. Under normal operation, backup clients do not have access to the replica resource on the target server. If a disaster occurs and the replica is needed, the administrator can promote the replica to become the primary virtual tape so that clients can access it.
- Network compression: Uses software compression on data that is transferred across an IP network during a network replication. Network compression improves overall bandwidth between two TS7500 Virtualization Engines that are replicating virtual volumes because the data will be compressed before being sent over the IP network.
- Network encryption: Secures data transmission over the network during replication. Initial key distribution is accomplished using the authenticated Diffie-Hellman exchange protocol. Subsequent session keys are derived from the master shared secret, making it very secure.
- Failover and failback: Failover supports high availability for TS7500 solution operations and can help eliminate the down time that can occur should a TS7500 Virtualization Engine fail. In the TS7500 solution failover design a TS7500 Virtualization Engine is configured to monitor another TS7500 Virtualization Engine. In the event that the virtualization engine being monitored fails to fulfill its responsibilities to the SAN clients it is serving, the monitoring TS7500 Virtualization Engine takes over its identity. When this happens, the worldwide node names and IP addresses associated with the failed TS7500 Virtualization Engine are transferred to the surviving TS7500 Virtualization Engine. The failback occurs when the system has recovered.
- Secure tape: Implements the Advanced Encryption Standard (AES) algorithm published by the National Institute of Standards and Technology, an agency of the United States government. With this option, you can create one or more keys that can be used to encrypt the data when it is exported to physical tape and decrypt when it is imported back to virtual tapes. Encryption helps make the data on the tape unreadable, unless the appropriate key is used.
- Local replication: Copies a complete virtual volume in the same TS7500 Virtualization Engine. Local replication is the same as network replication, except that the target and source servers are the same.
- NDMP backup: Enables backup applications and NAS devices to perform backup and restore using the Network Data Management Protocol V4 protocol over an IP network. The TS7500 solution acts as an NDMP server, centralizing management while reducing or eliminating locally attached tape devices from each NAS device. When a backup occurs, data is moved from an NAS device directly to the virtual library. Note that NDMP backup is mutually exclusive with failover/failback.
- iSCSI: Enables SCSI commands to be used over an IP network and hosts to connect via the Ethernet instead of Fibre Channel.
- Hosted backup: Makes virtual tape libraries and drives available to local systems by allowing backup applications to be installed directly onto the TS7500 Virtualization Engine, reducing or eliminating the need for a dedicated backup server. Note that hosted backup is mutually exclusive with failover/failback.
- Control path failover and data path failover: Enables automatic control path failover to a preconfigured redundant path without aborting the current job in progress. It also provides failover for multiple redundant paths in a SAN environment by automatically providing error

recovery to retry the current operation using alternate, preconfigured paths without aborting the current job in progress. This can provide flexibility in SAN configuration, availability, and management.

- Console and capacity support: Management console and capacity support is offered on a tiered, per-TB basis for customers ordering the Enterprise Edition. It includes the IBM Virtualization Engine TS7500 Management Console program, as well as entitlement to use the available disk capacity. The quantity of management console and capacity support required for every TS7500 Cache Controller and TS7500 Cache Module allocated to the TS7520 Virtualization Engine is dependent on the capacity feature selected on each cache unit.

5

# Configuration and planning

This chapter provides an overview of which options and features can be configured with the older system IBM TS7520 Virtualization Engine and the new IBM TS7500 Virtualization solution including the IBM TS7530 Virtualization Engine. It provides information about which configuration options are available and useful.

We explain how you can size the virtualization engine to meet your business requirements. We also discuss some usage considerations, as well as the related sizing and configuration requirements.

We cover the following topics:

- Configuration possibilities
- Sizing considerations
- Usage considerations
- Installation planning considerations

## 5.1 Configuration options

The TS7520 and TS7500 Virtualization Engines consist of several components, which can be configured with different options to meet your requirements. In this chapter we first provide a retrospect and describe the different configuration options for the TS7520 Virtualization Engine Limited Edition and for the TS7520 Virtualization Engine Enterprise Edition. Later we show the possibilities to configure the TS7500 Virtualization Solution included the new TS7530 Virtualization server. In 5.2, "Sizing considerations" on page 145, we give you detailed information about choosing the correct options and appropriate number of those options.

### 5.1.1 TS7520 Virtualization Engine Limited Edition

The TS7520 Virtualization Engine Limited Edition is an entry system for smaller accounts. It consists of a minimum configuration of:

- One IBM 3952 Tape Frame Model F05 (3952-F05)
- One IBM TS7520 Virtualization Engine server (3954-CV6)
- One TS7520 Cache Controller (3955-SV6)
- IBM Virtualization Engine TS7500 Limited Edition Software (5697-N66)

This configuration provides 6.5 TB usable capacity.

#### IBM 3952 Tape Frame Model F05

The Tape Frame holds the IBM Virtualization Engine TS7520 Model CV6, the TS7520 Cache Controller SV6, and if ordered, up to two TS7520 Cache Module SX6.

The Tape Frame can be ordered with Dual AC Power (FC1903). The Dual AC Power feature provides one additional Power Distribution Unit and a second power cord. With the second power cord and Power Distribution Unit, and because all other components of the TS7520 Virtualization Engine are already equipped with dual power supplies, the TS7520 can be connected to two independent power sources.

The Ethernet Switches (FC1906) are a configuration option for the Tape Frame and can be used to concentrate the three Ethernet ports (two onboard ports and one RSA).

#### IBM Virtualization Engine TS7520 Model CV6

The Virtualization Engine TS7520 Model CV6 offers different hardware and software features that can be included in the configuration.

##### *Hardware features*

At least one Dual Ported 4 Gbit Fibre Channel Card (FC3450) must be ordered. These two Fibre Channel (FC) ports are used to connect to the TS7520 Cache Controller. Up to five additional dual ported Fibre Channel cards can be ordered. These additional FC Ports can be used for host or physical tape connectivity. Up to a maximum of four FC ports can be used for physical tape connections. If you want to connect your host over FC to the TS7520, then you need to order at least two features FC3450.

The TS7520 Model CV6 already provides two onboard 1 Gbit Ethernet adapters, which are used for management access, but can be also used for Network Replication and for iSCSI connection. In addition, you can order up to four Quad Ported 1 Gbit Ethernet Cards (FC3451).

Fibre Channel Card (FC3450) and Ethernet Card (FC3451) can be intermixed in the TS7520, but not more than six cards can be installed in total.

To obtain higher performance for Backup Compression, you can order up to three additional Intel Xeon® Processor (FC3452) and up to seven 2 GB Memory Upgrade features (FC3460).

### *Software features*

The Limited Edition comes with the standard software function, which allows you to create:

- Up to 128 virtual libraries
- Up to 1024 virtual tape drives
- Up to 64,000 virtual cartridges

All other additional functions must be ordered separately:

- Path Failover (FC1682)
- Network Replication (FC7421)
- Network Encryption (FC7422)
- Network Compression (FC7423)
- 3494 Support (FC7424)
- Hosted Backup (FC7425)
- NDMP (FC7426)
- Secure Tape (FC7427)
- iSCSI Enable (FC7428)
- Enhanced Tape Caching (FC7430)

The feature codes listed in parentheses are the hardware feature codes on the 3954-CV6. The corresponding software feature codes are different depending on the geography where the TS7520 is ordered. Refer to Appendix C, “Feature codes” on page 507 for more details.

If you use Enhanced Tape Caching, then you must order additional FC Cards (FC3450) to support connections to physical tape libraries. The Feature NDMP (FC7426) is only needed if you want to use NDMP over Ethernet/IP. If you use NDMP over FC, this feature is not needed.

## TS7520 Cache Controller SV6

One TS7520 Cache Controller SV6 is required on a TS7520 Virtualization Engine and is ordered as 3955-SV6. The TS7520 Cache Controller provides 6.5 TB usable capacity.

## TS7520 Cache Module SX6

Up to two TS7520 Cache Module SX6s, each with 6.5 TB usable capacity, can be added to the TS7520 Limited Edition. The TS7520 Cache Module is ordered as 3955-SX6.

## TS7520 Virtualization Engine Limited Edition minimum configuration

The minimum configuration provides 6.5 TB usable capacity and two Ethernet connections which can be used as iSCSI connections. Figure 5-1 shows the minimum configuration.

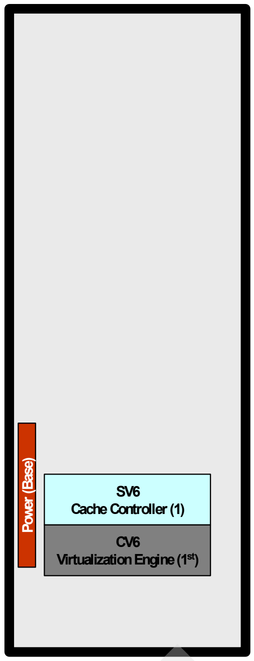



*Figure 5-1 TS7520 Virtualization Engine Limited Edition minimum configuration*

## TS7520 Virtualization Engine Limited Edition maximum configuration

The maximum configuration provides 19.5 TB usable capacity, and 10 FC, or 22 Ethernet connections, or a combination of both. Figure 5-2 shows the maximum configuration.

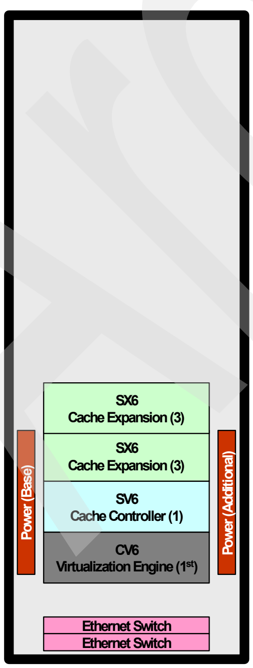



*Figure 5-2 TS7520 Virtualization Engine Limited Edition maximum configuration*

## 5.1.2 TS7520 Virtualization Engine Enterprise Edition

The TS7520 Virtualization Engine Enterprise Edition is a scalable system that meets the requirements from smaller to larger accounts. It has a minimum configuration of at least:

- One IBM 3592 Tape Frame Model F05
- One IBM Virtualization Engine TS7520 Model CV6
- Two TS7520 Cache Controllers
- IBM Virtualization Engine TS7500 Enterprise Edition Software (5697-N65)

This configuration provides 13 TB of usable capacity.

The TS7520 Server supports TS7500 Enterprise Edition V3.1 software after a firmware upgrade. See Chapter 13, “Upgrade and migration considerations” on page 435, for more details.

### IBM 3592 Tape Frame Model F05

The Tape Frame can hold one or two IBM Virtualization Engines TS7520 Model CV6, two TS7520 Cache Controllers and up to six TS7520 Cache Module SX6.

The Tape Frame must be ordered with Dual AC Power (FC1903). The Dual AC Power feature provides one additional Power Distribution Unit and a second power cord if connecting an additional base frame or an expansion frame. With the second power cord and Power Distribution Unit, the TS7520 can be connected to two independent power sources. This applies to all frames in an Extended Edition configuration: Base (FC7317), Secondary Base (FC7320), and Expansion (FC7318).

Because all components of the IBM TS7520 Virtualization Engine are already equipped with dual power supplies, it makes sense to order all Tape Frames with Dual Power feature. As a result, all TS7520 frames have a highly redundant power system.

#### *IBM 3592 Tape Frame Model F05 as Base Frame*

The Base Frame hosts one or two IBM Virtualization Engines TS7520 Model CV6, two TS7520 Cache Controllers, and up to six TS7520 Cache Module SX6. In a four-node configuration, two Base Frames are required.

The first Base Frame must be ordered with Dual AC Power (FC1903), two Ethernet Switches (FC1906), and one Fibre Channel Switch Kit (FC1907). This Fibre Channel Switch Kit provides two Fibre Channel Switches for the connection from TS7520 Model CV6 to the TS7520 Cache Controller. The Fibre Channel switches are only for internal connection and cannot be used for host or physical tape connection.

The Ethernet Switches are used to interconnect the TS7520 Model CV6 to the Fibre Channel switches and to other TS7520 Model CV6 in dual or four-node configurations.

#### *IBM 3952 Tape Frame Model F05 as Expansion Frame*

The Expansion Frame can host two TS7520 Cache Controllers and up to 10 TS7520 Cache Modules. Up to 10 Expansion Frames can be configured in a TS7520 Virtualization Engine solution.

The Expansion Frame must be ordered with Dual AC Power (FC1903).

### IBM Virtualization Engine TS7520 Model CV6

The Virtualization Engine TS7520 Model CV6 offers different hardware and software features that can be included in the configuration.

### *Hardware features*

Two Dual Ported 4 Gbit Fibre Channel Cards (FC3450) must be ordered. These four ports are used to connect to both TS7520 Cache Controllers. Up to four additional dual ported Fibre Channel cards can be ordered. These additional FC Ports can be used for host or physical tape connectivity. Up to a maximum of four FC ports can be used for physical tape connections. If you want to connect your host over FC to the TS7520, then you need to order at least three features FC3450.

The TS7520 Model CV6 already provides two onboard 1 Gbit Ethernet adapters which are used for management access, but can be also used for Network Replication and for iSCSI connection. In addition, you can order up to four Quad Ported 1 Gbit Ethernet Cards (FC3451).

The Fibre Channel Card (FC3450) and Ethernet Card (FC3451) can be intermixed in the TS7520 for a total of six cards.

To obtain higher performance for backup compression you can order up to three additional Intel Xeon Processor (FC3452) and up to seven 2 GB Memory Upgrade (FC3460). One of Memory Upgrade feature is required to support 64 K virtual cartridges in a HA configuration.

### *Software features*

The standard software function allows you to create per node:

- Up to 128 virtual libraries
- Up to 1024 virtual tape drives
- Up to 64 000 virtual cartridges

The Enterprise Edition base license includes:

- 3494 Support
- Enhanced Tape Caching

All other additional functions must be ordered separately:

- Path Failover (FC1682)
- Failover/Failback Enable (FC7420)
- Network Replication (FC7421)
- Network Encryption (FC7422)
- Network Compression (FC7423)
- Hosted Backup (FC7425)
- NDMP (FC7426)
- Secure Tape (FC7427)
- iSCSI Enable (FC7428)
- Local Replication (FC7429)

The feature codes listed in parentheses are the hardware feature codes on the 3954-CV6. The software feature codes are different depending on the geography where the TS7520 is ordered. Refer to Appendix C, “Feature codes” on page 507, for more details.

If you consider using Enhanced Tape Caching, then you should order additional Fibre Channel Cards (FC3450). If using backup compression, you should consider ordering additional Intel Xeon Processor (FC3452) and additional 2 GB Memory Upgrade (FC3460).

The Feature NDMP (FC7426) is only needed if you want use NDMP over Ethernet/IP. If you use NDMP over FC, then this feature is not needed.

In a dual-node or four-node configuration, the feature Failover/Failback Enable (FC7420) must be configured on all TS7520 CV6. And all TS7520 CV6 in the failover pair must have the same installed quantities of all optional features.

### TS7520 Cache Controller SV6

At least two TS7520 Cache Controller SV6 are required on a TS7520 Virtualization Engine and will be ordered as 3955-SV6. Each TS7520 Cache Controller provides 6.5 TB usable capacity, which means the two controllers provide 13 TB as a minimum cache capacity.

On each expansion frame, at least one TS7520 Cache Controller is required.

### TS7520 Cache Module SX6

Up to six TS7520 Cache Module SX6, each with 6.5 TB usable capacity, can be added to the Base Frame. In an expansion frame, up to ten TS7520 Cache Module SX6 can be configured.

The TS7520 Cache Module is ordered as 3955-SX6.

### Enterprise Edition minimum configuration

The minimum configuration provides 13 TB usable capacity and two Ethernet connections which can be used as iSCSI connections. Figure 5-3 shows the minimum configuration.

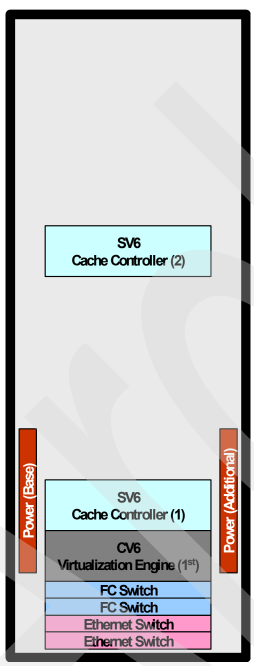



*Figure 5-3 TS7520 Virtualization Engine Enterprise Edition minimum configuration*

### Enterprise Edition single node: Base Frame maximum configuration

The maximum configuration for a single node system in a one Frame configuration provides 52 TB usable capacity and up to eight FC or 18 Ethernet connections, or a combination of FC and Ethernet connections. Figure 5-4 shows the maximum configuration.

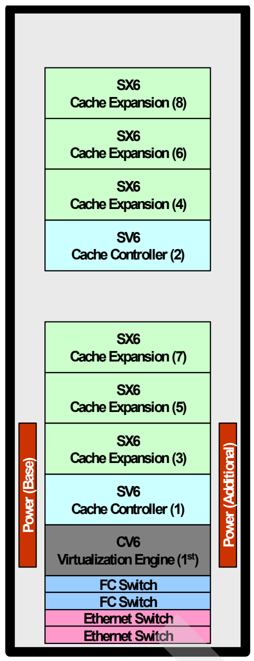



*Figure 5-4 TS7520 Enterprise Edition single Node / Base Frame maximum configuration*

## Enterprise Edition single node maximum configuration

The maximum configuration for a single Node system provides 832 TB usable capacity with one base frame and 10 expansion frames (assuming 500 GB drives). Eight FC or 18 Ethernet connection can be provided in a single node maximum configuration. Figure 5-5 shows the maximum configuration.

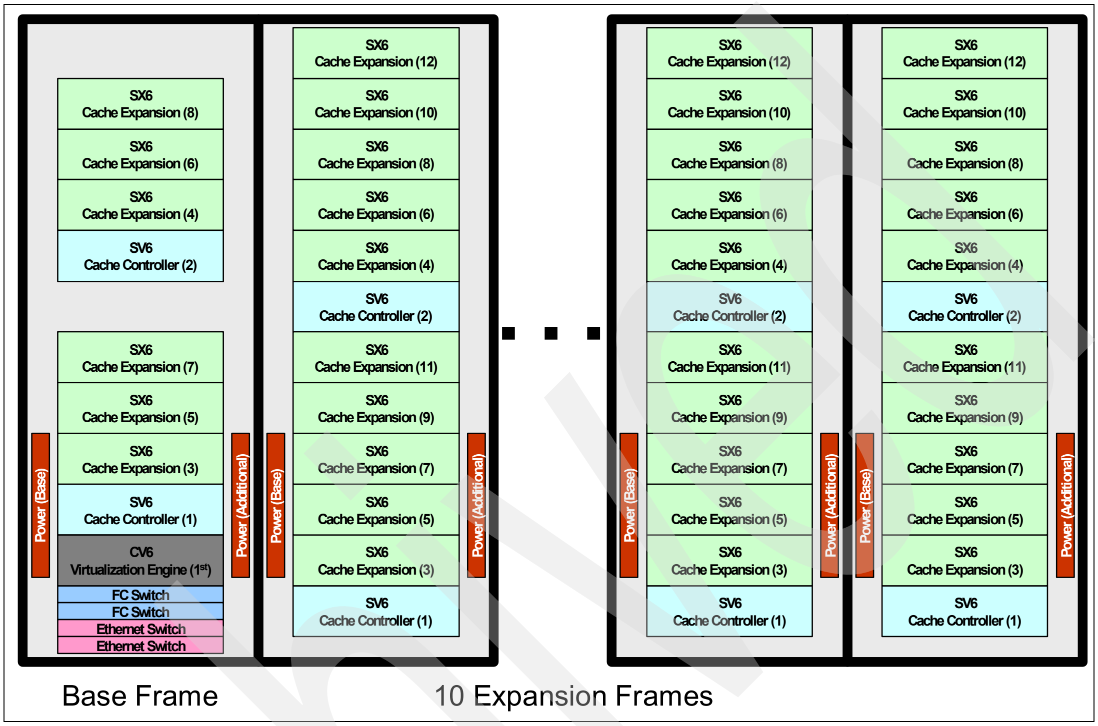



*Figure 5-5 TS7520 Enterprise Edition maximum configuration*

## Enterprise Edition dual-node configuration

The minimum configuration for dual-node system provides 13 TB usable capacity and four Ethernet connections which can be used as iSCSI connections. Figure 5-6 shows the minimum configuration.

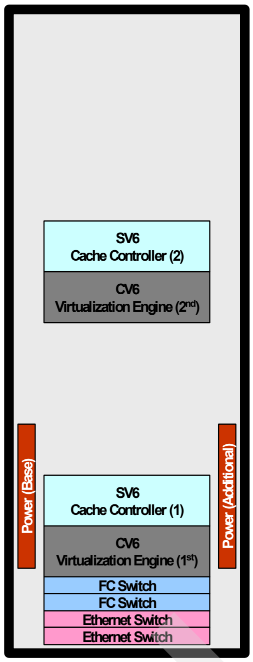



*Figure 5-6 TS7520 Virtualization Engine Enterprise Edition dual-node minimum configuration*

The maximum configuration for a dual-node system in a single base frame provides 52 TB usable capacity. With 10 expansion frames, the maximum configuration in a dual-node system provides 832 TB usable capacity (assuming 500 GB drives).

## TS7520 Virtualization Engine Enterprise Edition four-node configuration

The minimum configuration for a four-node system provides 26 TB usable capacity. Figure 5-7 shows the minimum configuration.

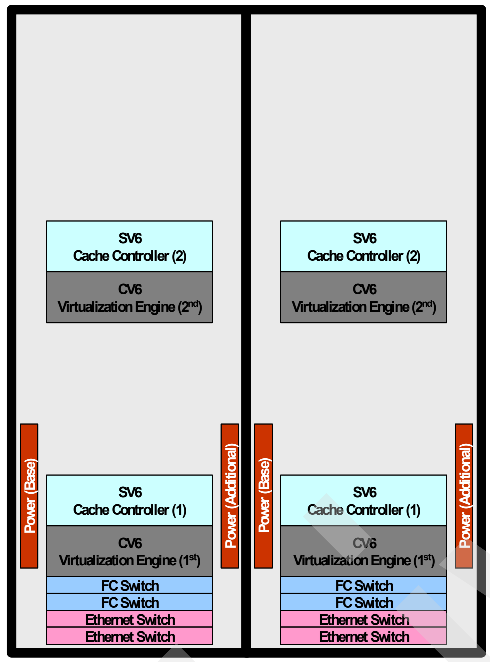



*Figure 5-7 TS7520 Virtualization Engine Enterprise Edition four-node minimum configuration*

A four-node system with two base frames provides 104 TB usable capacity. With 10 expansion frames, the maximum configuration in a four-node system provides 884 TB.

# 5.1.3 TS7530 Virtualization Engine Enterprise Edition

IBM TS7530 Virtualization Engine Server Model CV7 is the new generation processing engine of the TS7500 solution. It is a high-performance, high-capacity open system virtual tape solution for large tape environments.

The minimum TS7500 Enterprise Edition V3 configuration requires:

- One IBM 3592 Tape Frame Model F05
- One IBM Virtualization Engine TS7530 Model CV7
- Two TS7520 Cache Controllers
- IBM Virtualization Engine TS7500 Enterprise Edition V3.1 software

This configuration provides 26 TB of usable capacity with RAID 5 and 1 TB disk drive.

The T7530 Server supports TS7500 Virtualization Engine solutions running TS7500 Enterprise Edition V3.1 software only.

The TS7530 is not available as a limited edition.

## IBM 3592 Tape Frame Model F05

The tape frame can hold one or two IBM Virtualization Engine TS7530 Model CV7s, two TS7520 Cache Controllers, and up to six TS7520 Cache Module SX6s.

The Tape Frame must be ordered with Dual AC Power (FC1903). The Dual AC Power feature provides one additional Power Distribution Unit and a second power cord if connecting an additional base frame or an expansion frame. With the second power cord and Power Distribution Unit, the TS7530 can be connected to two independent power sources. This applies to all frames in an Extended edition configuration Base (FC7317), Secondary Base (FC7320), and Expansion(FC7318).

Because all components of the IBM TS7500 virtualization solution are already equipped with dual power supplies, it makes sense to order all tape frames with the dual power feature. As a result, all TS7500 frames have a highly redundant power system.

### IBM 3592 Tape Frame Model F05 as Base Frame

The Base Frame hosts one or two IBM Virtualization Engines TS7530 Model CV7, two TS7520 Cache Controllers, and up to six TS7520 Cache Module SX6. In a four-node configuration, two Base Frames are required.

The first base frame must be ordered with dual AC power (FC1903) and two Ethernet switches (FC1906). If a second base frame or an expansion frame is needed one Fibre Channel Switch Kit (FC1907) must be ordered also to install in the first frame. This kit provides two Fibre Channel switches for the connection from TS7530 Model CV7 to the TS7520 Cache Controllers.

**Note:** The Fibre Channel switches are only for internal connection and cannot be used for host or physical tape connection.

The Ethernet Switches are used to interconnect the TS7530 Model CV7 to the Fibre Channel switches and to other TS 7530 Model CV7 in dual or four-node configuration.

### IBM 3592 Tape Frame Model F05 as Expansion Frame

The Expansion Frame can host two TS7520 Cache Controllers and up to 10 TS7520 Cache Modules. Up to 10 expansion frames can be configured in a TS7500 Virtualization Engine solution. The expansion frame must be ordered with dual AC power (FC1903).

### TS7520 Cache Controller SV6

At least two TS7520 Cache Controller SV6 are required on a TS7530 Virtualization Engine and will be ordered as 3955-SV6. Each TS7520 Cache Controller provides a maximum of 13 TB usable capacity with 1TB disk and RAID5, which means the two controllers provide 26TB as a minimum cache capacity.

On each expansion frame, at least one TS7520 Cache Controller is required.

### TS7520 Cache Module SX6

Up to six TS7520 Cache Module SX6, each with a maximum of 13TB with 1TB disk and RAID5 usable capacity, can be added to the Base Frame. In an expansion frame, up to ten TS7520 Cache Module SX6 can be configured.

The TS7520 Cache Module is ordered as 3955-SX6.

### IBM Virtualization Engine TS7530 Model CV7

The Virtualization Engine TS7530 Model CV7 offers different hardware and software features that can be included in the configuration. The TS7530 Server provides the connection to the TS7530 VE Console and the customer SAN network only for connection to the client hosts and real tape libraries.

### *Hardware features*

Two Quad Ported 4 Gbit Fibre Channel Cards (FC3453) must be ordered. Two ports from each card are used to connect to both TS7520 Cache Controllers. Up to two additional dual ported Fibre Channel cards (FC3450) and up to three (included the required two cards for the Cache Controllers) quad ported 4 Gbit Fibre Channel cards (FC3453) can be ordered. These additional FC Ports can be used for host or physical tape connectivity.

In addition you can order up to two Quad Ported 1 Gbit Ethernet cards (FC3451).

To obtain higher performance you can order up to three additional AMD Opteron dual core processors with 4 GB memory (FC3454).

To obtain higher performance for backup compression you can order up to two Data compression Card (FC3455).

Every card needs a specific slot. See 3.1.2, “IBM TS7530 Virtualization Engine Controller (3955-CV7)” on page 63, for more details about slot configuration.

### *Software features*

The Enterprise Edition software V3.1 includes:

- Per node
  - Up to 128 virtual libraries
  - Up to 1,024 virtual tape drives
  - Up to 64,000 virtual cartridges
- Per failover pair
  - Up to 256 virtual libraries
  - Up to 2,048 virtual tape drives
  - Up to 128,000 virtual cartridges
- Per four-node configuration
  - Up to 512 virtual libraries
  - Up to 4,096 virtual tape drives
  - Up to 256,000 virtual cartridges
- 3494 support
- Enhanced Tape Caching
- Data shredding
- RAID6 with 1 TB disks
- Call Home for hardware errors

All other additional functions must be ordered separately:

- Path Failover (FC1682)
- Failover/Failback Enable (FC7420)
- Network Replication (FC7421)
- Network Encryption (FC7422)
- Network Compression (FC7423)
- Hosted Backup (FC7425)
- NDMP (FC7426)
- Secure Tape (FC7427)
- iSCSI Enable (FC7428)
- Local Replication (FC7429)
- Tape Duplication (available via request for price quotation (RPQ))

The feature codes listed in parentheses are the hardware feature codes on the 3854-CV7. The software features codes are different depending on the geography where the TS7530 is ordered. For more information about these feature codes refer to Appendix C, “Feature codes” on page 507.

## TS7530 Enterprise Edition minimum configuration

The minimum configuration provides 26 TB of usable capacity with RAID 5 and 1 TB disk. Figure 5-8 shows the minimum configuration.

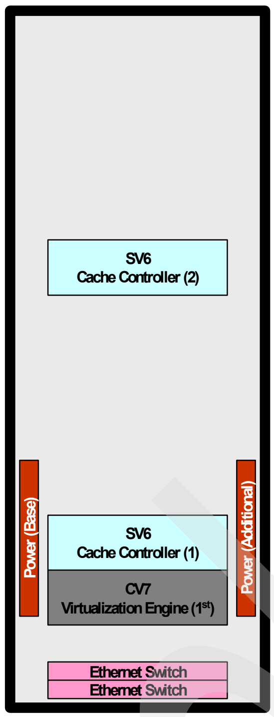



*Figure 5-8 TS7530 Virtualization Engine Enterprise Edition minimum configuration*

### TS7530 Enterprise Edition dual-node minimum configuration

The minimum configuration for a dual-node system provides 26 TB of usable capacity with RAID 5 and 1 TB disk. Two additional Fibre Channel switches are needed only if an expansion frame or a second base frame is added. Up to 24 Fibre Channel ports and up to 16 iSCSI ports are available for host server or tape attachment. Figure 5-9 shows the configuration without FC switches.

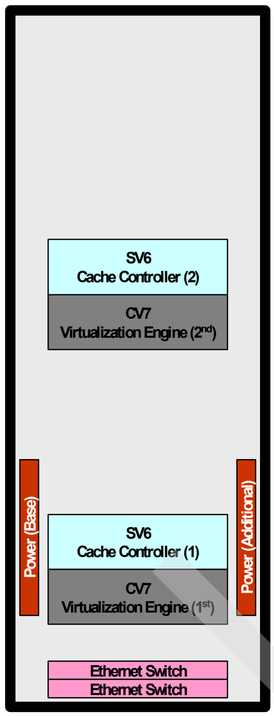



*Figure 5-9 TS7520 Virtualization Engine Enterprise Edition dual-node minimum configuration*

## Enterprise Edition four-node minimum configuration

The minimum configuration for four-node system provides 65TB usable capacity with RAID5 and 1TB disk. Additional two Fibre Channel switches are needed because a second base frame is added. Up to 48 Fibre Channel ports and up to 32 iSCSI ports available for host server or tape attachment. Figure 5-10 shows the configuration without FC switches.

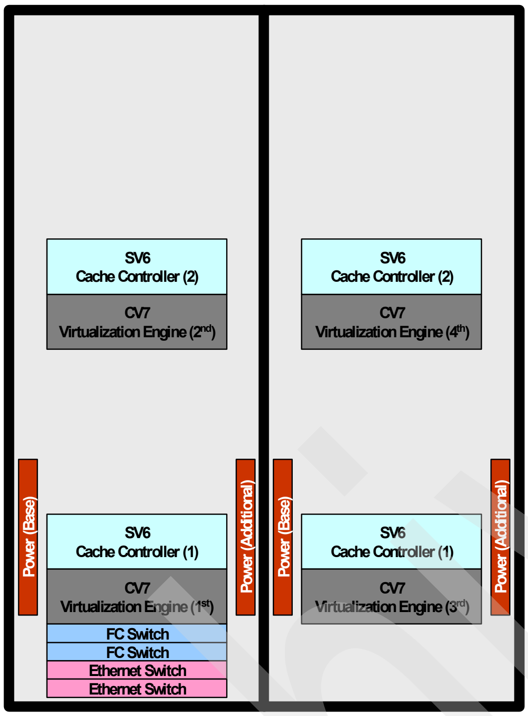



*Figure 5-10   TS7530 Virtualization Engine Enterprise Edition four-node minimum configuration*

## Enterprise Edition four-node maximum configuration

The maximum configuration provides 1768 TB with RAID5 and 1TB disk. A maximum of 10 expansion frames and two base frames host the disk cache. See Figure 5-11.

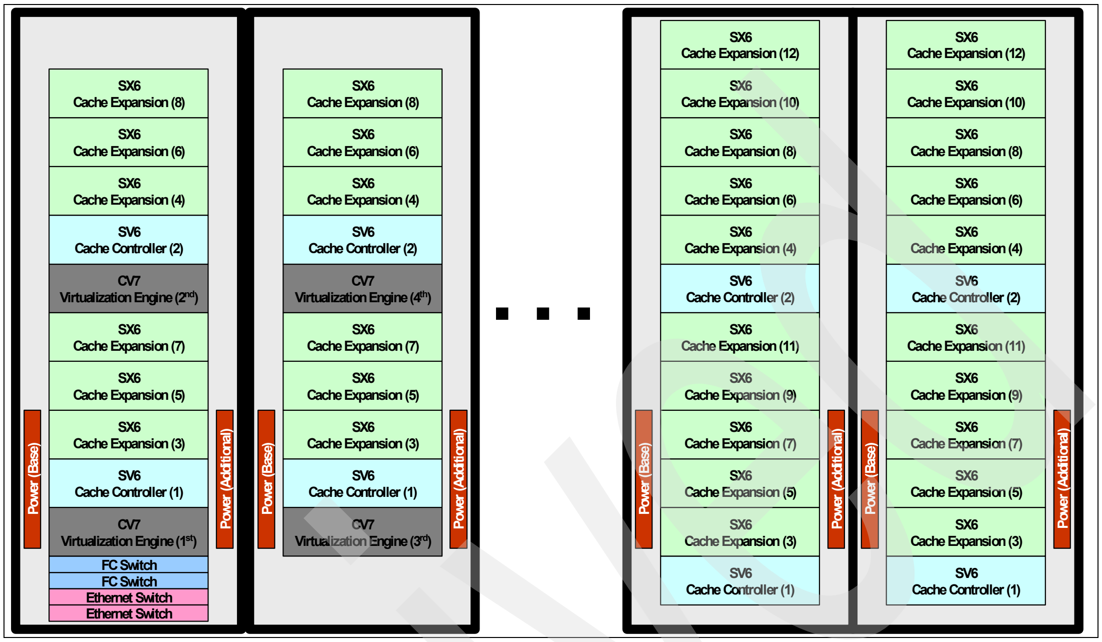



*Figure 5-11 TS7530 Virtualization Engine Enterprise Edition four-node maximum configuration*

> **Note:** The TS7530 base frame must be filled to maximum configuration (two TS7530 Virtualization Engine Servers, two TS7520 Cache Controllers, and six TS7520 Cache Modules) before you can expand the installation with an expansion unit frame.

# 5.2 Sizing considerations

Different aspects are important to consider for the sizing of your TS7500 Virtualization Engine. We cover the most important aspects in the following sections.

## 5.2.1 Volume size and number of volumes in a non-tape-caching environment

If you use Enhanced Tape Caching, then your virtual volume size is fixed by the volume size of your backend tape drive technology and therefore you should not change it.

If you do not use Enhanced Tape Caching, you can choose a different volume size. Using a smaller volume size can provide some advantages in your environment. Even though you can have as a theoretical maximum up to 64 000 virtual volumes on one server, the practical limitation in an environment with no tape caching is the disk cache capacity. You should not create more virtual volumes than you can store in the TS7500. Use the following formula to calculate the maximum number of virtual volumes:

```
(Total usable capacity the TS7500) / (Defined virtual volume capacity)
= Maximum number of virtual volumes
```

With a smaller volume size you can have more volumes in disk cache, which means that you can run more parallel jobs. The number of concurrent jobs is not only related to the number of virtual tape drives, it is also related to the number of virtual volumes which can be stored concurrently in the disk cache, because every virtual tape drives needs, of course, one virtual volume.

For instance, if you have a TS7500 with 26 TB of usable disk capacity and choose a virtual volume size of 500 GB (which is the nominal cartridge capacity for a TS1120 Tape Drive), then you can have just 52 volumes (26 TB/0.5 TB) in your disk cache. Therefore, you can run just 52 jobs in parallel. But if you choose a volume size of only 50 GB, then you can have up to 520 volumes in your disk cache.

Another reason for using a smaller volume size is that for one volume you can have just one access and in most cases you cannot migrate or stage data from a cartridge which is not full. If using a smaller volume size, then the time it is occupied is shorter, and, therefore, it can be migrated faster from the backup server to physical tape.

Conversely, if using a smaller volume size, you might end up with more virtual volumes and, therefore, your virtual library needs mores slots. Some backup software licenses the number of slots in a library. Depending on the license for your library, you might be limited in the number of slots that can be used. You need to calculate depending on the volume size. For instance, if you want to use 26 TB disk capacity, but you just have a license for a 128-slot library, then the volume size cannot be smaller than:

```
26TB / 128 Slot ~ 203 GB
```

However, your chosen volume size should fit your backup and restore requirements. For large datasets, you might need to choose a bigger volume size, and therefore you might need to adjust your disk capacity, as we discuss next.

## 5.2.2 Disk cache capacity

The optimum disk cache capacity is determined by a number of factors. We describe the most important factors in the following sections.

### General considerations

As a general rule of thumb, you should keep at least one daily backup that goes to TS7500 in the disk cache. One reason for this is that you can separate backup and migrating to backend tape or migrating over the backup server, because there might be performance impacts if backup (writing) and migration (reading) occur at the same time on the same disk cache drawer. The reason is that S-ATA, as we use in the TS7500, is nearly as good as FC disk for streaming reading or writing (backup/restore is streaming workload), but does not give optimal performance on mixed workloads.

### Enhanced Tape Caching considerations

There are different considerations which influence the disk capacity while using Enhanced Tape Caching.

One consideration is the number of parallel jobs (or the number of virtual tape drives that will be used in parallel) which need to be run as a maximum. Each job needs one virtual tape volume. Depending on the backend tape drive technology, you can calculate the disk capacity that is needed to run the number of jobs. For example, if using LTO4 Tape Drives as backend (LTO4 has a native capacity of 800 GB per cartridge) and you need to run 100 jobs in parallel (use 100 virtual tape drives in parallel), then you need at least a disk cache capacity of:

```
100 x 800 GB = 80 TB
```

As described in 1.3.3, “Enhanced caching” on page 17, if Enhanced Tape Caching is enabled, append writes to a migrated and reclaimed volume go to the physical tape and not to the disk cache. This means that append data does not get any benefit from a disk cached backup. Therefore, we recommend keeping a volume on disk until it is totally full or if you are not accessing the volume during normal operation.

Append writes occur if a backup does not totally fill a tape cartridge on one day, and it will be used on subsequent days again for writing until it is full. This means that at least one cartridge is in filling status and gets append writes.

Most backup applications allow you to set up different tape media pools to separate data from different backups and gain restore performance because the backup data is not spread over many tape cartridges. For each of those media pools, there is at least one filling cartridge.

Some backup applications, such as Tivoli Storage Manager, allow you to collocate data from one client or a group (the Tivoli Storage Manager term is Group Collocation) of clients to a set of cartridges. Collocation has the advantage that restoring from a client will be from one or a few tape cartridges. Not many tape mounts are required, which improves the restore performance. In combination with the TS7500, we must consider that for every collocated client or collocation group there is at least one filling cartridge. Therefore, client collocation with a high number of clients is not a good workload for the TS7500 with Enhanced Tape Caching enabled. We recommend using group collocation instead.

For the filling cartridge reserve enough disk cache capacity. For example, if you have 50 filling cartridges as a maximum in your system and you use LTO4 as backend tape drives, then you need a disk capacity of:

```
50 x 800 GB = 40 TB
```

As described before, we recommend keeping a volume on disk until it is totally full. You should migrate data only when the tape cartridge is full, as shown in Figure 5-12.

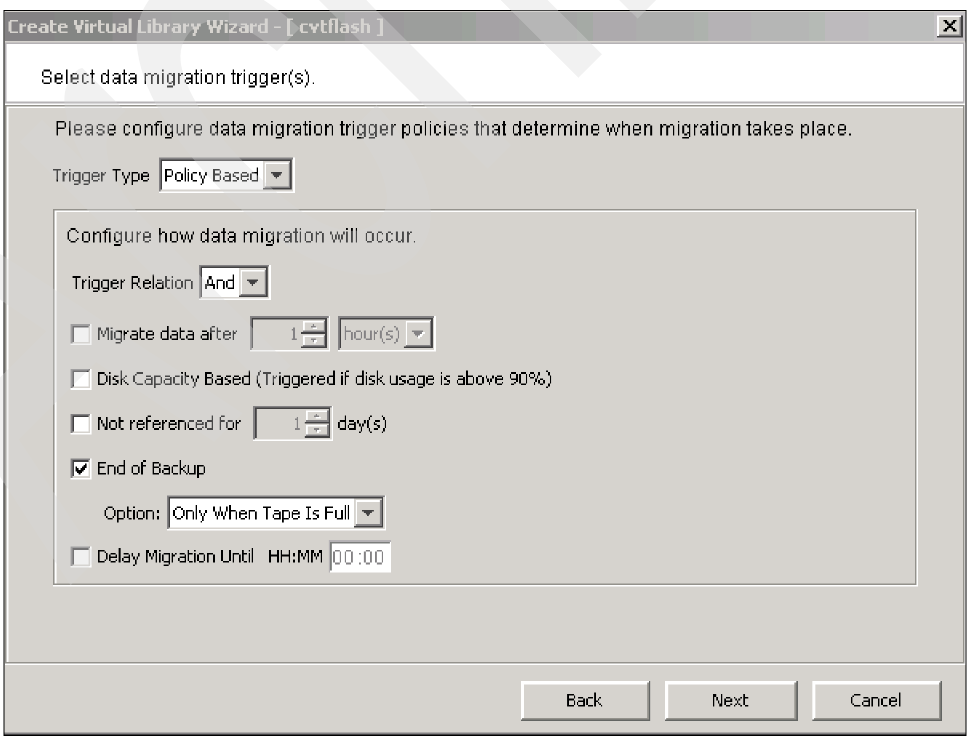



Figure 5-12 Set up tape caching

This eliminates append writes to a reclaimed volume. In this case, you do not get any benefit from having a copy on disk cache and on tape. If you have sized your disk capacity properly to keep all filling cartridges on disk cache, you can use the migration function *End of Backup* without the option *Only When Tape is Full* and use *No More Space* as the reclaim trigger, as shown in Figure 5-13.

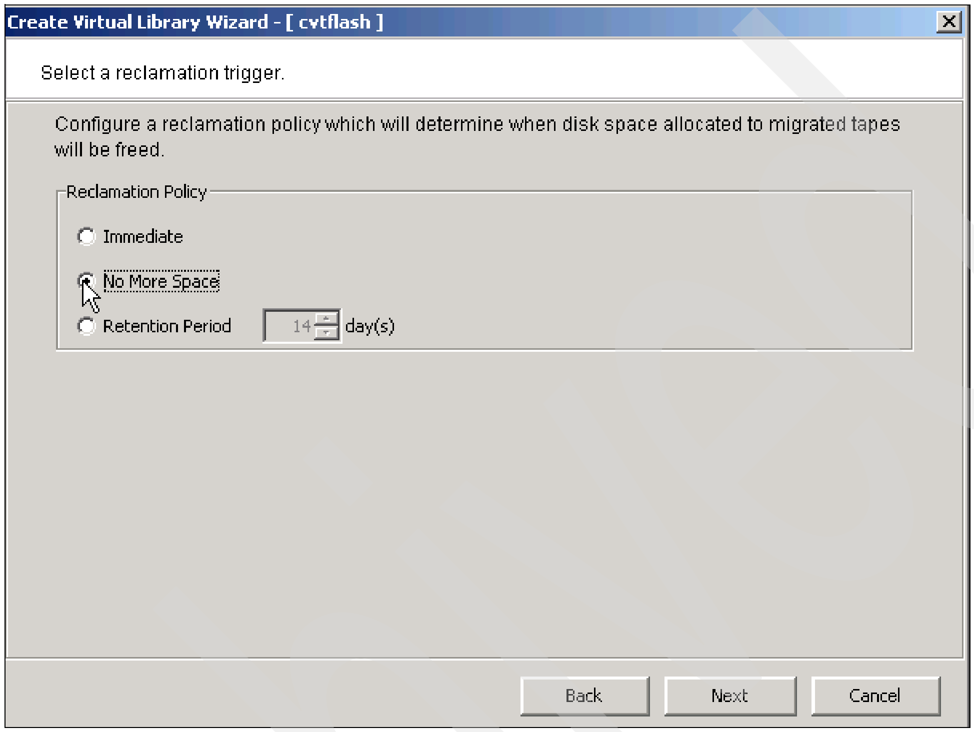



*Figure 5-13 Reclamation trigger*

### Restore considerations

Restore of small files and file systems or restore of incremental backups is faster from disk than from a tape drive, as discussed in 2.4, “Differences in tape and disk regarding backup and restore” on page 49. You should consider keeping this kind of data on the disk cache for faster restore and to meet your restore SLAs.

If you back up 1 TB of file system data daily and you want to keep this data for 14 days on disk cache, then you need to have at least a disk cache capacity of:

```
1 TB x 14 days = 14 TB
```

### Replication considerations

If you want to use replication, either local replication or remote replication, the replication target TS7500 needs the disk capacity for the replicated volumes. As explained in 1.3.1, “Tape virtualization functions” on page 10, replicated volumes cannot be used in conjunction with Enhanced Tape Caching. The replicated volumes always need space on the disk cache (Replication Repository) and this space is not reduced by Enhanced Tape Caching.

### Disk capacity sizing

All these different options must be considered together to get the total required disk capacity for the TS7500. In Table 5-1 we show an example of the total required disk capacity. In this example we use Enhanced Tape Caching with LTO4 on the backend. We need to run 100 jobs in parallel and have 50 filling cartridges. On this TS7500 we get 50 replicated volumes of a size of 800 GB from another TS7500. We back up 5 TB daily, which we keep for one day in the disk cache, and we back up 1 TB a day, which we keep on disk for 15 days.

*Table 5-1 Total required disk capacity*

| Tape caching enable | Number | Backend LTO4 capacity in TB | Total capacity in TB |
|---|---|---|---|
| Concurrent jobs | 100 | 0.8 TB | 80 TB |
| Filling cartridges | 50 | 0.8 TB | 40 TB |
| | Replicated volumes | Volume size | |
| Replication target | 50 | 0.8 TB | 40 TB |
| Daily backup: Keep one day on disk | | | 5 TB |
| | Daily backup in TB | Days on TS7500 Disk Cache | |
| Fast restore requirement | 1 | 15 TB | 15 TB |
| | | | |
| | | | |
| Total disk capacity required | | | 180 TB |

For these requirements we need at least 180 TB of disk capacity. We get 13 TB of usable disk capacity with RAID 5 and 1 TB disk per disk drawer. Therefore, we must order at least 14 disk drawers with a total capacity of 182 TB. This is the required space for two frames in the computer center.

### Disk cache assignment for multiple servers

Notice that on a multiple-node configuration, the disk assignment of the first two base frames is balanced to the server.

## 5.2.3 Performance considerations

Disk capacity is one part of the sizing considerations, the other one is performance. We describe important performance considerations in the following sections.

### Disk cache

Performance of a disk system is first related to the number of disk drives. The same is also valid for any virtual tape library, such as the TS7520 or TS7530. In Figure 5-14 we show the configuration that was used to obtain the performance numbers of the TS7520 shown in Figure 5-15 as a function of the number of disk drawers.

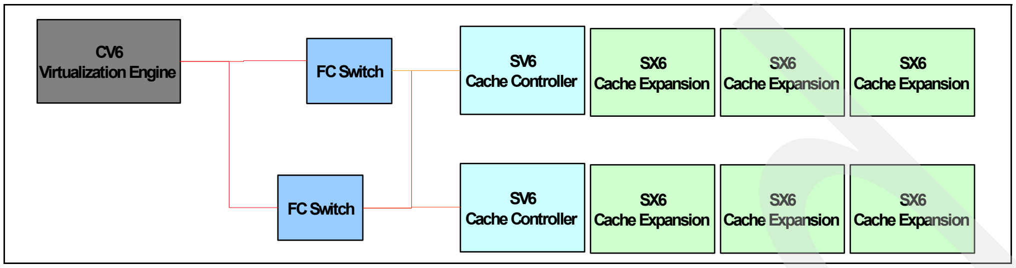



*Figure 5-14 TS7520 configuration used for the performance measurements*

As expected, the performance raises if more disk drives are used. See Figure 5-15.

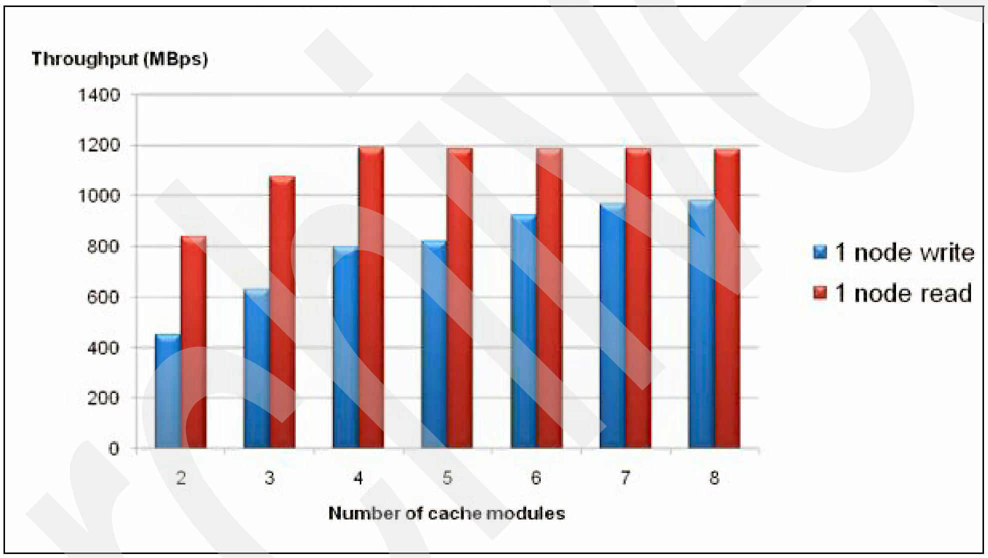



*Figure 5-15 TS7520 single node peak data rate (compression off)*

The charts in Figure 5-16 (write) and Figure 5-17 on page 152 (read) show data rates obtained for a single 3954-CV7. For the data point with four disk enclosures, there were two SV6s and two SX6s. These measurements were run on IBM System p Model 570 running AIX 6.1 with 4 Gb FC LP11002-E (Emulex) adapters.

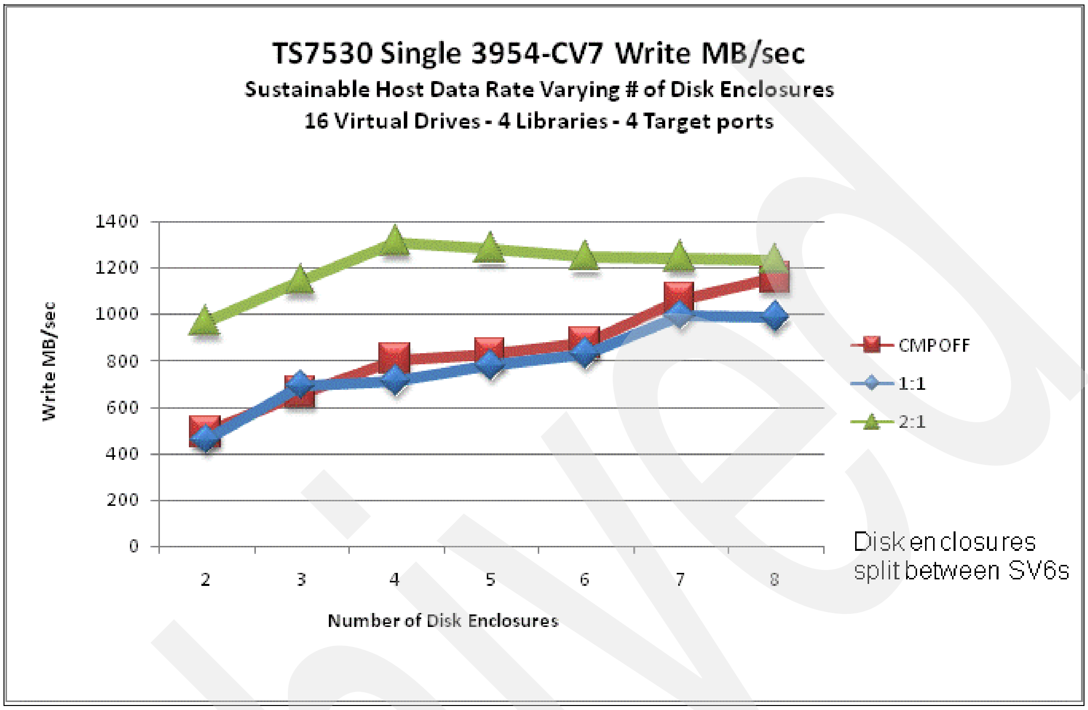



*Figure 5-16 TS7530 sustainable host write throughput*

The data series 1:1 and 2:1 indicate the ratio that the data compressed. 1:1 corresponds to non-compressible data. 2:1 is data that compressed at a ratio of 2:1. Higher data rates for non-compressible data can be achieved by purchasing additional disk storage. Data that compresses at ratios greater than 2:1 will also perform better.

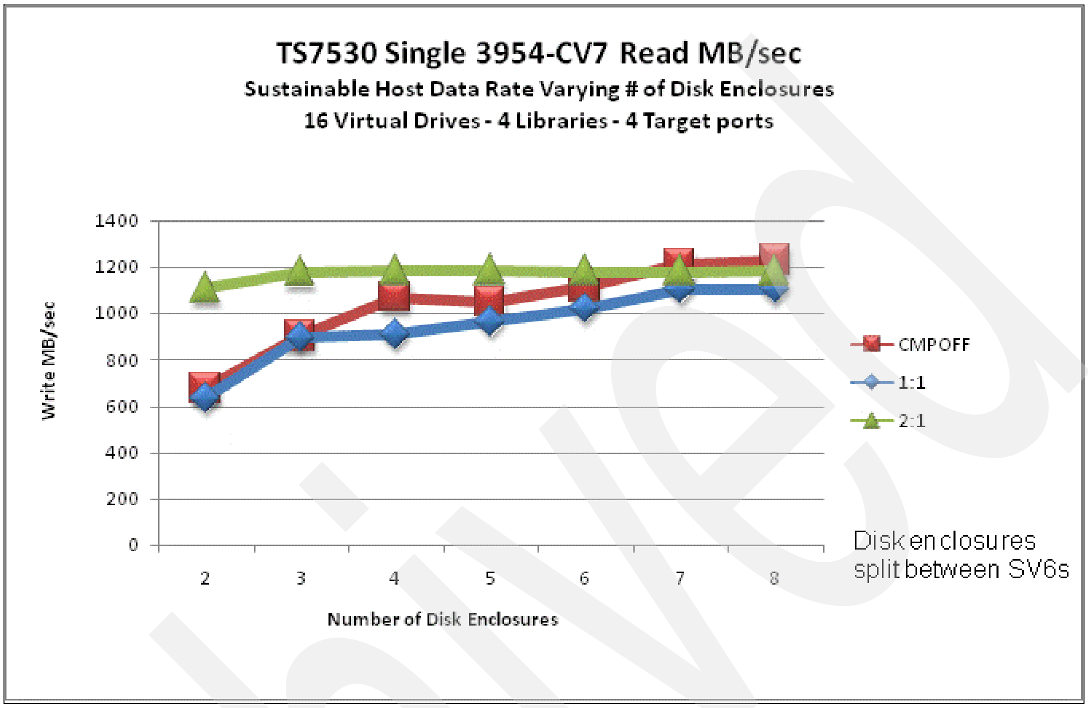



*Figure 5-17 TS7530 sustainable host read throughput*

After you have calculated the required disk capacity as described in 5.2.2, "Disk cache capacity" on page 146, check the performance figures above to determine whether your disk capacity configuration meets your performance requirements. If you have a given performance requirement, you might need to add additional disk capacity to meet this performance requirement.

The number of CV7 controllers as well as the number of SV6 Cache Controllers and SX6 Cache modules are key factors that determine the maximum achievable data rate possible with the TS7530, as shown in Figure 5-18.

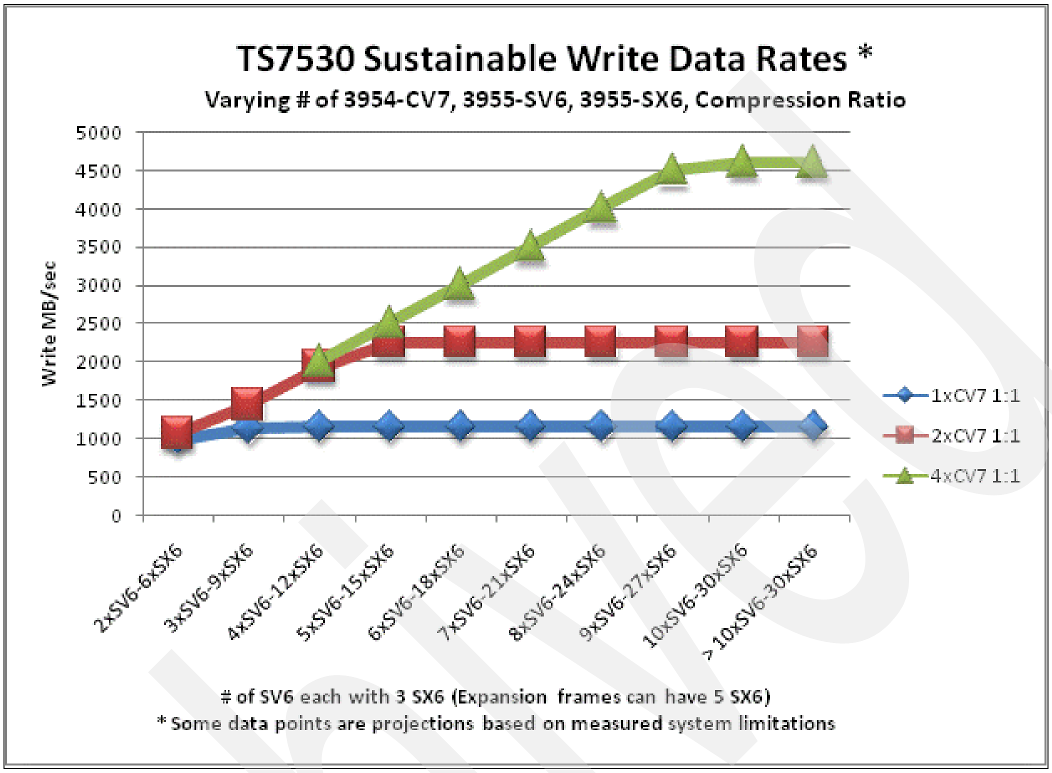



*Figure 5-18 TS7530 write performance with varying numbers of CV7, SV6, and SX6*

In order to achieve the compressible data rates, each CV7 server must be configured with two hardware compression cards. A single hardware compression card provides 600–750 MB/s of throughput capability. Two hardware compression cards provide almost twice the throughput capabilities of a single hardware compression card.

Figure 5-19 shows the corresponding read data rates.

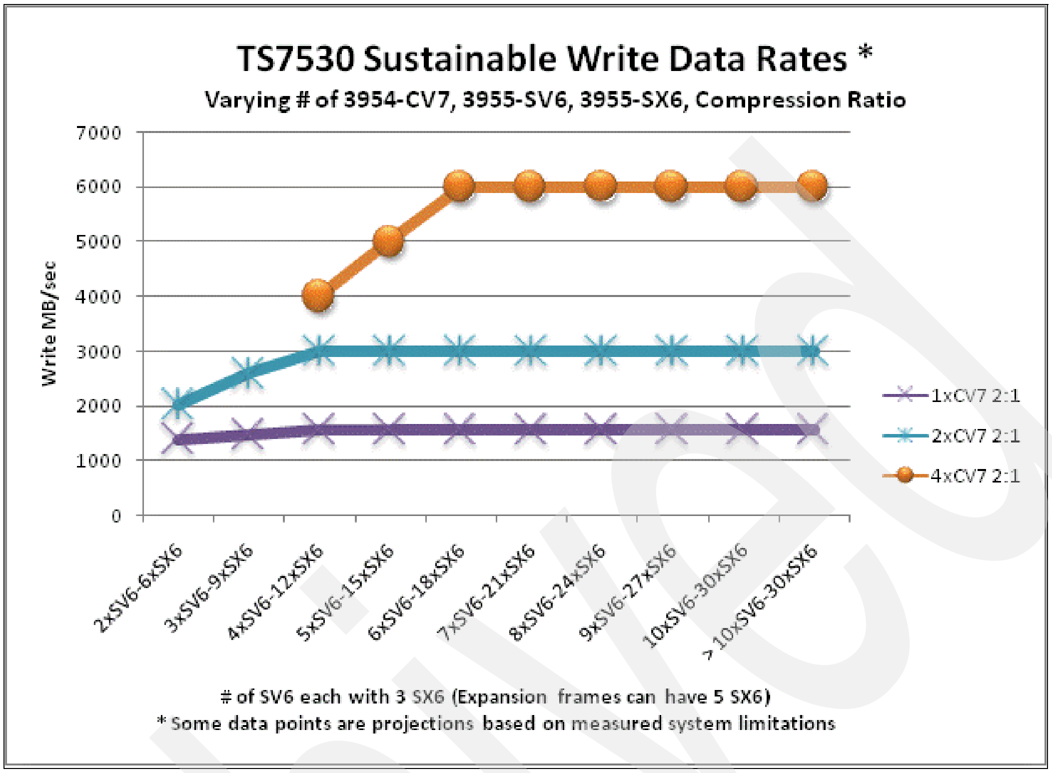



*Figure 5-19 TS7530 read performance with varying numbers of CV7, SV6, and SX6*

## Fibre Channel ports in TS7520 CV6

As described you can have up to six Dual Ported 4 Gbit Fibre Channel Cards (FC3450) in one TS7520 Model CV6. Four ports for the Enterprise Edition or two ports for the Limited Edition are used for the connection to the disk cache. To get high performance to your host server, you must also have four FC Ports for host connection. This means you have to order two Dual Ported 4 Gbit FC Cards (FC3450) for the host connections.

If you connect physical tape drives and libraries to the TS7520 for Enhanced Tape Caching or import / export, you need to order additional FC cards. You can use a FC port exclusively for host connection (as target port) or for tape connection (as initiator port) only. But you can use on a Dual Ported FC Card one FC Port for host connection and the second one for tape connection. For Enhanced Tape Caching we recommend using the same number of FC ports for host connection and for tape connection.

## Fibre Channel ports in TS7530 CV7

The TS7530 Model CV7 requires a minimum of four FC ports to connect to the disk cache. These ports are port 1 and 2, which are located on each of the first quad-port FC cards. To get more performance to your host server or physical tape drives up to 12 FC ports are also available if you order one quad-port and two dual-port HBAs as feature codes.

> **Note:** Depending on how the TS7530 Server is configured with additional FC cards, the adapter numbers change. An adapter is one physical port on a FC card.

See 13.4.5, “Add or remove Fibre Channel cards” on page 448, for additional information.

### Additional CPU TS7520 CV6

Additional Intel Xeon Processor (FC3452) and additional 2 GB Memory Upgrades (FC3460) improve the performance for compression. Whenever you use backup compression, we highly recommend that you add additional processors (FC3452) and additional memory for higher performance.

If using backup compression, you should consider that, even with additional processors and memory, you might not reach the same performance as without compression, especially if the compression ratio is low.

### Additional CPU TS7530 CV7

Additional AMD Opteron dual core card (FC3454) with 4 GB memory included can be ordered to obtain higher performance. At least one FC3454 is required when FC7425 (Hosted Backup) is installed.

### Hardware compression card

To obtain higher performance for backup compression you can order up to two data compression cards (FC3455). The card works with LZ-1 compression. Hardware compression is only available for the CV7 with IBM Virtualization Engine TS7500 Enterprise Edition V3.1 software.

Figure 5-20 shows the performance benefits of the compression cards with compressible data. Data rates for incompressible data (CV7-1:1) were comparable to rates with compression disabled (CV7-NoCMP). In other words, performance was not significantly affected by sending incompressible data to the compression cards. Figure 5-24 on page 160 shows the sustainable host write data rate for varying compression rates and number of virtual drives on a single CV7 Controller.

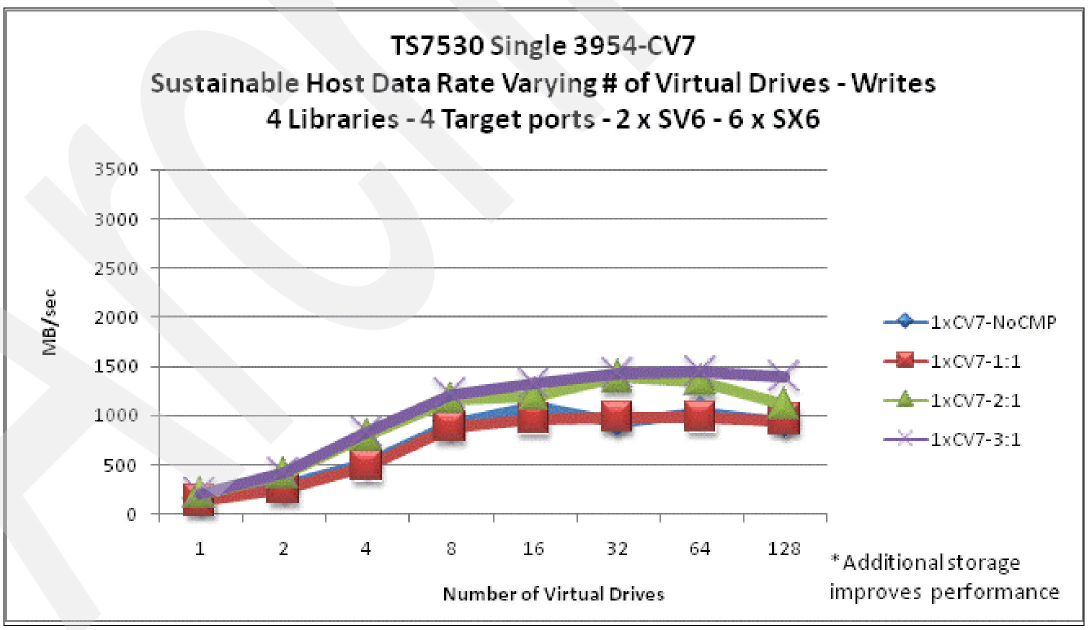



*Figure 5-20 Sustainable host write data rate (single CV7)*

Figure 5-21 shows the sustainable host write data rate for varying compression rates and number of virtual drives on dual CV7 controllers.

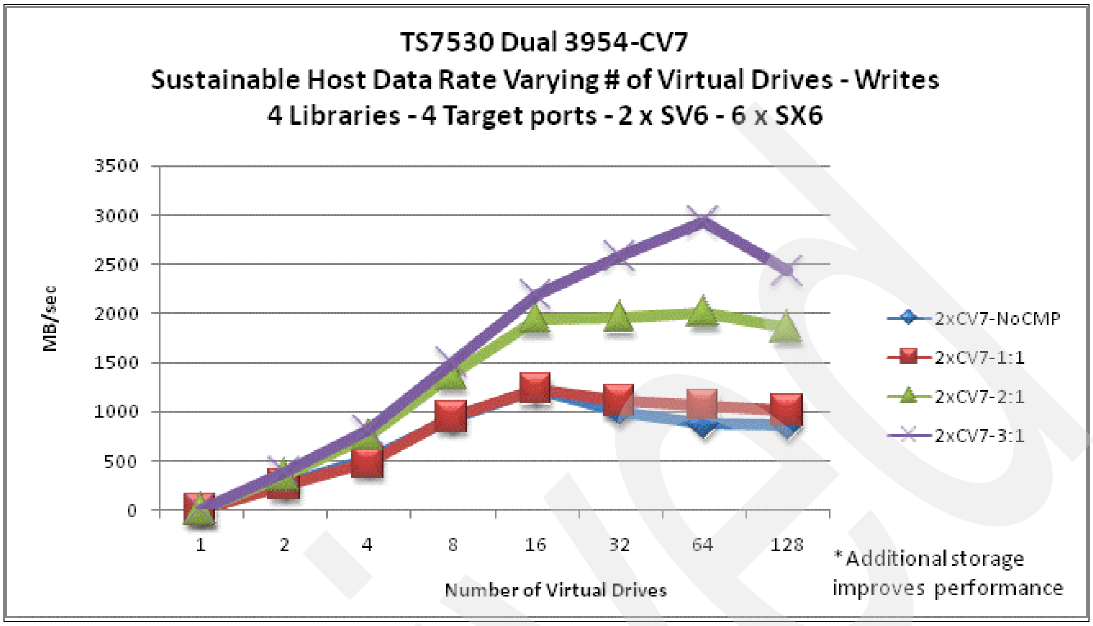



*Figure 5-21 Sustainable host write data rate (dual CV7)*

The amount of disk storage remained constant between the two charts and resulted in equivalent non-compressible data rates for single or dual CV7. Greater host achievable data rates were possible with compressible data because the host data is compressed before being written to disk. Additional storage would increase the data rates up to the limits of the servers and compression cards.

In the measured configuration, disk read data rates and the compression cards data rates were approximately the same. This resulted in no significant difference between the series in the charts in Figure 5-22. Though compressible data in this configuration did not result in faster data rates over incompressible data, capacity savings were still achieved.

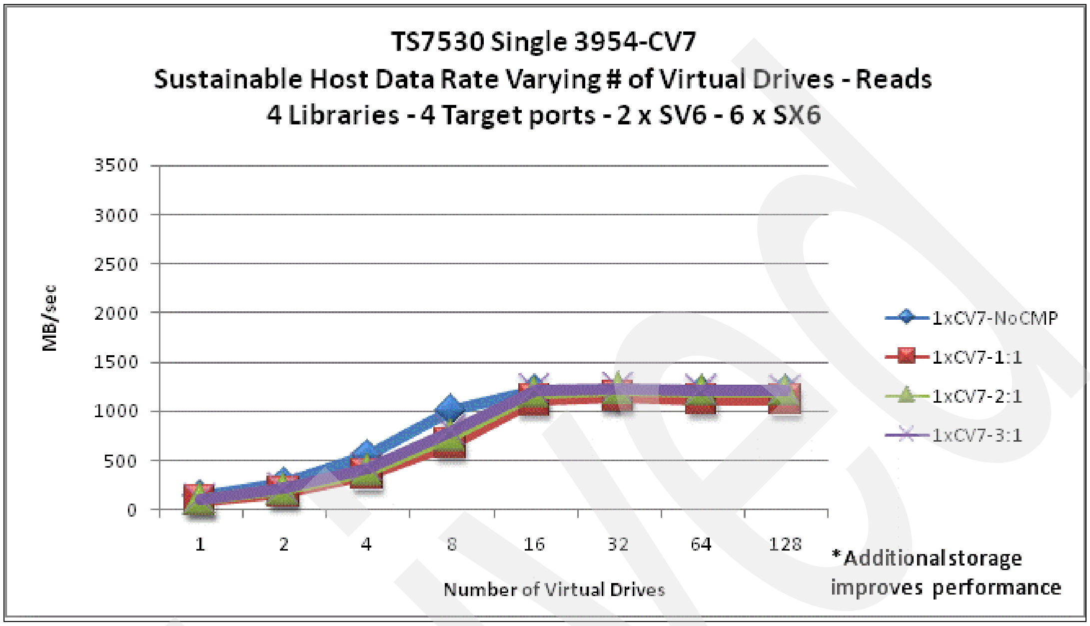



*Figure 5-22 Sustainable host read data rate (single CV7)*

Similar to the write data rates from the charts on the previous page, adding a second CV7 (Figure 5-23) resulted in greater achievable read host data rates with compressible data. This was a result of having a total of four hardware compression cards, two per 3954-CV7.

.

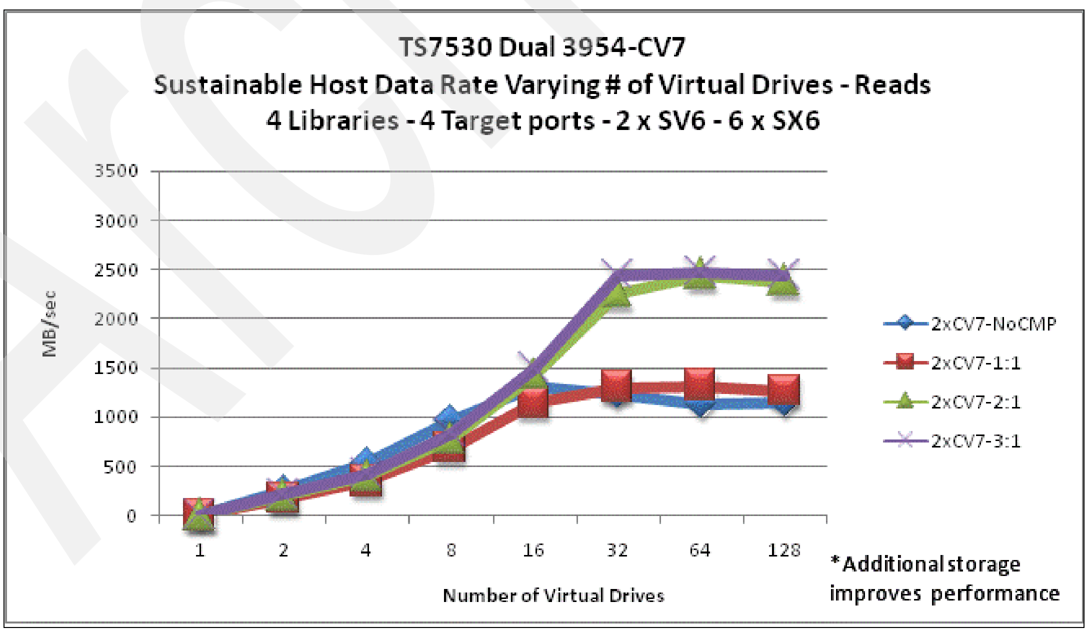



*Figure 5-23 Sustainable host read data rate (dual CV7)*

## 5.2.4 Virtual library sizing

Even though you can create a virtual library with 64 000 virtual volumes (slots) and up to 256 virtual tape drives, you should think about what size, as well as number of slots and drives, would make sense in your environment.

You should check with your backup application vendor to verify the library size (number of slots) supported with your license. Many backup applications license the number of slots in a library, and there is no difference for a virtual tape library. You should not create a virtual library with more slots than you really need or have licensed by your application.

The advantage of a virtual tape library is that you can have nearly unlimited virtual tape drives (1024 per node). However, the limitation per virtual library is 256 virtual tape drives, and you cannot assign more than 256 virtual tape drives to one SAN client. Also, you should consider how many tape device files you can handle and manage on your server and on your backup application.

## 5.2.5 Physical library sizing

If you connect a physical tape library to the TS7520 or TS7530 and use Enhanced Tape Caching , then you need to consider having enough physical tape drives. As described in 1.3.3, “Enhanced caching” on page 17, a scratch mount of a migrated volume where the disk cache was already reclaimed needs a mount of the physical cartridge first to verify the label on the cartridge. Even though this label verification takes just a few seconds, you should consider that a physical tape drive is occupied for at least one minute. This means that with one physical tape drive, you can have up to 60 scratch mounts per hour. If you do not use the TS7520 or TS7530 with Enhanced Tape Caching enabled as a replacement of your primary disk pool, then the scratch mount performance is sufficient for most environments.

You should also consider having enough physical tape drives to meet your restore requirements. As described in 1.3.3, “Enhanced caching” on page 17 read (restore of data) from migrated volumes where the disk cache was already reclaimed will occur from physical tape. You should set up the Enhanced Tape Caching policy in such a way that either the migration only occurs when no restore is required, or you need to have some additional tape drives for restore.

As already discussed, compression can decrease the overall performance. The general recommendation is not to use compression unless performance is not crucial for your environment. However, if you do not use compression, but use Enhanced Tape Caching, then you might need additional tape cartridges on your physical tape library, because you just get the native tape cartridge capacity. Therefore you need to do your sizing of the physical tape library without compression.

# 5.3 Usage considerations

The TS7520 and TS 7530 have enhanced functions that we discuss in the following sections. We describe how to use them in a customer environment and explain what you should consider, as well as what the pitfalls are.

## 5.3.1 Compression with TS7520

Compression can decrease the overall performance, even with additional processors (FC3452), especially if data is not compressible. Therefore we recommend that you use compression only if you know that the data is compressible, or just for data with a high compression ratio. It might be necessary for you to create different virtual libraries, one or more with compression enabled and one or more with compression disabled. If you enable compression on the VE Console for your TS7520, then all virtual tape drives are enabled for compression. You need to disable compression for your tape device files on your server for tape drives which should work without compression and hence have higher performance for that data.

Do not use compression if you use software encryption (Secure Tape) and export the data to physical tape or use Enhanced Tape Caching. Because encrypted data cannot be compressed by a physical tape drive and therefore the compressed data on the virtual volume does not fit any more on the physical tape cartridge.

> **Attention:** Do not use compression if you use software encryption (secure tape) and export the data to physical tape or use Enhanced Tape Caching.

## 5.3.2 Compression with TS7530

Software compression/decompression degrades system performance. With the TS7530 Server hardware it is possible to install one or two hardware compression cards. These dedicated cards allow you to increase the compression rate without stressing one of the server processor cards.

For more information see also *IBM Virtualization Engine TS7500 User Guide, Version 3 Release 1,* GC27-2179.

## 5.3.3 Enhanced caching, replication, and export functions

These three virtual tape options provide features to handle and manipulate virtual tapes in conjunction with physical libraries and the remote server. Each of the following features has another basic approach so that the functions are mutually exclusive.

### Enhanced caching

This option enhanced the functionality of VE for Tape by acting as a cache to your physical tape library, providing transparent access to data regardless of its location.

### Replication

Replicating data protects the information on a virtual tape by maintaining a copy of the virtual tape on the same VE for Tape server or on another VE for Tape server.

### Export network/physical copy

Copy the content of a single tape whenever this virtual tape is exported from a virtual library to the virtual vault. The destination is a physical tape with the same barcode in an attached physical library or the replication repository on a remote virtual tape server.

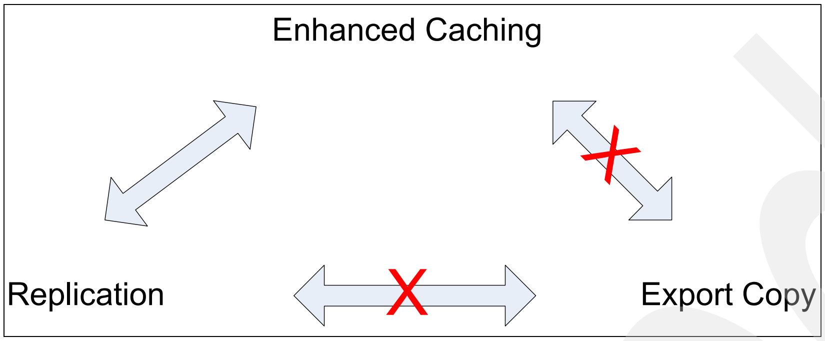



*Figure 5-24 Context enhanced caching, replication, and export*

### Enhanced caching versus export copy function

The export copy function has two suboptions in move mode:

- Delete virtual volume after export and copy.
- Retain virtual volume after export.

If the option move is enable then the virtual tape library emulates the export of the virtual tape to the virtual I/O. This means that the virtual library is no longer the owner of the virtual tape. But the enhanced caching function needs the original virtual tape source inside the virtual library.

### Enhanced caching versus replication

Both options are possible at the same time. To prevent any time conflicts between the trigger rules it is the customer's responsibility to set the order for the features. The selection panel is available in the Replication Setup Wizard, as seen in Figure 5-25.

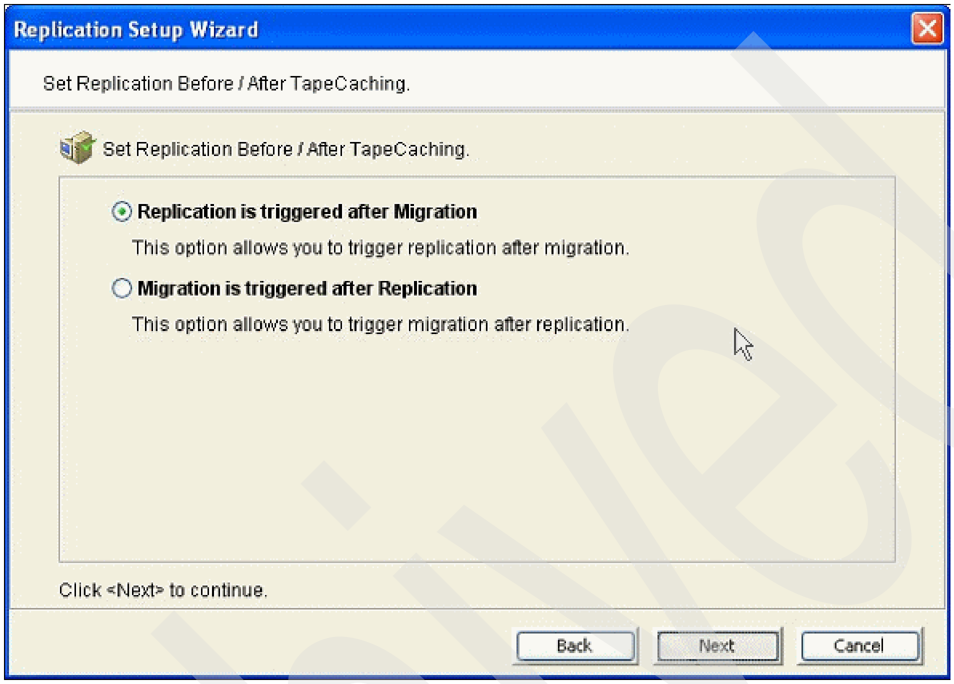



*Figure 5-25 Enhanced caching versus replication*

### Replication versus export copy

The export copy function has two suboptions in move mode:

- Delete virtual volume after export and copy.
- Retain virtual volume after export.

If the option move is enabled then the virtual tape library emulates the export of the virtual tape to the virtual I/O. This means that the virtual library is no longer the owner of the virtual tape. But the replication function needs the original virtual tape source inside the virtual library. If you export the tape before the replicas are synchronized then the data might not be in a valid state.

## 5.3.4 Remote and local replication data recovery

You can use the TS7500 as a disk backup option to create a second copy of your backup data to a remote location or to the same TS7500 because this provides the duplication of data faster.

In case of any disaster, you need to use those replicated volumes. As described in 1.3.14, "Network replication" on page 29, the replicated volumes are stored in the replication repository (replica storage). To use the replicated volumes, first you need to promote those volumes, which removes the replication setup for those volumes. The promoted volumes are now stored in the virtual vault.

Next you need to move the volumes to a virtual library or replicate the volumes back to the target system so you can use the volume from a host server. All those actions are manual tasks, and you need to use the VE Console or the Command Line Interface.

In Figure 5-26 the backup server has problems accessing the primary library, or cannot read one volume on the primary library. To read the volume on the secondary library, you first need to promote the volumes. Next you need to move the volumes from the virtual vault to the virtual library. After that, you can import or “check in” the volume into your backup application.

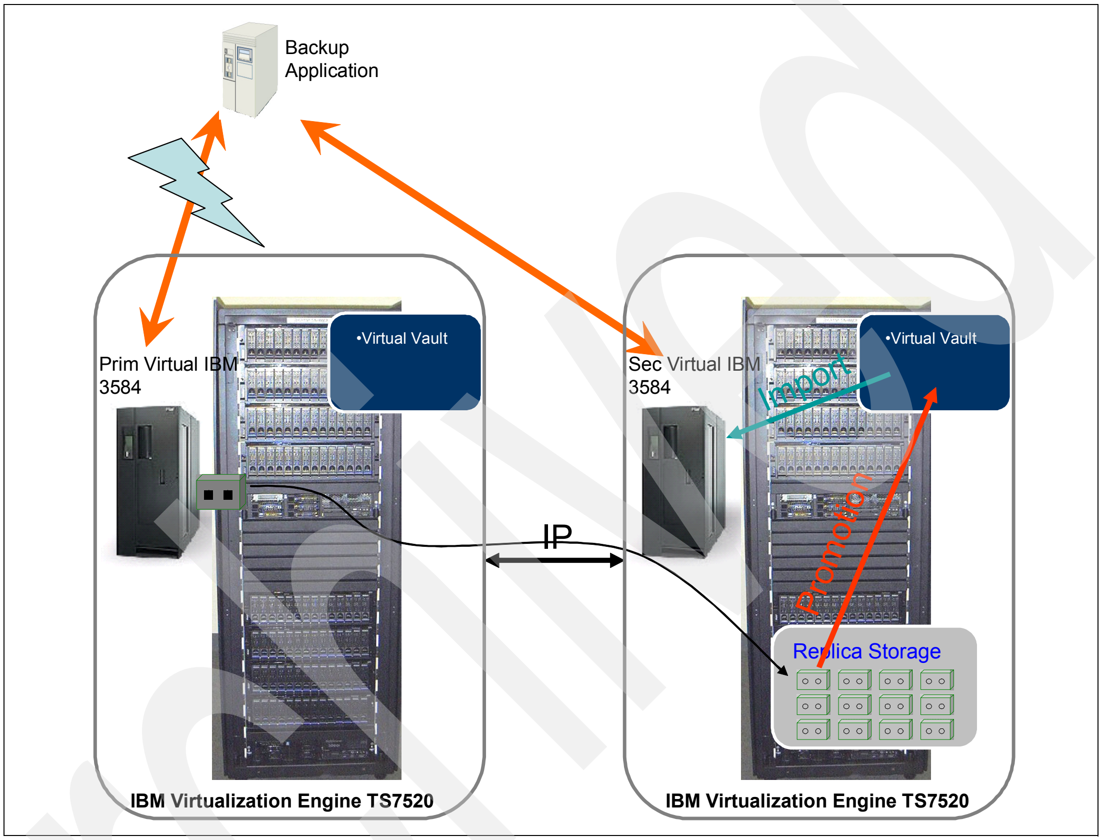



*Figure 5-26 Restore replicated volume*

As you can see from this example, the replication works automatically, but the restore or the access to the replicated volumes requires many manual tasks. Therefore, we recommend that before you use replication, you should create a procedure which includes all necessary tasks, including the tasks on your backup application, which are required to make the replicated volumes accessible on your backup application.

**Note:** If you are familiar with IBM VTS or TS7700, then you should keep in mind that Replication in the TS7500 does not have the same functionality as IBM VTS Peer-to-Peer or TS7700 Grid. Specifically, there is no automatic failover / failback for replicated volumes!

If you want to have a kind of automation for your disaster recovery, then you should not use the TS7500 replication function and should use functions from your backup application instead.

## 5.3.5 Enhanced Tape Caching

As described in 1.3.3, “Enhanced caching” on page 17, Enhanced Tape Caching has some limitations, such as scratch mounts and append writes. Therefore, those topics must be discussed and considered before you use Enhance Tape Caching.

**Note:** If you are familiar with IBM VTS or TS7700, then you should keep in mind that Enhanced Tape Caching from TS7500 does have the same functionality as IBM VTS or Grid! Specifically, there is no fast scratch mount capability.

Enhanced Tape Caching can be used if you use a primary disk pool that meets the desired performance during your backup window and is large enough to hold at least a daily backup. Then the next tier would be a TS7530 with Enhanced Tape Caching. Because of the primary disk pool, scratch mount performance would not be important and the performance with compression enabled might be sufficient. However, the TS7500 disk capacity should be large enough, as discussed 5.2.2, “Disk cache capacity” on page 146, to hold all filling cartridges.

## 5.3.6 Fibre Channel ports and host assignment equals load balancing

By default the virtual tape library and the associated drives will be assigned over one FC target port from the TS7530 to the host server. The default virtual libraries are the default target ports (physical ports - start with 1 and go from top to bottom) on PCI express slot 1 port 3 and on PCI Express slot 2 port 3. With this default configuration you do not get all of the advantages of control path failover (CPF) and data path failover (DPF) with failover and load balancing because you use just one FC port on the TS7530. See Figure 5-27.

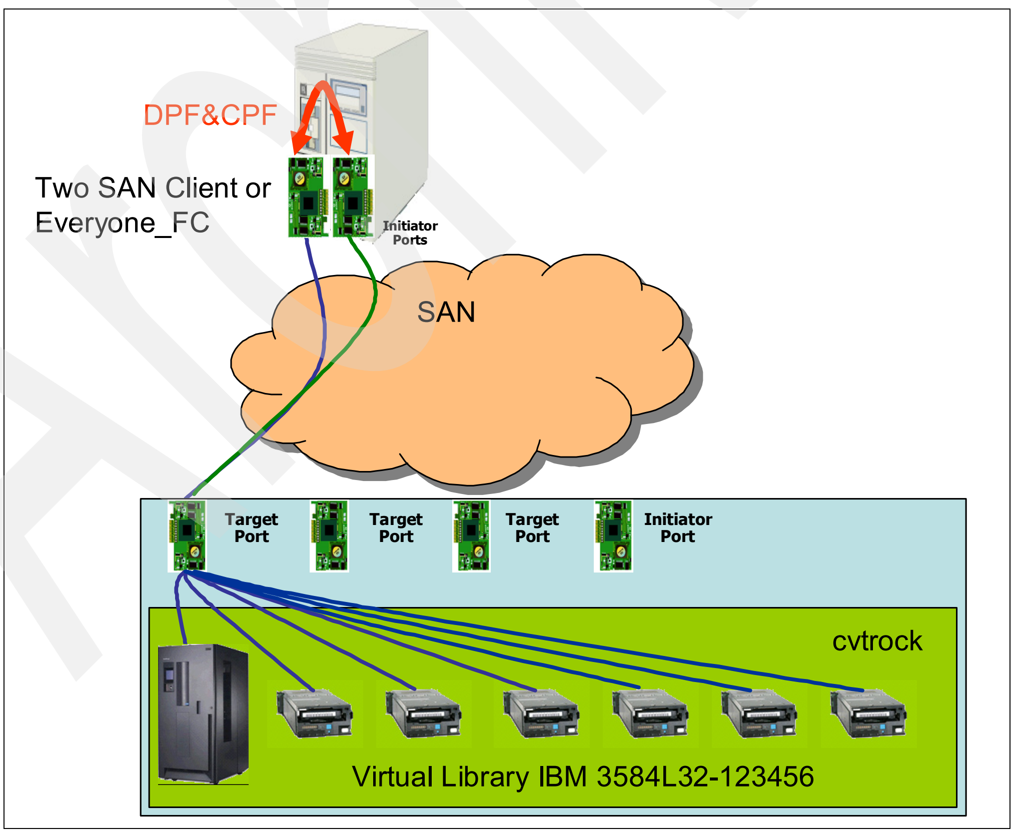



*Figure 5-27 Failover default configuration*

If you want to get full advantage of path failover, then you have to assign the virtual library and drives over two ports to your backup application server, as shown in Figure 5-28. To get high redundancy you should use two independent fabrics. However, load balancing and path failover also work with one SAN fabric.

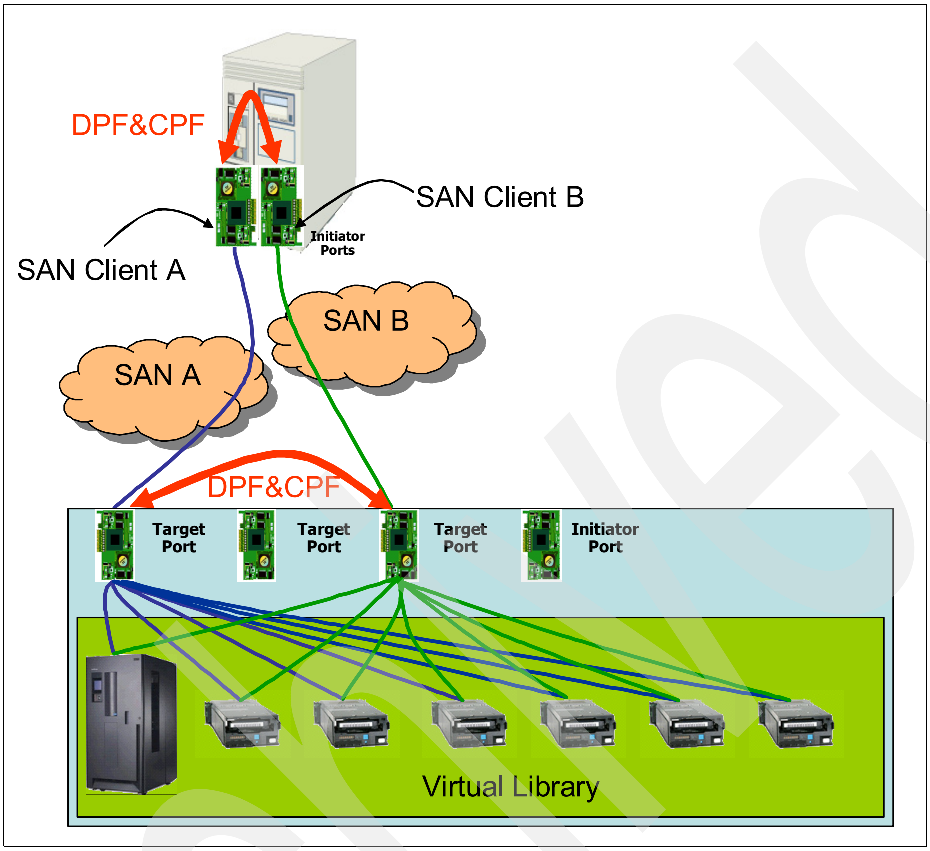



*Figure 5-28 Load balancing setup*

### 5.3.7 Disaster recovery considerations

Because, as already discussed, the TS7500 has limited automatic failover and disaster recovery capabilities, we recommend using your backup application capabilities, as shown in Figure 5-29.

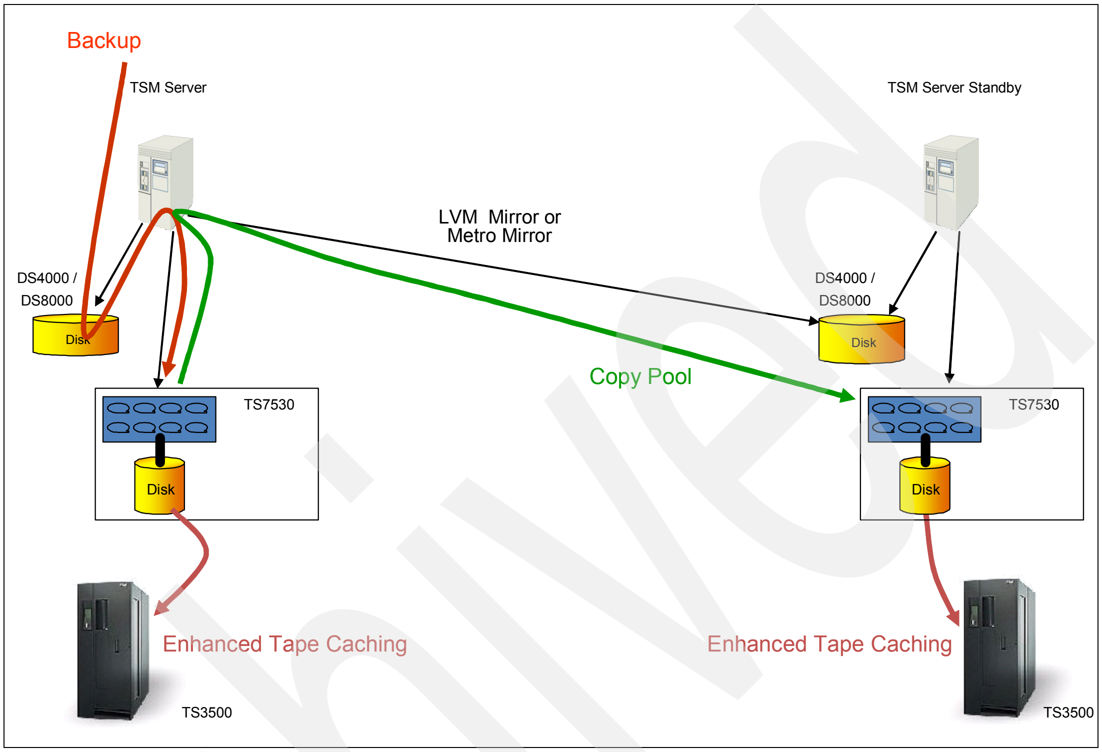



*Figure 5-29 Dual location environment for disaster recovery*

The primary disk pool is mirrored with logical volume manager or with Metro Mirror function from the DS4000 or DS8000. This means that, in case of a local disaster, the remote disk pool has the same data as the local disk pool. The data from the primary disk pool is migrated (or staged) to the local TS7500 and copied to the remote TS7500.

## 5.4 Installation planning

In this section we present important details to help you plan for the installation and basic setup of the TS7500. Planning is primarily a customer responsibility. You can find detailed planning information in the *IBM Virtualization Engine TS7500 Introduction and Planning Guide*, GC27-2177.

The default configuration for a TS7530 follows. For each CV7 host attach port (2 is the default number):

- One virtual library per port (2x3584) with 12 virtual LTO3 drives.
- 120 virtual volumes of 400 GB capacity per virtual library.
  - This is a fully configured base frame with 1 TB drives.
  - More virtual volumes are allocated if there is more space.
- Default generated volume identifications.
- No LUN masking is assumed here. Everyone has access.

The first step is to make the following decisions:

- How many FC HBAs need to be installed in your TS7530?

  Determine target ports and initiator ports.
- How many NICs have to be installed your VTL machine?

  Determine usage: iSCSI, communication with workstation, or replication.

## 5.4.1 Installation worksheets

We have provided implementation worksheets in Appendix D, “Installation and implementation checklists” on page 533, for you to record the information necessary to implement a TS7500 Virtualization Engine. Most of the worksheets need to be completed prior the installation of a TS7500 Virtualization Engine, as the values are needed to complete the installation.

## 5.4.2 Installation tasks

Installation involves both the IBM Systems Service Representative (SSR) and customer employees.

### IBM Systems Services Representative tasks

The IBM SSR installs the TS7500 Virtualization Engine and completes the following tasks to:

- Check out the hardware and connect to power.
- Connect cables from the base frame to the second base frame or expansion frames.
- Connect the network cables to customer network switches.
- Connect the Fibre Channel cables to customer network switches.
- Configures IP addresses according to customer requirements. A sample worksheet is provided in Appendix D, “Installation and implementation checklists” on page 533.
- Verify the communications between TS7500 Virtualization Engine and the Windows machine designated as the management console.
- Verify that the TS7500 Virtualization hardware is functioning properly.
- Activate all additional TS7500 Virtualization Engine features ordered by the customer.
- Verify that Call Home is working.
- Verify client host and physical tape device connections.

> **Note:** We recommend that you add a step to your implementation plan to verify that the SSR completed all the steps.

### SSR and customer task

Perform a system assurance review using the system assurance checklist or SAPR Guide.

### Customer tasks

Before you can complete configuration of the TS7500 Virtualization Engine you must complete the following tasks:

- Review the TS7530 Introduction and Planning Guide.
- Unpack and position 3952-F05 frames.

- Provide infrastructure:
  - 220V Power for each frame
  - Ethernet network
  - Internet access
  - Fibre Channel network
  - Physical tape libraries if needed
- Provide TS7530 VE Console Workstation hardware.
- Install and set up TS7500 software:
  - Installation of TS7530 VE Console
  - System administration setup and configuration of virtual libraries, devices, and tapes
  - System administration setup and mapping of client hosts to devices
  - System administration setup and configuration of SNMP alerts and e-mail notification
- Provide Call Home requirements: Call Home gateway server.
- Provide IP addresses to integrate the TS7500 virtualization solution in its own network.
- Add the TS7530 Virtualization Engine host addresses to the Domain Name Server (DNS).
- Create the SAN zoning for the hosts that will use TS7530 virtual drives.
- Create the SAN zoning for the physical libraries and tape drives that will be attached to the TS7500 Virtualization Engine Server.

The following sections describe the planning considerations for these steps.

## 5.4.3 Host attachment considerations

The TS7520 and TS530 VE for Tape Server are supported with a variety of Fibre Channel (FC) switches and Fibre Channel directors that support Fibre Channel Arbitrated Loop (FC-AL). The support is dependent on the server, operating system, and host bus adapter that are being used.

For a current list of supported products or more information about the support and prerequisites, refer to:

http://www.ibm.com/servers/storage/tape

For the supported host bus adapter (HBA) firmware levels and SAN fabric components, see:

http://www-03.ibm.com/servers/storage/support/config/hba/index.wss

## 5.4.4 SAN zoning

The TS7500 VE for Tape Server has very specific recommendations about how SAN zones are created.

**Recommendations**: The recommendations are:

- Use zones based on World Wide Port Name (WWPN).
- Use two member zones, that is, one initiator port and one target port per zone.
- For each backup server, create a separate zone for each HBA that will access TS7500 virtual resources.

Figure 5-30 shows a typical dual-fabric design with direct connected storage and host zone.

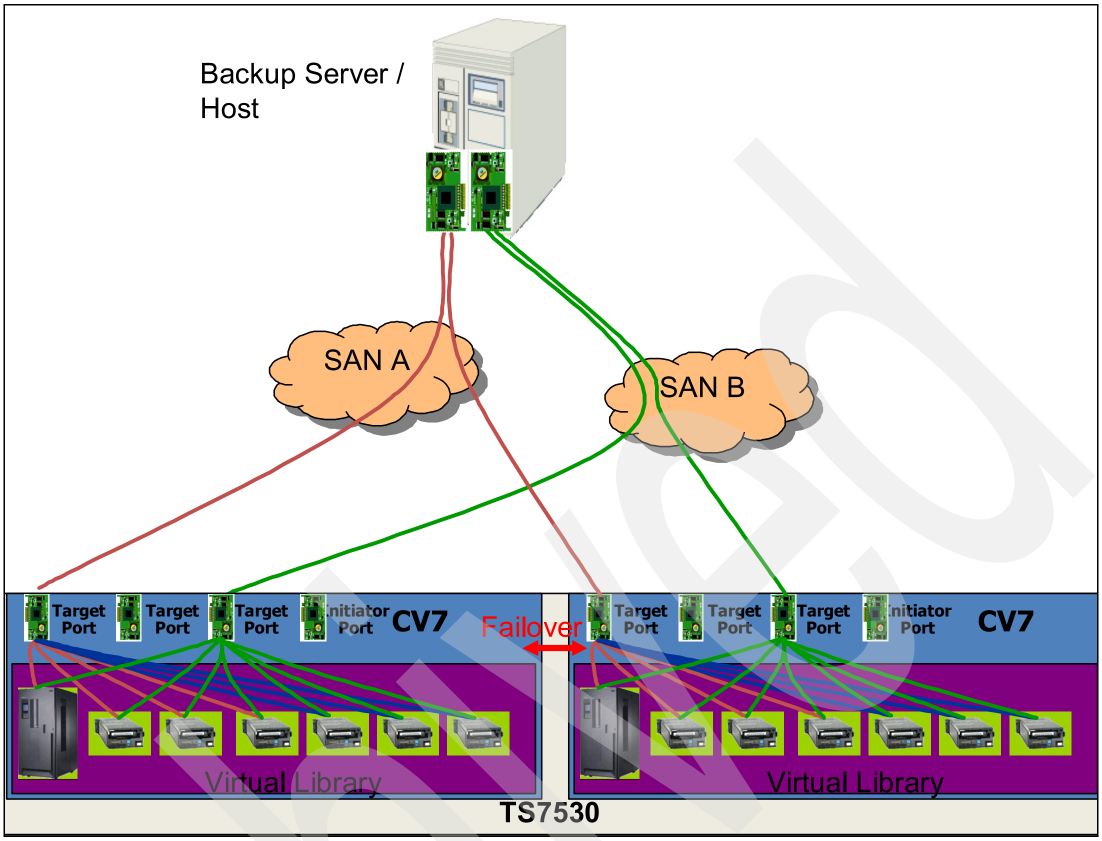
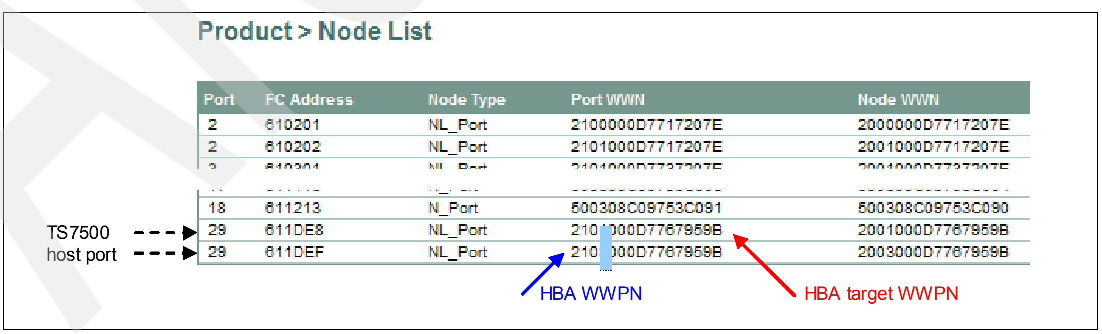



*Figure 5-30 Typical dual-fabric design with direct connected storage and host zones*

When creating zones at a SAN switch for host ports (target ports) provided by TS7500 the following information is important. A Fibre Channel adapter or port pertaining to a TS7500 can be configured as initiator when connecting a physical tape library or disk system or it can be configured as target when connecting a host system to a TS7500. When connecting a host system to a TS7500 via a SAN switch the appropriate Fibre Channel adapter or port pertaining to TS7500 must be configured as *target*. Subsequently, the SAN switch detects two WWNNs, as shown in Figure 5-31.




| Port | FC Address | Node Type | Port WWN | Node WWN |
|---|---|---|---|---|
| 2 | 610201 | NL_Port | 2100000D7717207E | 2000000D7717207E |
| 2 | 610202 | NL_Port | 2101000D7717207E | 2001000D7717207E |
| ... | ... | ... | ... | ... |
| 18 | 611213 | N_Port | 500308C09753C091 | 500308C09753C090 |
| 29 | 611DE8 | NL_Port | 210[illegible]00D7767959B | 2001000D7767959B |
| 29 | 611DEF | NL_Port | 210[illegible]00D7767959B | 2003000D7767959B |

*Figure 5-31 SAN switch view of TS7500 WWNN*

In this configuration, the target WWN has a 1 as the fourth digit, and the HBA WWN has a 3 as the fourth digit. When creating a zone for devices pertaining to TS7500, the target WWN must be zoned and *not* the HBA WWN.

You can use the VE Console to verify the target and host WWNN. To do so, select the adapter that needs to be zoned for host connectivity and verify the according WWNN, as shown in Figure 5-32.

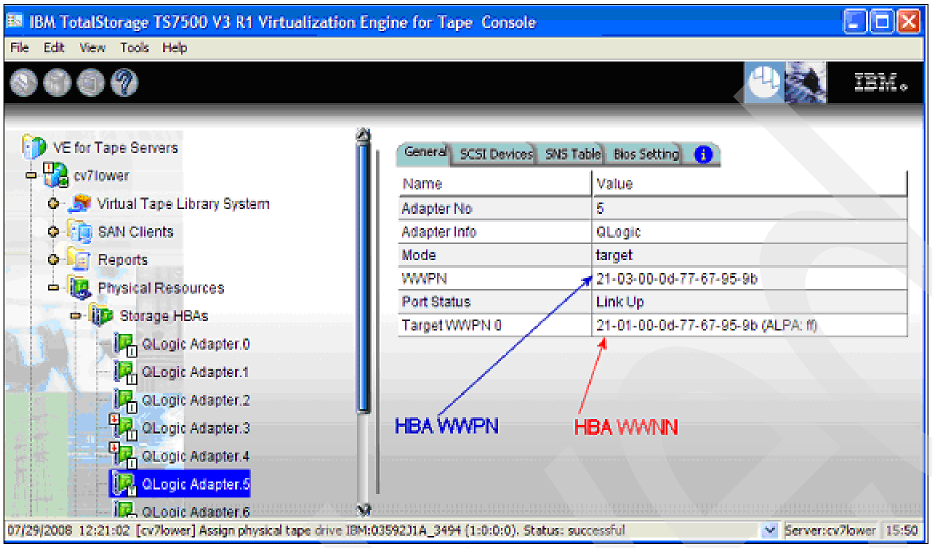


*Figure 5-32 TS7500 view of adapter/port WWNN*

For more information see *IBM Virtualization Engine TS7500 Introduction and Planning Guide, Version 3 Release 1,* GC27-2177.

## 5.4.5 Failover/failback

The IBM Virtualization Engine TS7500 failover option provides high availability by eliminating the downtime that can occur if a TS730 server (software or hardware) fails. You must take into consideration the following requirements when setting up a failover configuration:

- You must have two TS7500 Virtualization Engines (3954-CV7) servers in a single 3952 Tape Frame Model F05 or four TS7500 Virtualization Engines (3954-CV7) servers with a second frame.

  Failover to another TS7500 Virtualization Engine in a different 3952 Tape Frame Model F05 is not possible because both TS7520 Cache Controllers (3955-SV6) must have access to the same disks.

- All servers must have the same TS7500 Virtualization Engine options licensed.
- Feature Code 7420 Failover/Failback must be included in the initial order from the plant or installed with an MES.
- You must use static IP addresses.

  Two IP addresses are needed for each adapter. One IP address is for management, which you use for your VE Console, called *server IP address*. The other IP address is used for a heartbeat connection, called *service IP address*.

  – Two IP addresses for the first heartbeat (service) connection and the management (server) connection on each node for eth0

  – Two IP addresses for the second heartbeat connection and the management connection on each node for eth1. (It must be on a different subnet than the first heartbeat connection.)

- If a physical tape library is used, the library must be zoned to both TS7500 Virtualization Engines (3954-CV7) servers.
- Replication is not allowed between two TS7530 Virtualization Engine servers in the same frame.

For additional information about the failover option, see the *IBM Virtualization Engine TS7530 User Guide,* GC27-2179.

## 5.4.6 Management console

IBM provides you with a graphical user interface called *IBM TotalStorage 7500 V3 R1 Virtualization Engine for Tape Console* (TS7530 VE for Tape Console), which allows you to configure, monitor, and service one or more TS7520 (must be upgraded) or TS7530 Virtualization Engine servers. The SSR should provide you with an installation package that contains the TS7530 VE for Tape Console on a CD.

> **Notes:** Note the following:
>
> - The TS7530 VE for Tape Console code level cannot be lower than the code level of the TS7530 Virtualization Engine Server code being managed.
> - The first install of TS7530 VE for Tape Console should be on a Microsoft Windows platform.
> - You should install this VE for Tape Console on a machine dedicated as the TS7530 Management Console server.
> - You can install additional TS7530 VE for Tape Consoles. The additional TS7530 VE for Tape Consoles can be installed on Microsoft Windows platforms.

Refer to 6.1, “Installation of the TS7530 Virtualization Engine hardware” on page 182, for the steps needed to install the TS7530 VE for Tape Console.

## 5.4.7 Supported operating environments

The TS7530 Virtualization Engine can be used with a wide range of operating environments. For the most current list of supported products or for more information about support, refer to:

http://www.ibm.com/servers/storage/tape

At general availability, the TS7500 Virtualization Engine supported the following operating systems at the minimum levels indicated:

- AIX 5L V5.1, V5.2, and V5.3
- Sun Sparc-based servers with Solaris 8, 9, and 10
- Microsoft Windows 2003 (build 3790 or greater)
- Microsoft Windows 2008
- i5/OS V5R3 and V5R4 i5/OS
- 64-bit HP-UX 11.0 (TS7520 V1 only), 11iv1, 1iv2, and 1iv3
- Linux distributions:
  - xSeries® and Intel 32-bit servers (x86) and 64-bit servers (ia64) with Linux SLES 10.1
  - xSeries and Intel 32-bit servers (x86) and 64-bit servers (ia64) with Linux SLES 9 SP4
  - xSeries and Intel 32-bit servers (x86) and 64-bit servers (ia64) with Linux RHEL 4.6
  - xSeries and Intel 32-bit servers (x86) with Linux Asianux 2.0

## 5.4.8 Device drivers

The IBM device driver needs to be installed on all operating systems that will use TS7500 VE for Tape virtual drives and libraries.

The latest device driver code can be downloaded from either of the following anonymous ftp sites:

```
service.boulder.ibm.com
```

```
ftp.software.ibm.com
```

Table 5-2 lists the parent folders on the IBM ftp sites where you can find the latest device drivers for all IBM libraries and drives supported by the TS7500 VE for Tape server.

Separate device drivers are provided for each supported hardware architecture. It is important that a device driver compatible with your hardware architecture is installed.

Linux device drivers are dependent on the Linux kernel level and will only install on an environment with the supported kernel.

*Table 5-2 Device driver download location and minimum level*

| System | Device driver folder | Driver prefix | Minimum level |
|---|---|---|---|
| AIX | ftp://ftp.software.ibm.com/storage/devdrvr/AIX/ | | 11.0.2.0 |
| HPUX | ftp://ftp.software.ibm.com/storage/devdrvr/HPUX | | ► HPUX 11i atdd<br>► 3.5.0.66<br>► HPUX 11.23 (Itanium II) atdd<br>► 5.5.0.66<br>► HPUX 11.23 PI (PA-RISC) atdd<br>► 5.6.0.66<br>► HPUX tapeutil<br>► 4.3.5.0 |
| SLES10 | ftp://ftp.software.ibm.com/storage/devdrvr/Linux/SLES10/Latest | ► Intel x86 (Windows 32-bit)<br>► Intel IA64 (Itanium) | ► lin_tape 1.10.0<br>► IBMtapeutil 1.4.4 |
| SLES9 SP4 | ftp://ftp.software.ibm.com/storage/devdrvr/Linux/SLES9/Latest | ► Intel x86 (Windows 32-bit)<br>► Intel IA64 (Itanium) | ► lin_tape 1.10.0<br>► IBMtapeutil 1.4.4 |
| Solaris | ftp://ftp.software.ibm.com/storage/devdrvr/Solaris | | 4.1.6.6 |
| RHEL 4.4 | ftp://ftp.software.ibm.com/storage/devdrvr/Linux/RHEL4/Latest | ► Intel x86 (Windows 32-bit)<br>► Intel IA64 (Itanium) | ► lin_tape 1.10.0<br>► IBMtapeutil 1.4.4 |
| Asianux 2.0 | ftp://ftp.software.ibm.com/storage/devdrvr/Linux/Asianux2.0/Latest | ► Intel x86 (Windows 32-bit) | ► lin_tape 1.10.0<br>► IBMtapeutil 1.4.4 |
| Windows 2003 | ftp://ftp.software.ibm.com/storage/devdrvr/Windows/Win2003/Latest | ► Intel x86 (Windows 32-bit)<br>► Intel IA64 (Itanium)<br>► Intel EM64T/AMD64 | 6.1.8.4 |

| System | Device driver folder | Driver prefix | Minimum level |
|---|---|---|---|
| **Documentation** | | | |
| Publica-tions | ftp://ftp.software.ibm.com/storage/devdrvr/Doc | | |

**Notes:**

- The 3494 device driver package normally starts with the character string:
  - atldd on AIX
  - lmcpd on Solaris and HP-UX
  - ibmatl on Linux and Windows
- The device driver package for AIX normally starts with the characters Atape.
- The device driver package for all other platforms starts with the characters:
  - IBMtape on Solaris
  - Lin_tape on Linux
  - ATDD on HP-UX
  - IBMtape on Windows

Detailed instructions for installing the device drivers can be found in the *IBM Tape Device Drivers - Installation and User's Guide,* GC27-2130.

We recommend that you review the appendix titled *Verifying Proper Attachment of Your Devices* and include verification in your implementation plan.

## 5.4.9 Additional planning considerations

Additional planning considerations might apply if you plan to use Tape Encryption or other optional features.

### Encryption

IBM Virtualization Engine TS7500 currently supports encryption based on the Advanced Encryption Standard algorithm published by the National Institute of Standards and Technology, an agency of the US government. With AES encryption, you can create one or more keys that can be used to encrypt the data when it is exported to physical tape and decrypt when it is imported back to virtual tapes. The data on the tape cannot be decrypted without the appropriate keys. The longer the key, the harder it is to break the encryption code.

**Secure Tape** Uses 128-bit AES algorithms to encrypt data
**TS1120** Uses 256-bit AES algorithms to encrypt data

Both encryption techniques can be used on the same TS7530 VE for Tape Server. However, Secure tape and TS1120 encryption are mutually exclusive, in that, data encrypted using the Secure Tape algorithm must be decrypted with the Secure Tape algorithm (and vice versa).

We recommend that you use the encryption technique that best conforms with your local security and encryption standards.

### Performance

Some of the advanced features (for example, encryption, compression) have the potential to impact performance.

We recommend that you add steps (one for each of the advanced features) in your implementation plan to profile and understand the performance characteristics of the TS7500 VE for Tape Server with your data.

## 5.5 Planning and sizing the TS7500 Virtualization Engine for i5/OS

Good planning for backup and recovery processes that *fit your business* are critical if you need a system up and running most of the time. As the time for running in production mode within a 24-hour day and within a 7-day week increases, this planning becomes even more critical.

This section cannot make you an expert in overall backup and recovery planning. However, it does review many basic planning considerations that lead into planning for effective use of the TS7500 Virtualization Engine in your overall backup and recovery planning process.

### 5.5.1 How virtual tape library fits in with i5/OS backup and recovery strategy

In this section we give you a *quick list* of things that you must consider, so we can discuss them in the context of using the IBM TS7500 Virtualization Engine within your strategy. In other words, the use of a *virtual tape device* should expedite the actual saving and restoring of objects necessary for recovery, but you have to ensure that the processes you develop include the *right objects*, saving at the *right time*, and testing your recovery processes before the actual need for a *business recovery*.

We recommend that you consider the following steps when developing a backup and recovery strategy for a System i environment running i5/OS in at least one partition.

- Determine what to save and how often to save it.
- Determine your save window. This is the amount of time:
  - Objects being saved can be unavailable for use
  - The entire system can be unavailable for i5/OS *save system* functions

  Note that i5/OS has *save while active* functions for many objects However, further coverage of those capabilities are beyond the scope of this IBM Redbooks pubication. For more discussion of all save and restore considerations while running applications under i5/OS, refer to the iSeries® Information Center Systems management - Availability and Systems Management - Backup and Recovery topics. Recommended documents located there include:

  - *IBM Systems: iSeries Systems management: Plan a backup and recovery strategy* PDF
  - *IBM Systems: iSeries Backup and Recovery Version 5 Revision 4*, SC41-5304-08, PDF
- Consider recovery time and choose availability options.
- Test developed backup and recovery strategy.

After a customer determines what to save and how often to save, the customer will probably decide on an approach similar to the following schedules:

- Daily save the libraries and objects which regularly change, such as application libraries, user profiles, configuration objects, and so on
- Save entire system every week.

Typically, the objects that regularly change have to be restored more frequently and in a shorter period of time, compared to objects that do not change frequently. A virtual tape library may provide a faster save and restore than a physical tape library in some cases, therefore, it might be a good idea to regularly save the frequently changing objects to a virtual tape library and save entire system objects to a physical tape drive.

Note that i5/OS supports parallel and concurrent save operations to properly set up virtual tape library configurations as it does for physical tape environments and V5R4 i5/OS virtual tape image catalog support.

Some customers who require a relatively short save window and do not want to invest in fast tape drives, might want to perform both daily and weekly saves to the virtual tape library, and duplicate weekly saves to physical tapes, or duplicate both daily and weekly saves to physical tapes.

Depending on a properly estimated or actual experience with recovery time periods, you have to decide how long a time period to keep virtual tapes. This requires sizing the required disk space in TS7500 Virtualization Engine accordingly.

Customers with many systems or partitions might want to use virtual tape libraries to enable save of all systems in the same general save window time period, each of them to a different virtual tape library.

All backup and recovery approaches require careful management of tapes, especially in the virtual tape library environment because both virtual and physical tapes are used. This is especially valid for customers with many systems, each of them using virtual tape library and physical tape library.

For examples that can help determine your processes, see Chapter 9, “Using TS7500 with i5/OS” on page 313.

## 5.5.2 Planning for copying virtual tapes to physical tapes

From an i5/OS viewpoint, we recommend that you connect a physical tape library to the i5/OS partition and duplicate virtual tape data to real physical media on the attached tape device. You do this using the BRMS DUPMEDBRM command or the i5/OS Duplicate Tape (DUPTAP) command.

## 5.5.3 Planning for the TS7500 Virtualization Engine with System i

In principle, each virtual tape library can attach to multiple host adapters, and it can attach to each host adapter via multiple ports in the TS7500. We decide which host FC adapters - Input Output Processors (IOAs) will access a virtual tape library when we assign storage area network (SAN) clients to virtual tape library using the virtualization engine console. We decide which ports in TS7500 each host adapter will see by zoning SAN switches and by selecting target FC ports when we create a SAN client in the virtualization engine console. For more information refer to 6.7, “SAN clients” on page 216.

In a System i environment, we attach a virtual tape library to many host servers only if we plan to share the virtual tape library among them. We do not attach some tape drives from a virtual tape library to one i5/OS and some drives to another i5/OS, as is possible with other host servers. This is because only one control path is possible in a virtual tape library and each i5/OS must have a control path defined.

We do not expect that many customers will share a virtual tape library among multiple i5/OS partitions. They will rather define a virtual tape library for each i5/OS and if needed move virtual tapes from one to another virtual tape library by using the Virtualization Engine console.

Because each IOA in i5/OS establishes only one path to a virtual tape library, it makes sense to zone switches or select target FC ports so that each IOA sees a virtual tape library through only one FC port in TS7500.

Regarding this, we recommend that you assign one or more virtual tape libraries to one IOA in i5/OS, each virtual tape library containing one or two tape drives. For planning the number of tape drives in a virtual tape library, also consider parallel and concurrent save described later in this section.

You might also want to assign each virtual tape library to one IOA, multiple assignment using the same port in TS7500. These possibilities are shown in Figure 5-33.

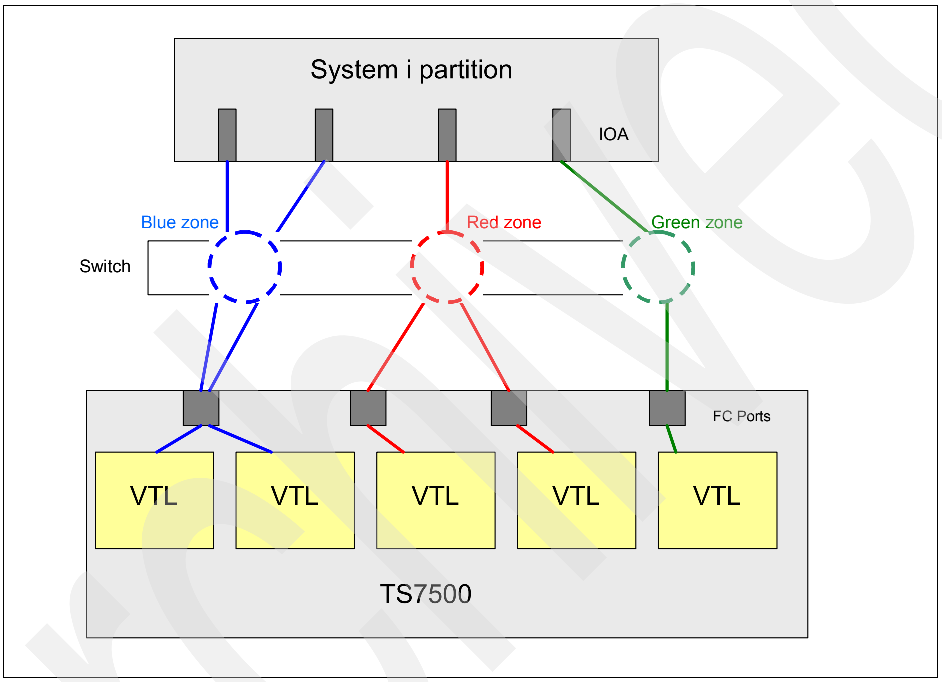



*Figure 5-33 Connecting Virtual Tape Libraries to System i partition*

## 5.5.4 Parallel and concurrent save

*Parallel save and restore* is the ability to save or restore a single object or library in i5/OS to multiple backup devices from the same job. This includes saving only *changed objects*. This technique can drastically reduce the time needed to save an object; it is especially efficient with saving large files.

When you use this function, it is essential to have a tracking mechanism, for recovery purposes, to know what objects are on what tape volumes. In the context of this book, Backup and Recovery Media Services is the strategic product for i5/OS that we assume is used in this book.

Parallel save can be done to multiple virtual tape drives from different virtual tape libraries, or it can be done to multiple virtual tape drives within the same virtual tape library. With parallel save to virtual tape drives from different virtual tape libraries, you might experience better save performances than with saving to multiple virtual drives within the same virtual tape library, providing that each virtual tape library is connected to separate FC adapters via a separate port in the TS7500. However, when using virtual tape drives from different virtual tape libraries, consider that you must restore from tapes in different media locations.

You can also decide to parallel save to virtual tape drives within the same virtual tape library. This save might not perform as quickly as saving to different virtual tape libraries, but it provides easier management of tapes for restore.

*Concurrent save and restore* is the ability to save or restore different libraries or directories to multiple backup devices at the same time from different jobs. Concurrent save and restore also means saving or restoring different objects from a single library or directory to multiple backup devices at the same time from different jobs. You can consider doing concurrent saves to virtual tape drives from different virtual tape libraries. It might be enough to plan one tape drive in each virtual tape library to be used for concurrent saves.

### 5.5.5 Sizing the disk capacity in IBM TS7500 Virtualization Engine

We recommend sizing disk space within IBM TS7500 Virtualization Engine for each i5/OS partition separately. When sizing the required disk space in SV6 and SX6, it is important to keep in mind that a virtual tape does not have fixed capacity. When created, a tape has capacity of 5 GB by default, unless you specify different capacity when you create it. When data is saved to the tape, its capacity increases as needed. This is different to physical tapes which have fixed capacity.

Therefore, with virtual tapes you just size the amount of disk space needed, regardless of how many tapes will be defined. This is the opposite to sizing physical tapes where you size the number of tapes needed.

To properly size the required disk space, you have to estimate how long you will keep any backed up data within the IBM Virtualization Engine TS7500. This depends on your company's backup policies, and the critical nature of the data and the frequency at which it would need to be restored to the system.

When determining how long saved data will stay in IBM Virtualization Engine TS7500 before exporting to physical tape or deleting it, you should consider at least the following issues:

- Usually, some data used by a critical application must be restored faster than others. Typically, this data would be kept on virtual tapes, and other less critical data or less frequently required data can be exported to physical tapes on slower physical tape drives.

  Often the data that has to be restored quickly expires (becomes obsolete information) in a few days and is replaced by a more recent version of that data. Then the obsoleted data can simply be erased from the TS7500 cache disks.

- Each company has agreements about how quickly specific backup data has to be restored. Typically, this is included in agreements often called *service-level agreements*. For example:
  - Backup of Domino® mail that is kept for less than two weeks must be restored in one hour.
  - Mail that is kept for longer than two weeks can be restored in three hours.

We recommend sizing disk space within IBM Virtualization Engine TS7500 for each i5/OS partition separately. The following formulas help you to estimate how much disk space is required for a specific i5/OS partition.

- If full backup is done every day the formula is:

  ```
  (daily amount of backup data) x (number of days the backup is kept) = disk
  capacity required for current backup environment
  ```

  *Example 5-1 Disk capacity current backup*

  ```
  A customer saves daily 500 GB of data, and he keeps the saved data for 14 days.
  Disk capacity required for current backup environment is as follows:
  500 GB x 14 = 7000 GB = 7 TB
  ```

- If incremental backup is done every day and full backup is done every week the formula is:

  ```
  (weekly amount of backup data) x (number of weeks the backup is kept) +
  (daily amount of backup data) x 10 = disk capacity required for current backup
  environment
  ```

  **Note:** In this case, we recommend keeping the daily incremental backup data for at least one week (7 days) in order to apply to the last full backup. To be on the safe side, we suggest keeping these incremental saves for 10 days rather than 7 days, just in case some problem occurs with the next full backup.

  *Example 5-2 Disk capacity current backup and weekly backup*

  ```
  A customer saves weekly 1.4 TB as full backup, and he saves daily 200 GB of
  incremental backup. He keeps the saved data for 3 weeks (more than 10 days).
  Disk capacity required for current backup environment is as follows:
  1.4 TB x 3 + 200 GB x 10 = 6.2 TB
  ```

For more information about TS7520 sizing refer to 5.2, “Sizing considerations” on page 145.

# Part 3

# Setting up the TS7500

In this part of the IBM Redbooks pubication we describe the different setup steps that are required to implement your TS7530 or TS7520 Virtualization Engine. These steps include installation of the Virtualization Engine console (VE console), basic hardware configuration, and implementation of enhanced functions features.



# 6

# Initial setup

In this chapter we present details to help you set up the base features of a TS7530 Virtualization Engine. We explain how to:

- Install the TS7530 Virtualization Engine for Tape Console.
- Set up and configure a TS7530 Virtualization Engine.
- Verify the installation of the TS7530 Virtualization Engine.
- Configure a virtual tape library with virtual tape drives.
- Connect a physical tape library and drives.
- Configure a virtual library and drives and enable Enhanced Tape Caching.
- Configure tape duplication.

# 6.1 Installation of the TS7530 Virtualization Engine hardware

The TS7530 Virtualization Engine is shipped pre-assembled with software preloaded. You have to install the Virtualization Engine for Tape Console to complete the installation.

## 6.1.1 IBM Systems Services Representative tasks

The IBM Systems Service Representative (SSR) who installed the TS7530 Virtualization Engine should have completed the following tasks:

- Unpacked and setup the TS7530 Virtualization Engine frames
- Connected the network cables
- Connected the Fibre Channel cables
- Configured IP addresses according to customer requirements; a sample work sheet has been provided in Appendix D, “Installation and implementation checklists” on page 533
- Verified that the TS7530 Virtualization hardware is functioning properly
- Verified the communications between TS7530 Virtualization Engine and the Windows machine designated as the management console
- Activated all additional TS7530 Virtualization Engine features ordered by the customer
- Performed initial execution of the Failover/Failback Wizard, if ordered

## 6.1.2 Customer tasks

Before you can complete configuration of the TS7530, you must have completed the following tasks:

- Added the TS7530 Virtualization Engine host address or addresses to the Domain Name Server (DNS)
- Created the SAN zoning for the hosts that will use TS7530 virtual drives
- Created the SAN zoning for the physical libraries and tape drives that will be attached to the TS7530 Virtualization Engine Server
- Installed the TS7530 Virtualization Engine for Tape Console

# 6.2 Basic Initialization through RSA

Before installing the Virtualization Engine for Tape Console, you can configure and verify the console status through the Remote Supervisor Adapter (RSA) interface. The IBM System Service Representative (SSR) or you can use the RSA interface for configuring network settings, for example, or to check the status of the VTL system although you cannot connect the VTL through normal Ethernet ports.

We have included these steps for information purposes. Normally, the SSR completes the tasks listed below as part of the initial installation and setup, and you can continue with the steps described in 6.3, “Virtualization Engine for Tape Console” on page 185.

## 6.2.1 Logging in to the Remote Supervisor Adapter

You can find the RSA Ethernet port on the rear side of the TS7530 controller (Figure 6-1).

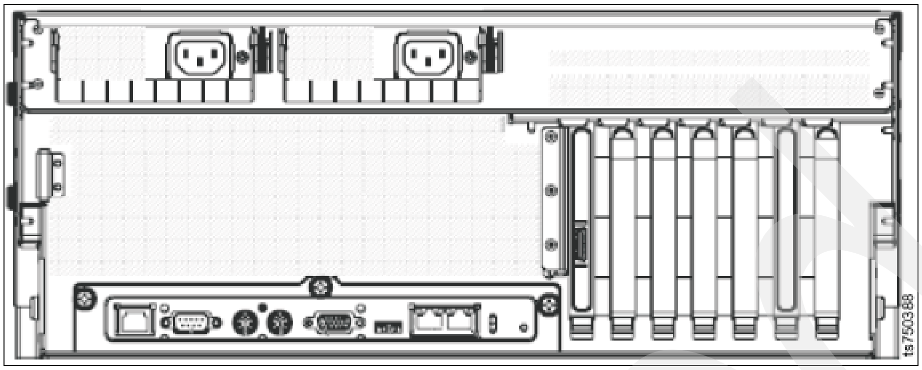


*Figure 6-1 TS7530 (3954-CV7) server rear view*

RSAs that have not been initialized by manufacturing (including new FRUs) have a default IP of DHCP. If a DHCP host is unavailable, the RSA assigns a static IP address of 192.168.70.125 and subnet mask 255.255.255.0.

To access the RSA Web interface:

1. Open a Web browser. In the address field type the IP address or host name of the RSA interface.
2. Type in a user name and password in the Enter Network Password window. The default user ID and password are USERID / PASSW0RD (with a zero, not the letter O). The welcome window opens.
3. Select a timeout value from the drop-down list in the field that is provided. If your browser is inactive for that number of minutes, the RSA logs you off the Remote Supervisor Adapter II Web interface. Depending on how your system administrator has configured the global login settings, the timeout value might be a fixed value.
4. Click **Continue** to start the session.

## 6.2.2 Remote control

When you use the remote control function, you can view and interact with the server console, and you can assign to the server a CD-ROM drive, diskette drive, or disk image that is on your computer. You must log in to the RSA with a user ID that has read/write access to use any of the remote control features.

A remote console is an interactive graphical user interface (GUI) display of the server, viewed on your computer. You see on your monitor exactly what is on the server console, and you have keyboard and mouse control of the console. To remotely access a server console:

1. In the navigation pane, click **Remote Control**.
2. To control the server remotely, use one of the links at the bottom of the Remote Control page. If you want exclusive remote access during your session, click **Start Remote Control in Single User Mode**. If you want to allow other users remote console keyboard, video, mouse (KVM) access during your session, click **Start Remote Control in Multi-user Mode**. A new window will open that provides access to the remote disk and remote console functionality. Note that the remote disk function does not support multiple users.

For more information about RSA see *Remote Supervisor Adapter II SlimLine and Remote Supervisor Adapter II User's Guide,* 43w7827, which you can download using the following link:

http://www-304.ibm.com/systems/support/supportsite.wss/docdisplay?lndocid=MIGR-57091&brandind=5000020

## 6.2.3 Configuring VTL on the virtual panel of the RSA

In this section we will configure a host name only, but you can change all of the VTL configurations including a network configuration like VE for Tape Console through the RSA remote control session. If you want information about more detailed procedures for RSA, refer to the *IBM Virtualization Engine TS7500 Installation Roadmap Guide with Virtual Tape Library Version 3 Release 1*, GC27-2178.

As mentioned previously, the following steps are normally performed by the IBM SSR:

1. In the Welcome window shown in Figure 6-2:
   a. In the Login field, type `vetaperservice`.
   b. In the Password field, type `service4u`.
   c. Press the Enter key.

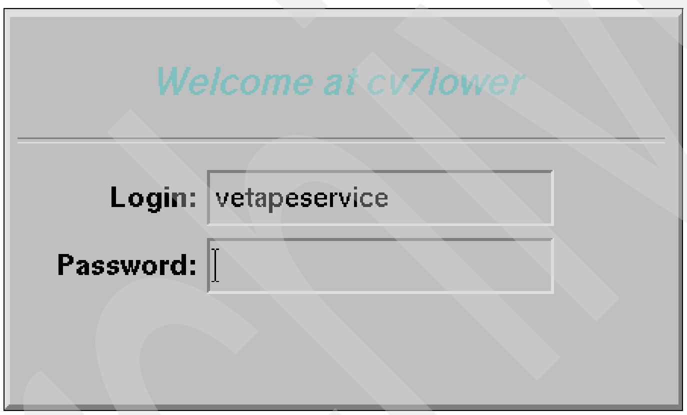



*Figure 6-2 Welcome window*

2. After login, right-click **VE Console** and select **Console,** as shown in Figure 6-3.

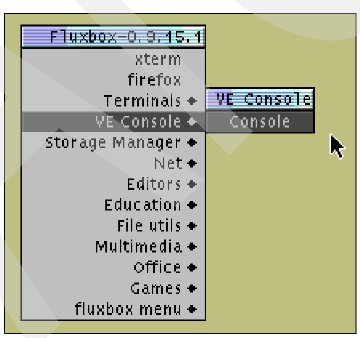



*Figure 6-3 Selecting VE Console on the x-windows*

3. Right-click the server and then click **System Maintenance** → **Set Hostname,** as shown in Figure 6-4.

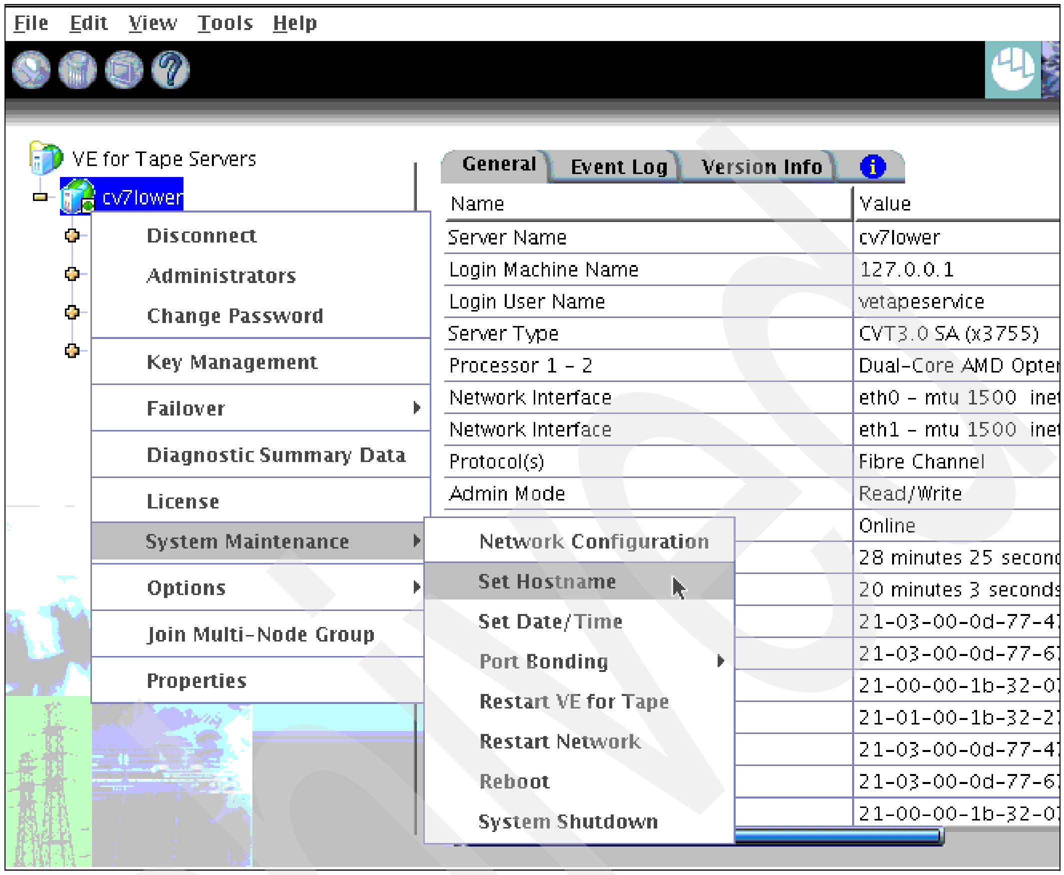


*Figure 6-4 Set Hostname menu*

4. In the New hostaname field, type a hostname (Figure 6-5). Valid characters are letters, numerals, the underscore character, and the hyphen character. Click **OK**.

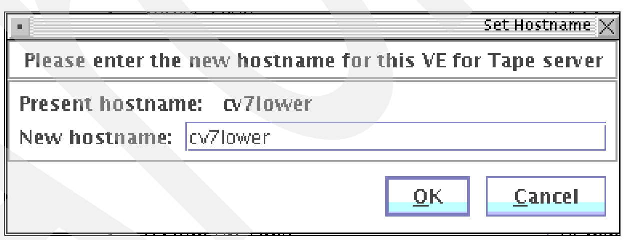


*Figure 6-5 Set Hostname window*

5. If required, change the network address through the VE Console. You can find the procedures in 6.5, “Verifying your configuration” on page 199.

## 6.3 Virtualization Engine for Tape Console

IBM provides you with a graphical user interface (GUI) called *IBM TotalStorage 7500 V3 R1 Virtualization Engine for Tape Console* (TS7530 VE for Tape Console), which allows you to configure, monitor, and service one or more TS7530 Virtualization Engines. The SSR provides you with an installation package that contains the TS7530 VE for Tape Console on a CD.

**Notes:**

- The TS7530 VE for Tape Console code level cannot be lower than the code level of the TS7530 Virtualization Engine Server code being managed.
- The first installation of TS7530 VE for Tape Console should be on a Microsoft Windows platform.
- You should install this VE for Tape Console on a machine dedicated as the TS7530 Management Console server.
- You can install additional TS7530 VE for Tape Consoles. The additional TS7530 VE for Tape Consoles can be installed on either Microsoft Windows or Linux.

You should install the TS7530 VE for Tape Console on a machine dedicated as the TS7530 Management Console server. You can also install the TS7530 VE for Tape Console on additional servers.

## 6.3.1 Windows installation

The TS7530 VE for Tape Console installation CD includes a setup program for installation on Microsoft Windows computers. To install the TS7530 VE for Tape Console:

1. Insert the TS7530 VE for Tape Console installation CD into your CD drive.
2. When the CD browser launches, click **Install Products** on the panel shown in Figure 6-6.


*Figure 6-6 TS7530 VE for Tape Console: autorun install products*

3. If autorun has been disabled and the initial window is not displayed, use Windows Explorer to locate the install file on the TS7530 VE for Tape Console installation CD. Double-click **Launch.exe,** as shown in Figure 6-7.

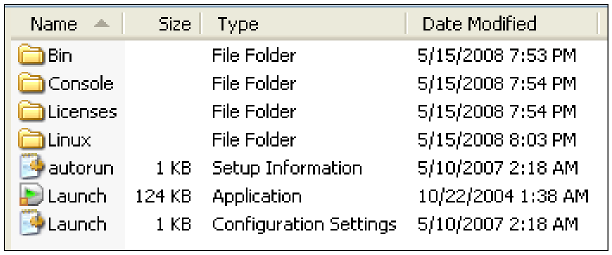



*Figure 6-7 TS7530 VE for Tape Console: Manually starting the install process*

4. To install the TS7530 VE for Tape Console, click **Install Console GUI** on the panel shown in Figure 6-8.


*Figure 6-8 Install Console GUI*

5. To continue the TS7530 VE for Tape Console setup, click **Next** on the panel shown in Figure 6-9.

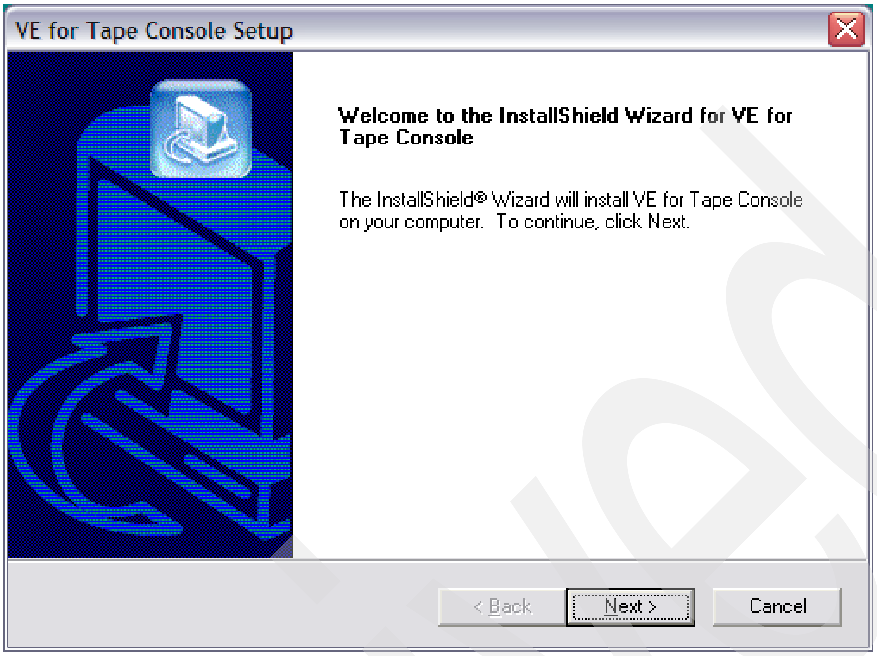



*Figure 6-9 TS7530 VE for Tape Console Install Welcome panel*

6. When the TS7530 VE for Tape Console installation starts, it checks for the existence of a previous installation. You must delete these files before the installation can continue. After the files are deleted, you can continue the installation of the TS7530 VE for Tape Console. Click **OK** on the window shown in Figure 6-10.

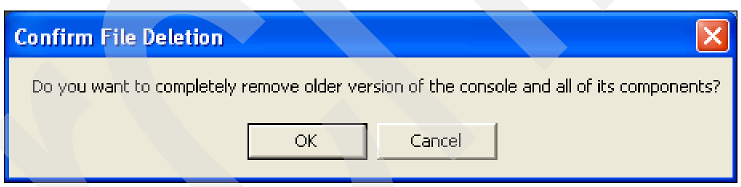



*Figure 6-10 Confirm the previous file deletion*

7. Review the TS7530 VE for Tape Console software license agreement. To accept the terms and conditions specified, click **Accept** as on the panel shown in Figure 6-11.

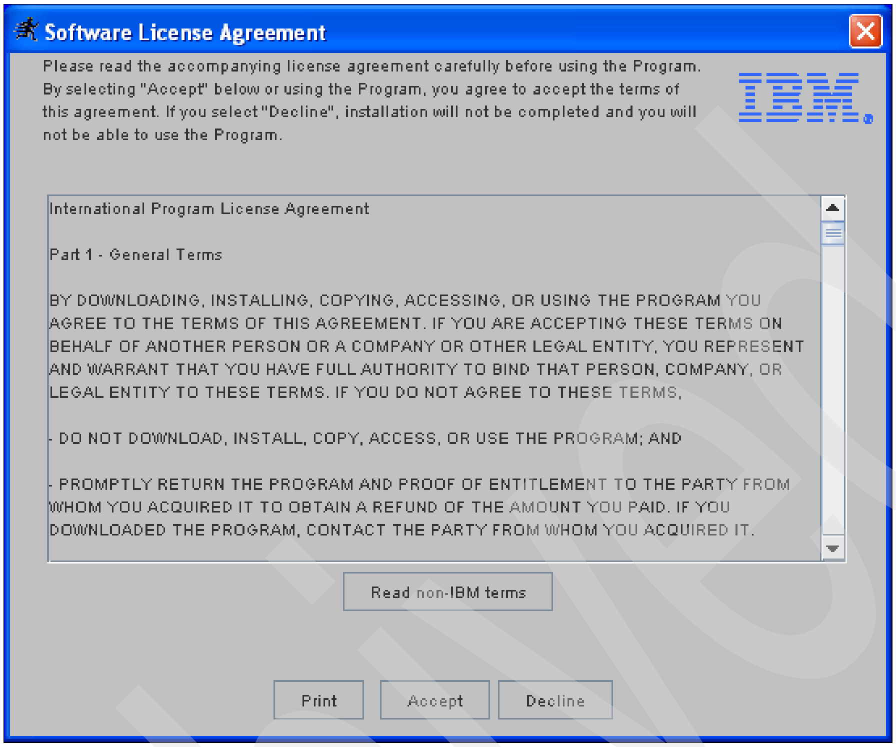


*Figure 6-11 TS7530 VE for Tape Console install software license agreement*

8. In the VE for Tape Console setup of the installation wizard you can enter your name and the name of the company and click **Next** on the panel shown in Figure 6-12.

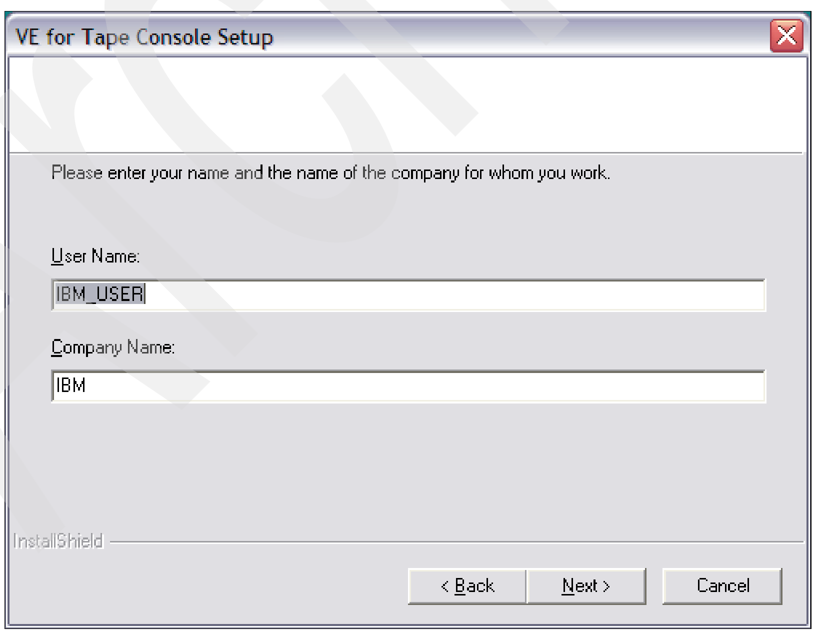


*Figure 6-12 TS7530 VE for Tape Console install location*

9. In the Choose Destination Location window of the installation wizard, you can change the VE Console installation location. We recommend that you install the VE tape Console in

the default destination (C:\Program Files\IBM\VE for Tape). Specify the destination location and click **Next** (Figure 6-13).

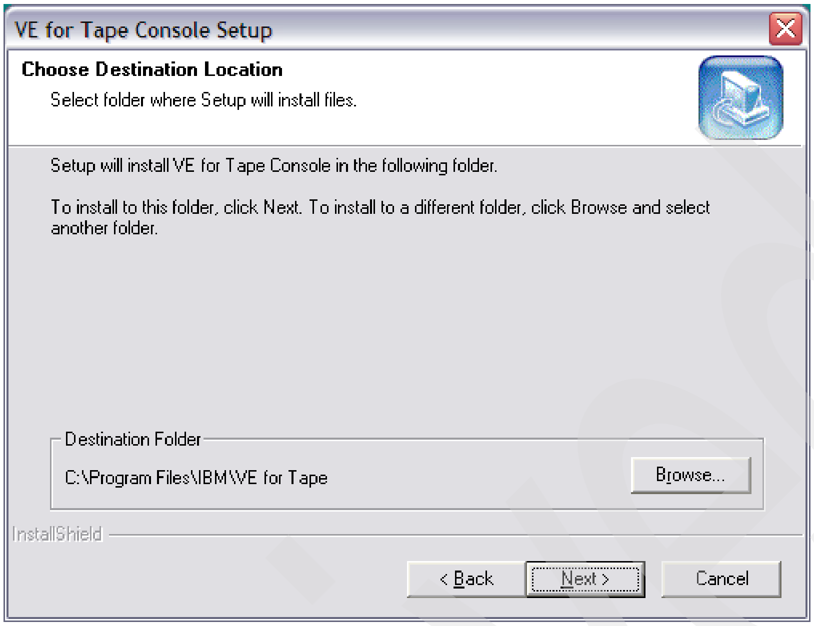



*Figure 6-13 TS7530 VE for Tape Console install location*

10.In the Select Program Folder window of the installation wizard you can change the name of the TS7530 VE for Tape Console program folder. We recommend that you use the default TS7530 VE for Tape Console folder name (IBM\VE for Tape). Specify the program folder name and click **Next** on the panel shown in Figure 6-14.

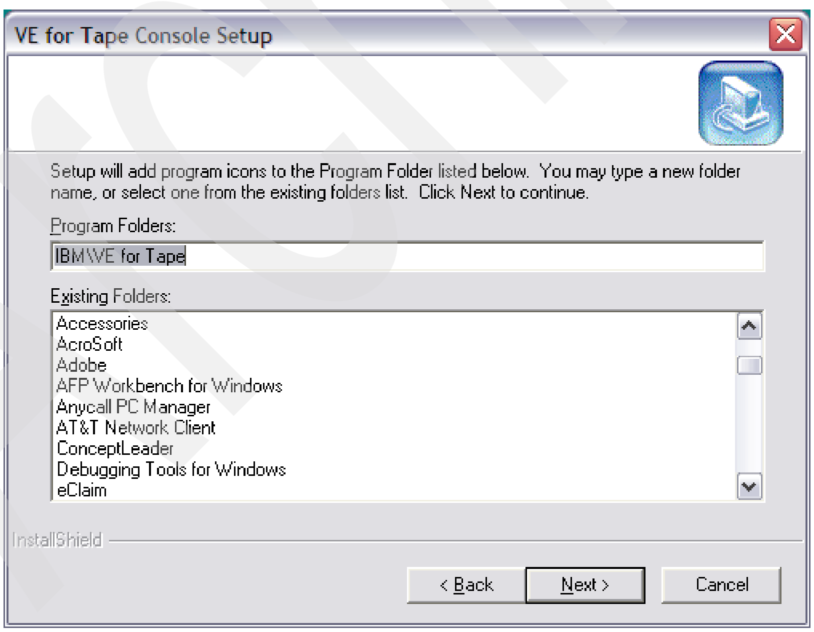



*Figure 6-14 TS7530 VE for Tape Console program folder name*

11. Review the settings. Click **Next** on the panel shown in Figure 6-15 to start copying the files.

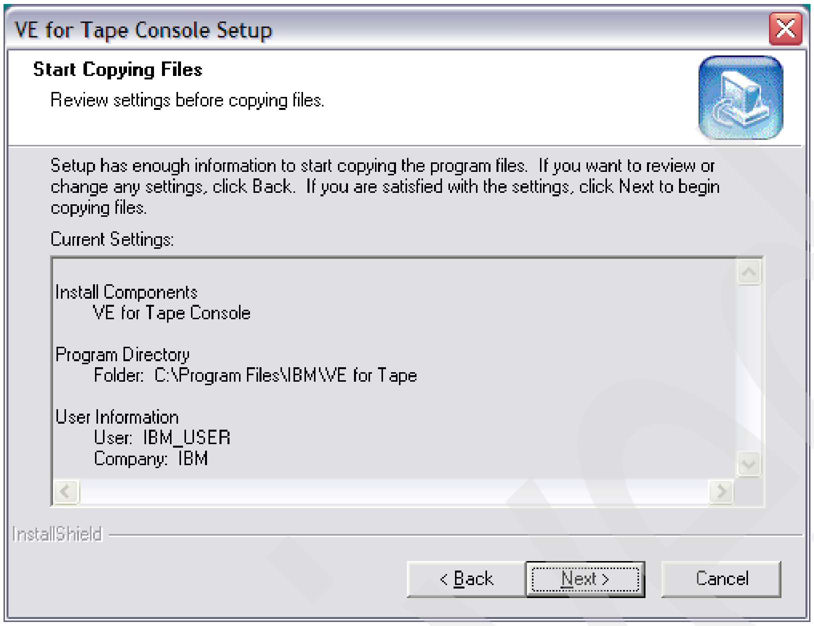



*Figure 6-15 TS7530 VE for Tape Console install start copying files*

You should see the Setup Status panel (similar to the one shown in Figure 6-16) displayed while the files are being copied.

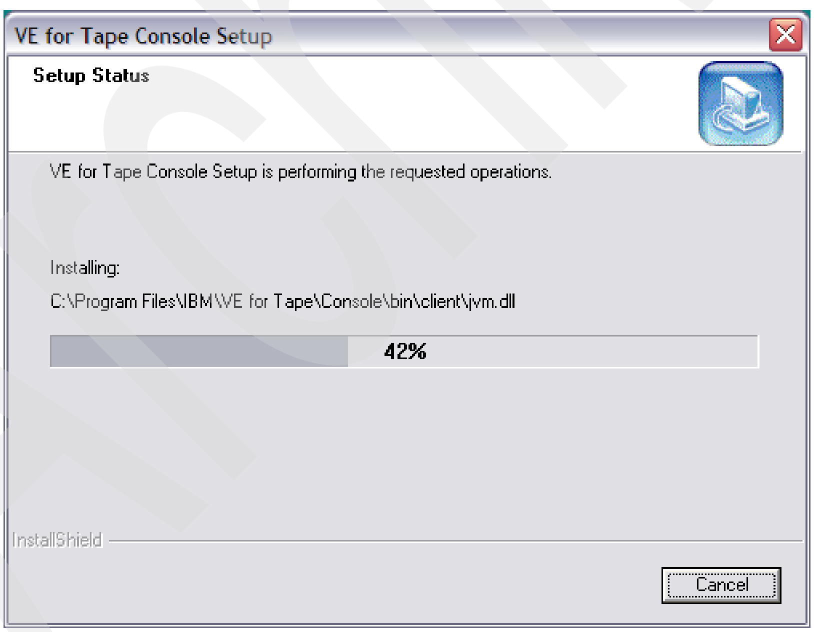



*Figure 6-16 TS7530 VE for Tape Console install setup status*

12.Click **Finish** on the panel shown in Figure 6-17 to complete the installation.

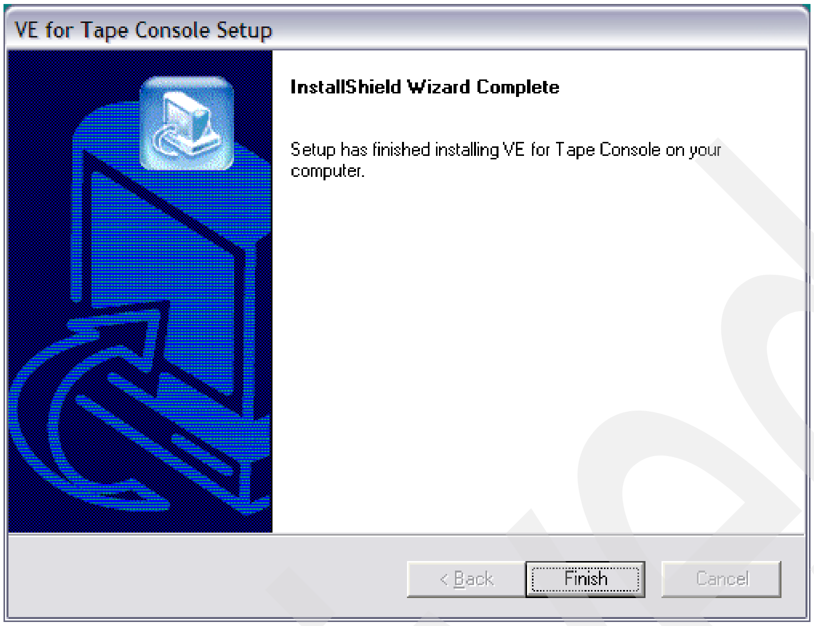



*Figure 6-17 TS7530 VE for Tape Console install completion*

### 6.3.2 Starting TS7530 VE for Tape Console for the first time

To access your TS7530 Virtualization Engine server you must use the TS7530 VE for Tape Console. On the TS7530 VE for Tape Console, an instance of a TS7530 Virtualization Engine server is considered as a TS7530 VE for Tape Server. For example, in a dual-node system you have two TS7530 VE for Tape Servers. The steps to access a TS7530 VE for Tape Server initially are:

1. To launch the TS7530 VE for Tape Console double-click the desktop icon created during the install (Figure 6-18).


*Figure 6-18 Icon*

2. If you attempt to start the TS7530 VE for Tape Console with code that is a lower level than the code running on the TS7530 VE for Tape Server your login attempt will fail and you will see an error window (Figure 6-19). To correct this problem, install the same level of code for both the TS7530 VE for Tape Server and the TS7530 VE for Tape Console.

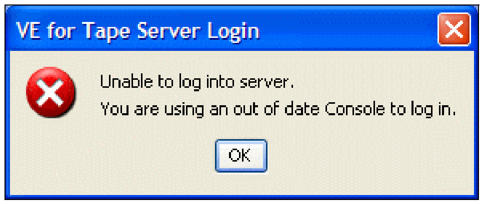



*Figure 6-19 TS7530 VE for Tape Console failure with back-level code*

You should see the TS7530 VE for Tape Console window (Figure 6-20).

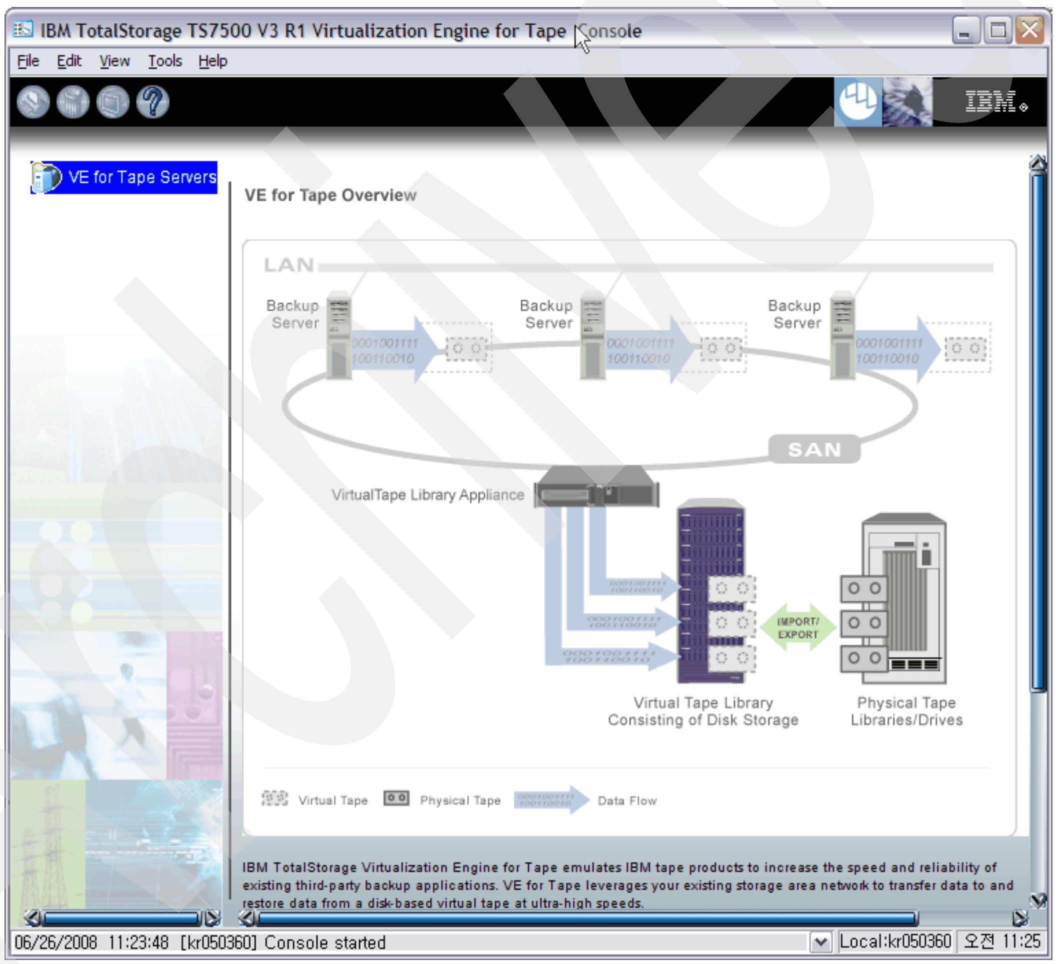



*Figure 6-20 TS7530 VE for Tape Console Initial window*

3. When you start the TS7530 VE for Tape Console for the first time you must create a connection for each of your TS7530 VE for Tape Servers. To add a new TS7530 VE for Tape Server right-click the **VE for Tape Servers** object and select **Add,** or select **Edit** → **Add**.

**Note:** After the initial access to a VE for Tape Server you do not have to re-enter the network name or TCP/IP address on subsequent logins.

4. In the VE for Tape Login window (Figure 6-21) specify the information required to register and connect to a TS7530 VE for Tape Server. Click **OK**.

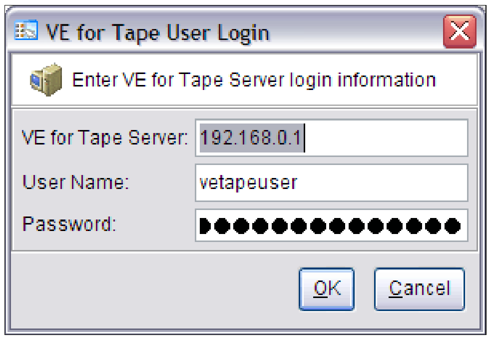



*Figure 6-21 TS7530 VE for Tape User Login*

The fields are:

**VE for Tape Server** The network name or TCP/IP address of the TS7530 VE For Tape Server. The TCP/IP address was configured by the SSR during the TS7530 install. Refer to the sample worksheets in Appendix D, “Installation and implementation checklists” on page 533.

**User Name** Your user name on the TS7530 VE for Tape Server.

**Password** The password associated with the user name.

**Tip:** The default user name is vetapeuser and the default password is veuserpassword. The user name and password are *case sensitive*.

5. If the connection is successful, you can see the current status of the TS7530 VE for Tape Server that you added displayed as shown in Figure 6-22. You are presented with an overview of the hardware installed on your TS7530 VE for Tape Server at the top of the scrollable area. If you scroll to the bottom of this area, you can review current system drive usage. Of course, you can see some important information like IP addresses, the number of hardware compression cards, and so on.

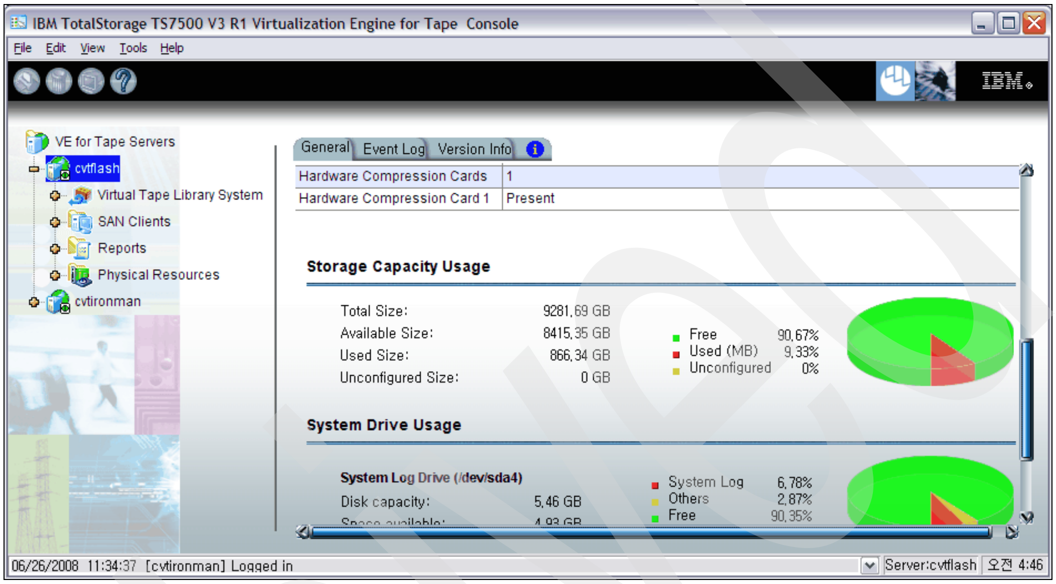



*Figure 6-22 TS7530 VE for Tape Console Status window*

On the top left of the window (Figure 6-22) you can locate the name of the TS7530 VE for Tape Server name. In our example, the TS7530 for Tape Server names are cvtflash and cvtironman, as detailed in Figure 6-23. These example systems are configured as a high-availability (HA) configuration.

The default name exists for all of TS7530 series. SANSystem1 and SANSystem2 are the default names for a TS7500 Enterprise Edition. You so not have to use the default server names because the TS7530 VE for Tape Console is able to manage lots of TS7530 VE for Tape Servers.

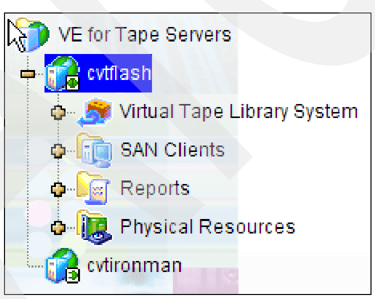



*Figure 6-23 VE for Tape Server name*

6. If a user does not use TS7530 VE for Tape Console for a specific time (default 10 minutes), the connection will be dropped by TS7530 VE for Tape Server automatically (Figure 6-24). If you want to reconnect the VE for Tape Server, double-click the name of the VE for Tape Server. For more information about how to change this value see 6.4, “Initial configuration” on page 196.

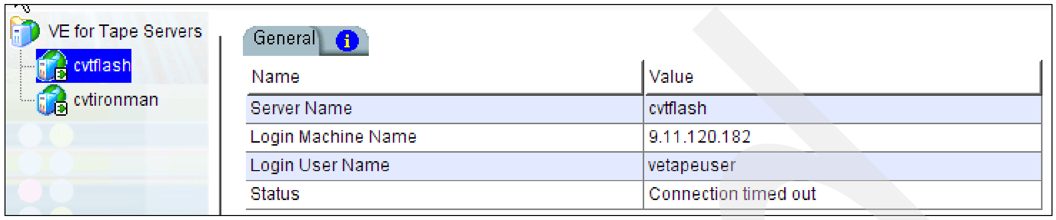



*Figure 6-24 Logged out status*

> **Tip:** In this IBM Redbooks pubication we use <your TS7530 server> to represent the name assigned to your TS7530 VE for Tape Server. Always remember to replace <your TS7530 server> with the name of your TS7530 VE for Tape Server.

## 6.4 Initial configuration

The first time that you connect to a TS7530 VE for Tape Server you should perform basic configuration. The section will take you through the steps to change the:

- Default password
- TS7530 VE for Tape Console options

### 6.4.1 Changing the default password

This section describes the steps to change the default password. As the default password is documented in the *IBM Virtualization Engine for Tape TS7500 Version 3 Release 1 - User’s Guide,* GC27-2179, we recommend that the default password be changed soon after installation.

To change the default password:

1. Right-click **<your TS7530 server>** and select **Change Password** from the panel shown in Figure 6-25.

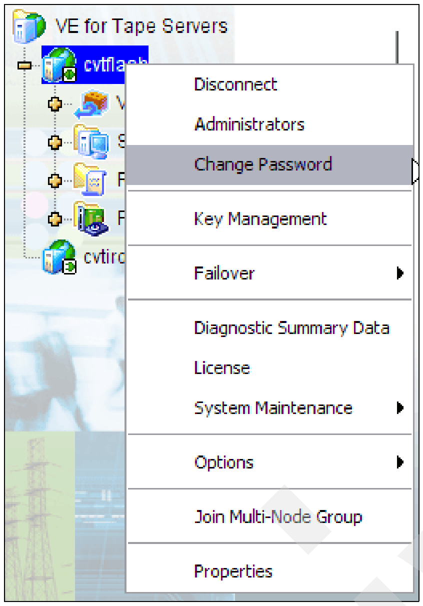



*Figure 6-25 Change Password menu*

2. In the Change VE for Tape Login Administrator Password window (Figure 6-26) specify:
   – Default password (veuserpassword)
   – New password
   – New password again to confirm

   Click **OK**.

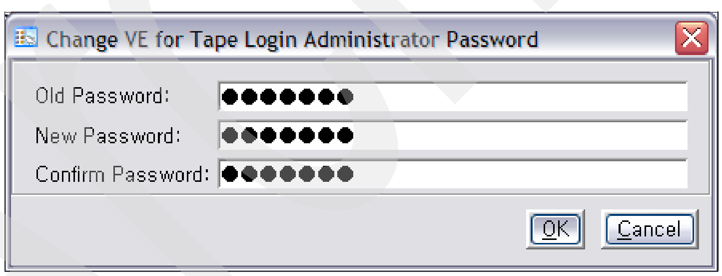



*Figure 6-26 Change VE for Tape Login Administrator Password*

## 6.4.2 Changing console options

To change the TS7530 VE for Tape Console options select **Tools** → **Console Options** from the panel shown in Figure 6-27.

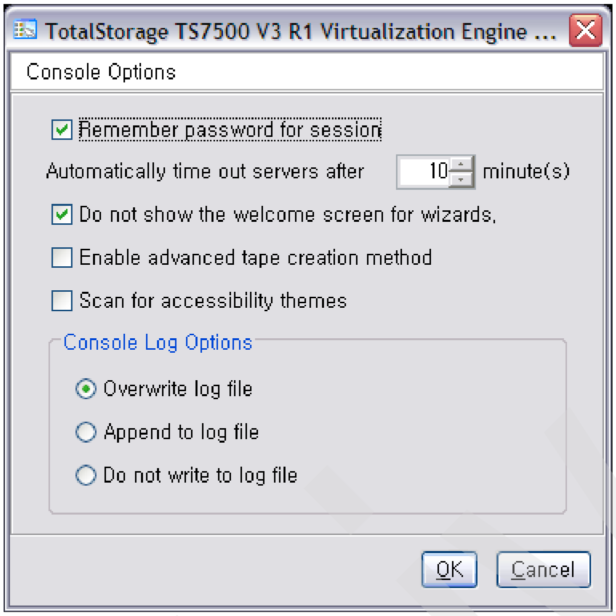



*Figure 6-27 Console Options panel*

When you set the TS7530 VE for Tape Server session time-out value to 0 minutes, your session will never time out. A time out value of 0 is useful during the implementation phase.

We discuss setting and using advanced tape creation in 6.9, "Advanced Tape Creation method" on page 228.

If your computer uses Windows Accessibility Options, select the option of **Scan for Accessibility Themes**.

> **Recommendation:** Do not use advanced tape creation until you are familiar with the operation of TS7530 VE for Tape Server virtual volumes and understand the ramifications of changing volume capacities.

Set the following TS7530 VE for Tape Console options in accordance with your local security policy when the TS7530 is moved into production:

- Remember password for session.
- Automatically time out servers.

Further information about console options can be found in the *IBM Virtualization Engine for Tape TS7500 Version 3 Release 1 - User's Guide*, GC27-2197.

## 6.5 Verifying your configuration

This section describes how you can verify the configuration of the TS7530 VE for Tape Server after installation by the SSR. You should use these steps to verify:

- Network
- Storage
- HBAs
- Disk storage availability
- Physical tape storage

### 6.5.1 Network

The SSR performs the network configuration during the installation of the TS7530 Virtualization Engine.

> **Recommendation:** Do *not* change the network configuration unless you know exactly what you are doing and have a backout strategy in place.

You can verify the current network information as follows:

1. Right-click **<your TS7530 server>,** then select **System Maintenance** → **Network Configuration** from the panel shown in Figure 6-28.

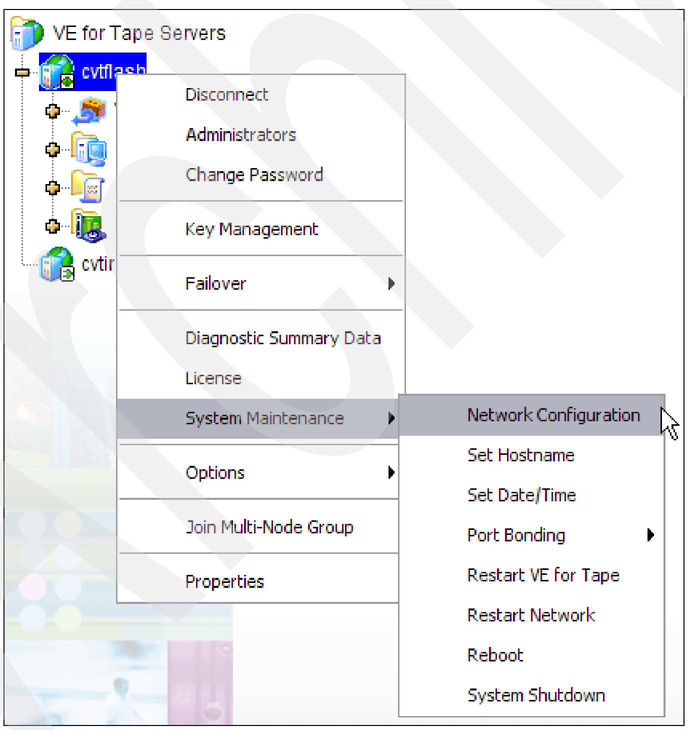



*Figure 6-28 Network Configuration menu*

2. You can review and optionally specify new configuration values in the TS7530 VE for Tape Server Network Configuration window shown in Figure 6-29.

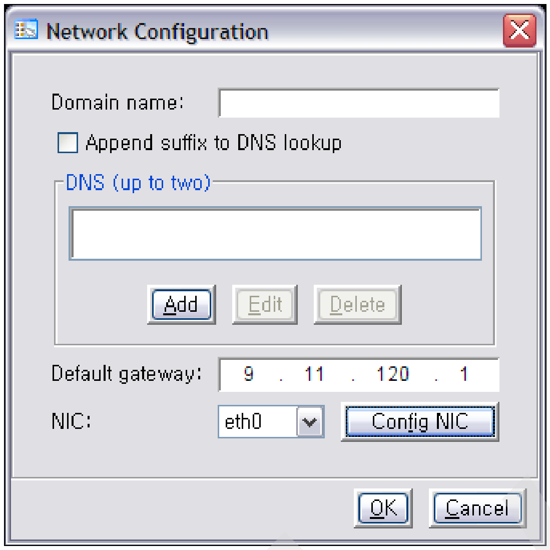



*Figure 6-29 Network Configuration menu*

The network configuration panel contains the following information:

**Domain name** The domain name.

**Append suffix to DNS lookup**
If this option is checked and you specify a domain name, the domain name is automatically appended to the machine name during name resolution.

**DNS** The IP address of up to two DNS servers.

**Default gateway** The IP address of the default gateway. Without a default gateway you may not be able to connect to your TS7530 VE for Tape Server from outside of the current subnet.

**NIC** The list of Ethernet cards (NICs) installed in the TS7530 Virtualization Engine.

> **Hint:** You cannot change the network settings for a TS7530 VE for Tape Server running in high-availability mode. To change the network settings you must first remove the failover configuration.

3. You can review (and optionally) change the settings for each TS7530 for Tape Server Network Interface Card (NIC) by selecting either ETH0 or ETH1 from the NIC drop-down and clicking **Config NIC** on the panel shown in Figure 6-30. When the IP Address Configuration panel is displayed (Figure 6-30) you can add, edit, or delete the IP address. In Version 2 Release 1, Eth1 was a DHCP address by default. With the TS7530 VE for Tape Server, this address is static by default. In this way booting will be faster since the machine does not try to boot from a DHCP server that may not be there.

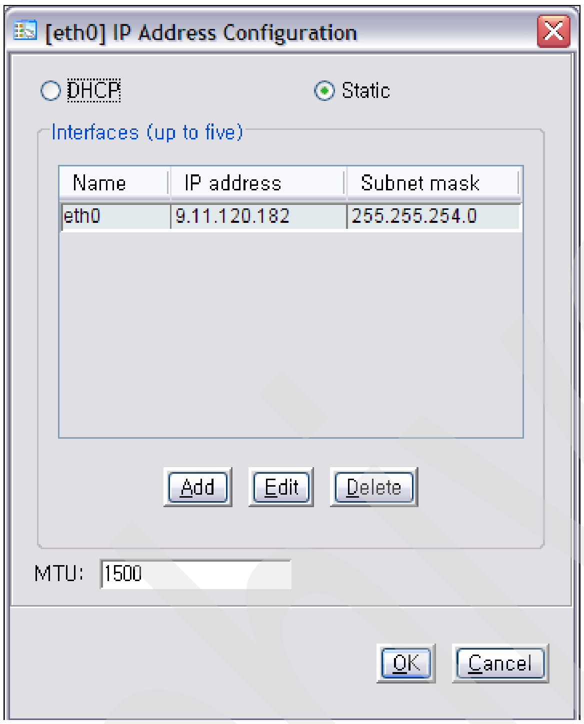



*Figure 6-30 IP Address Configuration menu*

The network configuration panel contains the following information:

– DHCP or static

Select the value for your need.

> **Note:** For an active-active failover configuration you must use static IP addresses.

– MTU

Default: 1500. Set the maximum transfer unit of each IP packet. If your card supports it, set this value to 9,000 for jumbo frames.

> **Note:** We recommend that you do not change this value without detailed network knowledge. Before changing this value you must check the connected server, switch environment, and so on.

## 6.5.2 Storage HBAs

To verify the TS7530 VE for Tape Server Storage HBA configuration in an Enterprise Edition configuration, left-click **<your TS7530 server>** to expand the menu, then left-click **Storage HBAs** (but do not expand). See Figure 6-31.

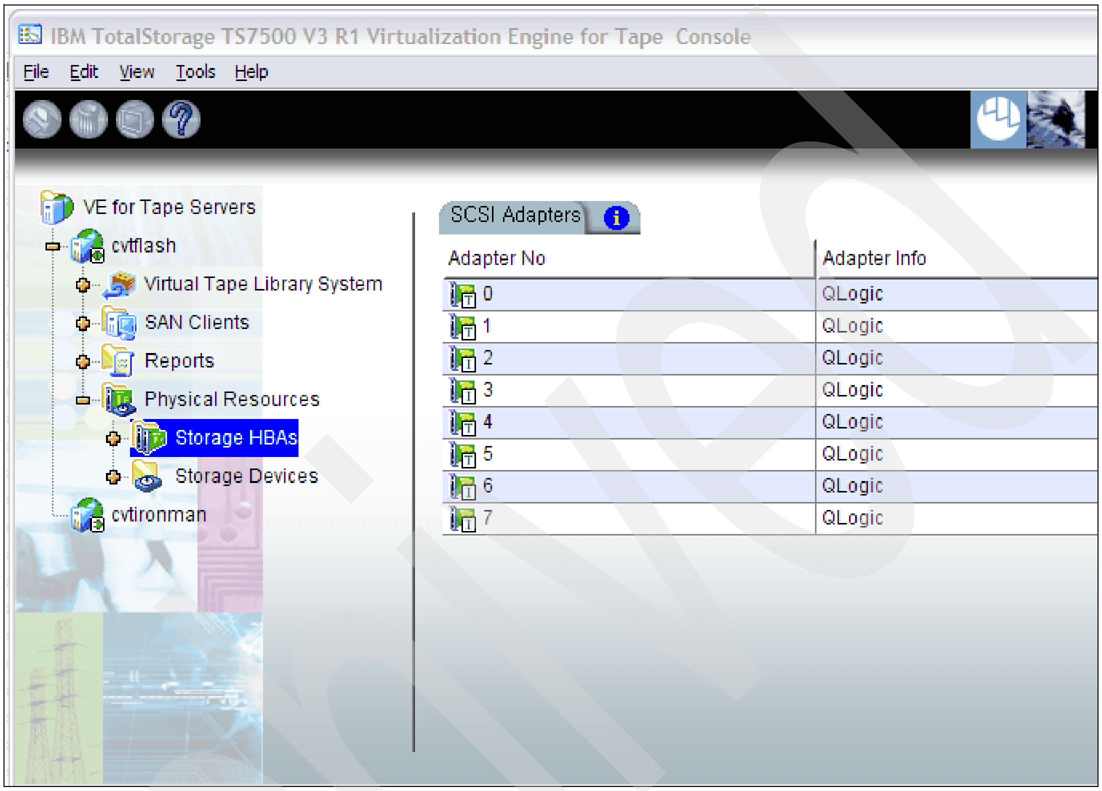



*Figure 6-31 TS7530 VE for Tape Server Storage HBAs*

The Enterprise Edition (EE) of the TS7530 Virtualization Engine comes with two quad-ported Fibre Channel adapters in PCI express slots 1 and 2. These adapters support multi-WWPN mode for failover operations. The Enterprise Edition of the TS7500 Virtualization Engine can use an optional quad-port Fibre Channel adapter in slot 3. In the Enterprise Edition, the first two ports of each quad-port Fibre Channel adapter in PCI express slots 1 and 2 are connected to the disk cache either directly or through the internal Fibre Channel switch.

Adapters numbered 2, 3, 6, and 7 (slots 1, 2) are directly attached to the 3955-SV6 disk subsystems. The little box by the adapter graphic must have a green letter `I` indicating that the adapter is in initiator mode.

Adapters numbered 0, 1, 4, and 5 are set to target or initiator mode by default. These adapters are wanted for host access to virtual tape resources. Also, these adapters are used to attach backup application servers or physical tape drives. The little box by the adapter graphic should have a green letter T indicating that the adapter is in target mode or a green letter I indicating initiator mode.

If the adapters are to be used for direct physical tape library and drive access, the adapters must remain in initiator mode.

Figure 6-32 shows the QLogic® adapter numbers displayed in the VE Console for a TS7530 Server with various Fibre Channel card configurations.

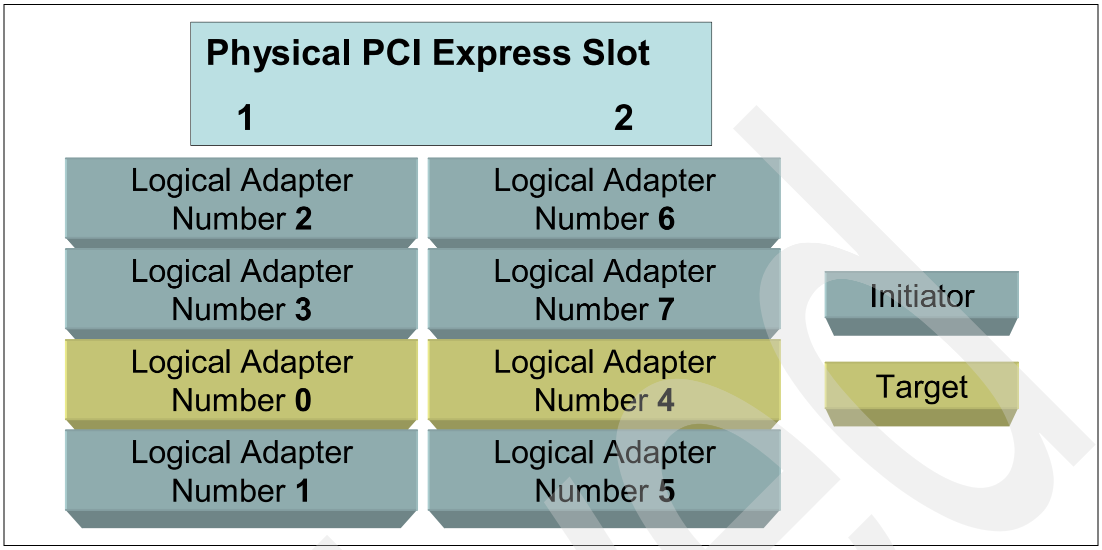



*Figure 6-32 QLogic adapter numbers displayed in the VE console, two 4-port Fibre Channel cards*

For more specific information see the *IBM Virtualization Engine for Tape TS7500 Version 3 Release 1 User's Guide,* GC27-2179.

> **Note:** PCI Express slot 4 does not hold Fibre Channel cards. A port in initiator mode with devices attached cannot change to target mode. A port in target mode with virtual tape libraries assigned cannot change to initiator mode.

The steps to change an adapter into target mode are described in Chapter 12, "Operation" on page 377.

## 6.5.3 Verifying storage devices

You can verify the TS7530 VE for Tape Server Storage Device status from the TS7530 VE for Tape Console as follows:

1. Left-click **<your TS7530 server>** to expand the menu.

2. Left-click **Storage Devices** (but do not expand) as shown in Figure 6-33.

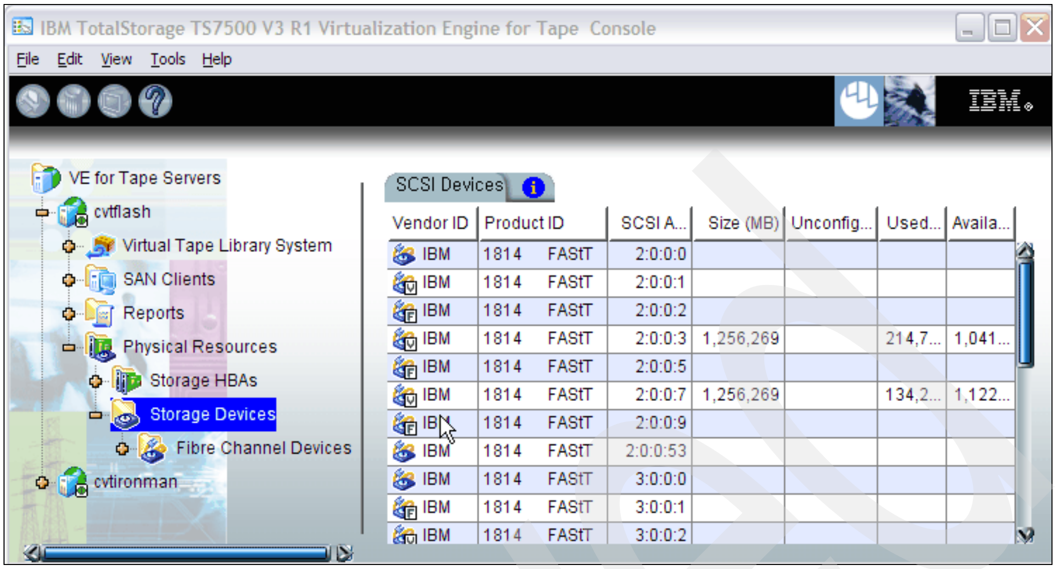



*Figure 6-33 TS7530 VE for Tape Server storage devices*

The SCSI address column in Figure 6-33 uniquely identifies each disk resource. The format is *A*:0:0:*L*, where *A* is the adapter number from Figure 6-31 on page 202 and *L* is the logical unit (LUN) number. For example, 2:0:0:0 is the disk resource accessed through adapter 2 with LUN number 0.

- The icons for disk resources with SCSI addresses 0:0:0:0, 0:0:0:2, 1:0:0:0, 1:0:0:1, 0:0:0:31, 2:0:0:31, 1:0:0:31, and 3:0:0:31 do not display a green letter **V**. These devices are reserved for uses other than virtual access.
- Disk resource 0:0:0:0 is the boot logical unit for the TS7530 (3954-CV7) Server.
- Disk resources 0:0:0:2, 1:0:0:0, and 1:0:0:1 are reserved and used when upgrading to a dual TS7530 (3954-CV7) Server high-availability configuration.
- Disk resources 0:0:0:31, 2:0:0:31, 1:0:0:31, 3:0:0:31 access logical drives used for in-band communication with the disk storage agent software.

All other disk resources should have the little box with the green V. The V indicates that the disk resources have been prepared for virtual access or enlisted. In other words, they are available to the TS7530 VE for Tape Server to be used as storage for the virtual cartridges or the TS7530 VE for Tape Server database.

**Note:** The icons for all other disk resources display a green letter V or F. The V indicates devices that have been enlisted, that is, they have been prepared for virtual access. These devices are available to the server for use either as the server database or as virtual tape cartridges. The F indicates devices that have been enlisted by the server that is a failover partner of the current server.

## 6.6 Virtual libraries

The TS7500 Virtualization Engine comes preconfigured with two virtual TS3500 Tape Libraries per TS7530 Server. Each tape library contains 12 virtual LTO 3 Tape Drives and 253 tape cartridge slots. Each library is preconfigured with virtual tape cartridges. The number of tape cartridges preconfigured is proportional to the total system capacity.

Each default library and the associated drives have been assigned to the default SAN client Everyone_FC. For more information about SAN clients refer to 6.7, “SAN clients” on page 216.

The default libraries are accessible when the TS7500 Virtualization Engine is turned on. You can immediately start using these libraries without any additional configuration necessary through the VE console. However, the VE console provides information helpful in creating the necessary zones when connecting to a SAN.

For detailed information about how to create and change a virtual library, refer to the *IBM Virtualization Engine for Tape TS7500 Version 3 Release 1 - User’s Guide*, GC27-2197.

## 6.6.1 Library name cross reference

The TS7530 VE for Tape Server lists supported tape libraries using the product ID returned by a SCSI inquiry. Table 6-1 cross references the IBM Tape libraries with their SCSI product IDs.

*Table 6-1 Library: Product ID cross reference*

| IBM library | Product ID |
|---|---|
| IBM Total Storage 3584 with TS1120, 3592 drives | 03584L22 |
| IBM Total Storage 3584 with LTO drives | 03584L32 |
| IBM TS3500 with TS1120, 3592 drives | 03584L22 |
| IBM TS3500 with LTO drives | 03584L32 |
| IBM TS3100 with LTO drives | 3573-TL or TS3100 |
| IBM 3573 with LTO drives | 3573-TL |
| IBM TS3200 with LTO drives | 3573-TL or TS3200 |
| IBM TS7510 Virtualization Engine with LTO, TS1120, or 3592 drives[a] | TS7510 |
| IBM TS7520 Virtualization Engine with LTO, TS1120, or 3592 drives[a] | TS7520 |
| IBM TS7530 Virtualization Engine with LTO, TS1120, or 3592 drives[a] | TS7530 |
| IBM Total Storage 3576 with LTO drives | 3576-MTL |
| IBM TS3310 with LTO drives | 3576-MTL |
| IBM Total Storage 3582 with LTO drives | ULT3582-TL |
| IBM Total Storage 3583 with LTO drives | ULT3583-TL |
| IBM System Storage TS3400 with TS1120 Tape Drives | 3577-TL |

a. During virtual library creation, you can select a virtual library type of TS7530, TS7520, or TS7510. These options emulate IBM TS3500 library models appropriate for the virtual tape drive technology selected. TS7530, TS7520, and TS7510 are only used if your backup application vendor requires them. Check with your backup application vendor.

For detailed information about the emulation mode, refer to the *IBM Virtualization Engine for Tape TS7500 Version 3 Release 1 - User’s Guide*, GC27-2197.

## 6.6.2 Creating a virtual library and drives

In the following example we take you through the steps to create a virtual TS3500 library with six virtual 3592-J1A Tape Drives. Our library will be named LibVirtual-3584L22. In this example the virtual library does not utilize any of the new features of the TS7530 Virtualization Engine.

To create a new virtual library:

1. As shown in Figure 6-34, right-click **Virtual Tape Libraries**. Select **New** to start the wizard.

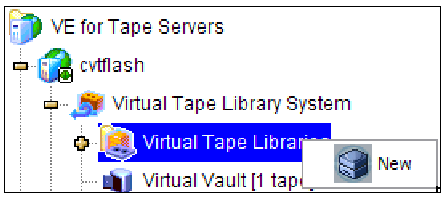



*Figure 6-34 Virtual library: Starting the Create Virtual Library Wizard*

2. The Specify Equivalent Library Creation window (Figure 6-35) only appears only if:

   – There is a physical library attached.
   – No previous equivalent library has been created.

   If this item is selected, all physical drives and cartridges in the physical library will automatically be assigned to a single virtual library.

   > **Note:** Only activate this option if you require only one cached library that contains all the drives and cartridges in the physical library.

   Deselect the option and click **Next**.

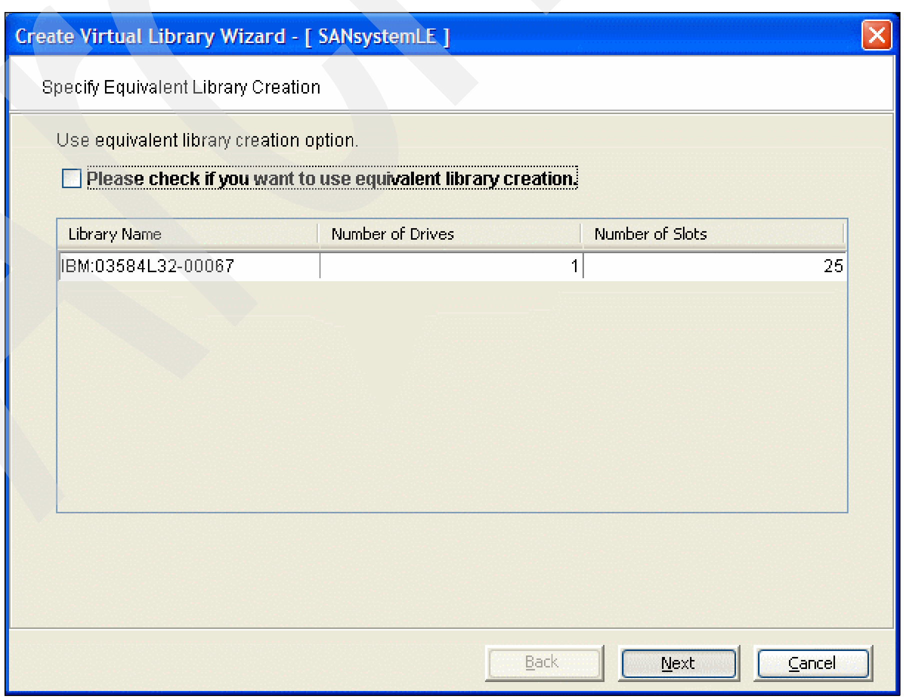



*Figure 6-35 Virtual library creation: Specify Equivalent Library Creation*

3. We are creating a TS3500 virtual library with 3592 drives. From the table in 6.6.1, “Library name cross reference” on page 205, you must choose the library that returns the product ID 03584L22**.** Select the library type, specify the library name, and click **Next**.

   It is important to choose a library type supported by your backup application.

   You should establish and document the naming convention to be used for virtual tape drives and libraries.

   **Note:** The Maximum Drives and Maximum Slots columns of the Create Virtual Library Wizard show the maximum number of drives and storage slots in a single frame. You can override the maximum number of drives and storage slots if you wish to virtualize a library with expansion frames.

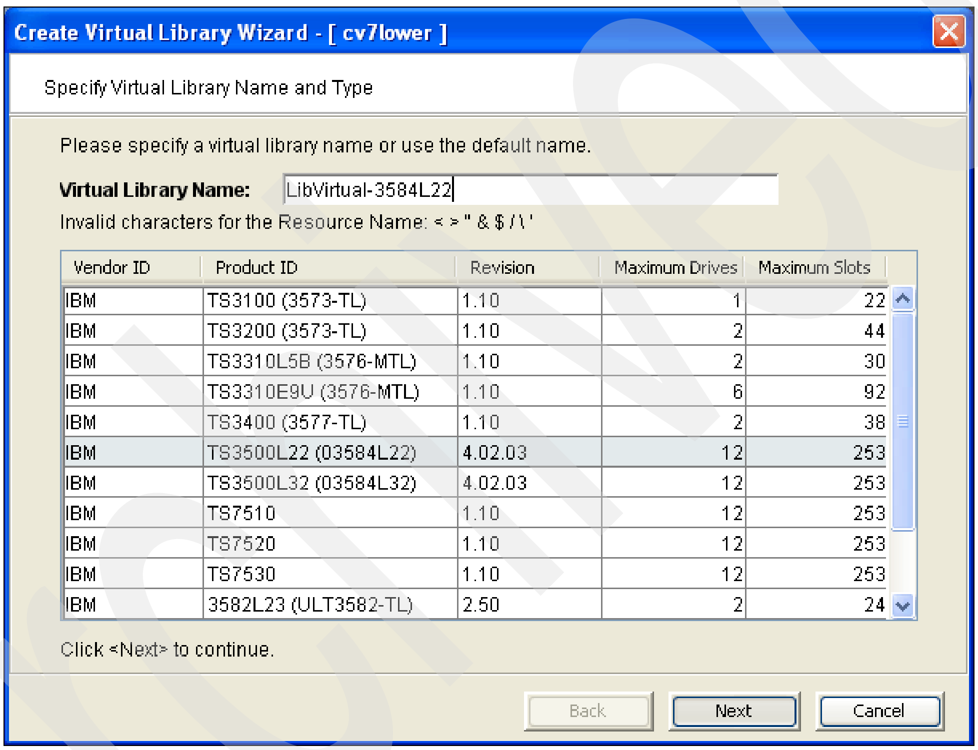



*Figure 6-36 Virtual library creation: Specify Virtual Library Name and Type*

4. Specify the tape drive attributes in the panel shown in Figure 6-37 on page 208:

   – Drive drive type you wish to virtualize: 3592-E05
   – Drive prefix: DrvVirt-3592E05
   – Number of virtual drives to create: 6

   It is important to choose a drive type supported by your backup application.

   Click **Next**.

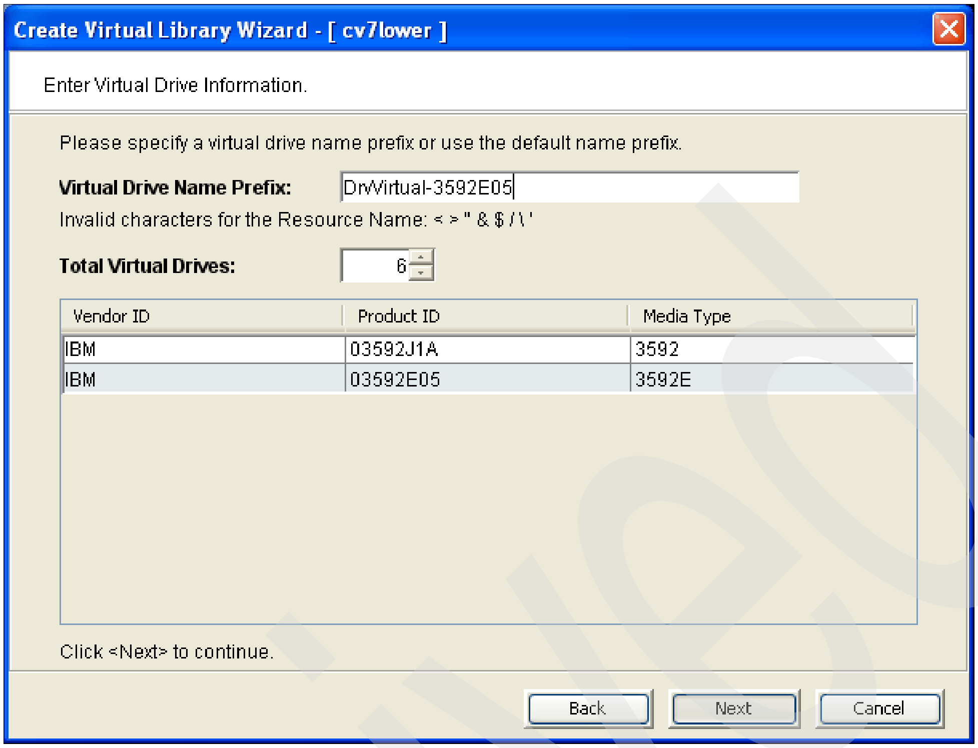



Figure 6-37 Virtual library creation: Enter Virtual Drive Information

5. This example illustrates the creation of a virtual library without Enhanced Tape Caching. See 6.10, “Physical libraries and Enhanced Tape Caching” on page 233. This describes the steps required to create a virtual library that uses Enhanced Tape Caching to migrate data to physically attached (backend) tape.

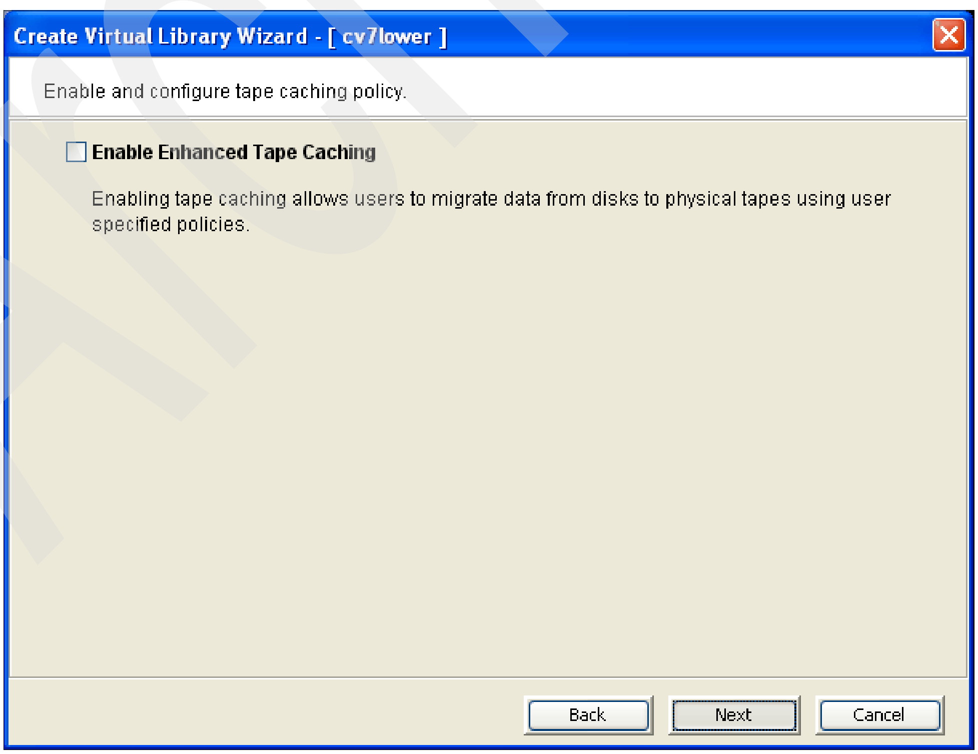



Figure 6-38 Virtual library creation: Enable Enhanced Tape Caching

> **Important:** You will see references throughout this and other chapters to Enhanced Tape Caching and automated tape caching. Both terms refer to the same function.

6. Select the Export Physical Copy / Network Copy option (Figure 6-39) if you want the TS7530 VE for Tape Server to automatically *move* or *copy* virtual volumes to physical tape or to another network-attached TS7530 VE for Tape Server, respectively, whenever a virtual tape volume is moved to the *input/output station (I/O station)*.

   For detailed information about Export Physical Copy/Network Copy refer to the *IBM Virtualization Engine for Tape TS7500 Version 3 Release 1 - User's Guide*, GC27-2197.

   We chose not to invoke this function. Click **Next**.

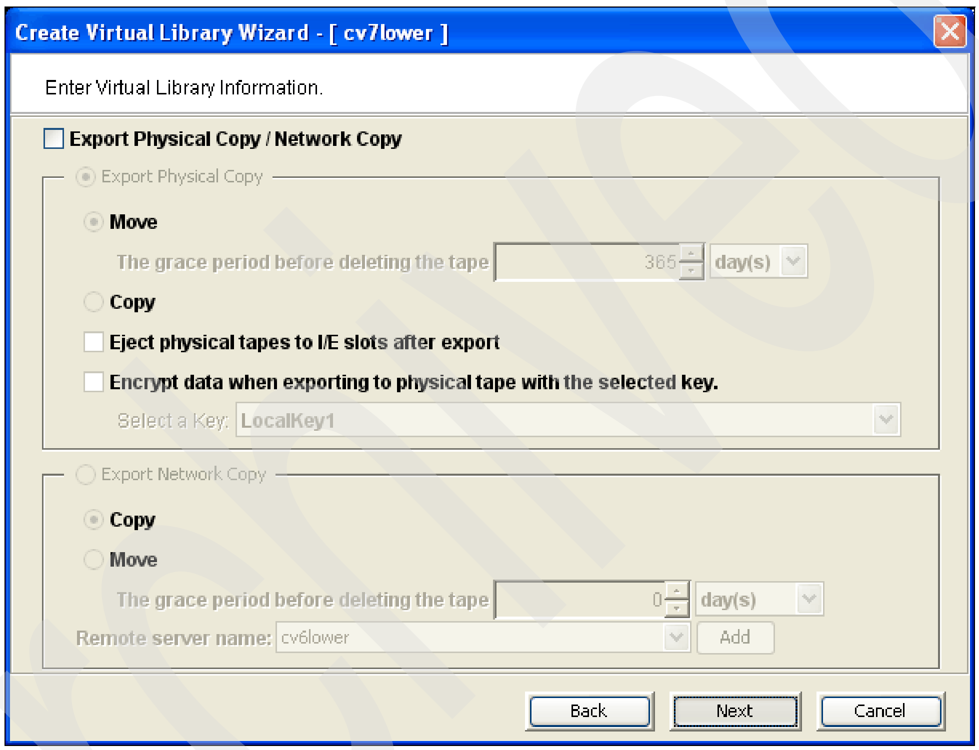



*Figure 6-39 Virtual Library Export Physical Copy/Network Copy*

The Export Network Copy options are:

**Move** Delete virtual volume after export.

**Copy** Retain virtual volume after export.

The Export Physical Copy option writes data to physical tape whenever a virtual tape is moved to an IE slot from a virtual library (by a backup application or other utility after a backup). In order to use Export Physical Copy the physical tape library must support barcodes because when VE for Tape attempts to export to physical tape it must find a matching barcode in a physical library (you do not need to specify which physical library). If you select Export Physical Copy, determine whether you want the virtual tape copied (retained) or moved (removed) after the data is transferred. If you select Move, indicate how long to wait before deleting it. Also, indicate whether you want to export your physical tapes to the library's import/export slots after archiving. You can encrypt the data while exporting as long as you have created at least one key. (For more information, refer to 12.5, "Enhanced Tape Caching" on page 399.)

Export Network Copy replicates data to another VE for Tape server whenever a virtual tape is moved to an IE slot from a virtual library (such as from a backup application or other utility). If selected, determine whether you want the virtual tape copied (retained) or moved (removed) after the data is replicated. If you select Move, indicate how long to wait before deleting it. Also, select the remote server from the list of existing target servers. You can also click Add to add another VE for Tape server.

> **Important:** Export Network Copy is not compatible with enhanced caching. You can select either Export Physical Copy or Export Network Copy for a virtual library, but not both.

7. In the panel shown in Figure 6-40 on page 211, specify additional library attributes:

**Barcode Starts/Ends** Specifies the range of barcodes that will be used when creating virtual tape volumes for this library. These options define the barcode range for the virtual volumes, but does not create the virtual volumes. By default, barcodes increment in an alphanumeric sequence, for example, XXXX00 to XXXXZZ. To set the barcode to increment in a numeric sequence (XXXX01 to XXXX10), set the last three digits of the Barcode Ends field to 999, for example, XXX999.

**Slot** The maximum number of tape slots in your tape library.

**Import/Export Slots** Number of slots used to take tapes in and out of the library.

> **Tip:** The number of virtual volumes that you can define for a virtual library is limited by the number of slots defined for that library. The maximum number of slots that can be defined for a single virtual library is 65,536. For example, if you specify 1000 slots for a virtual library, the maximum number of virtual volumes in that virtual library will be 1,000. The number of slots cannot be changed after virtual library creation.

Click **Next** as shown in Figure 6-40 on page 211.

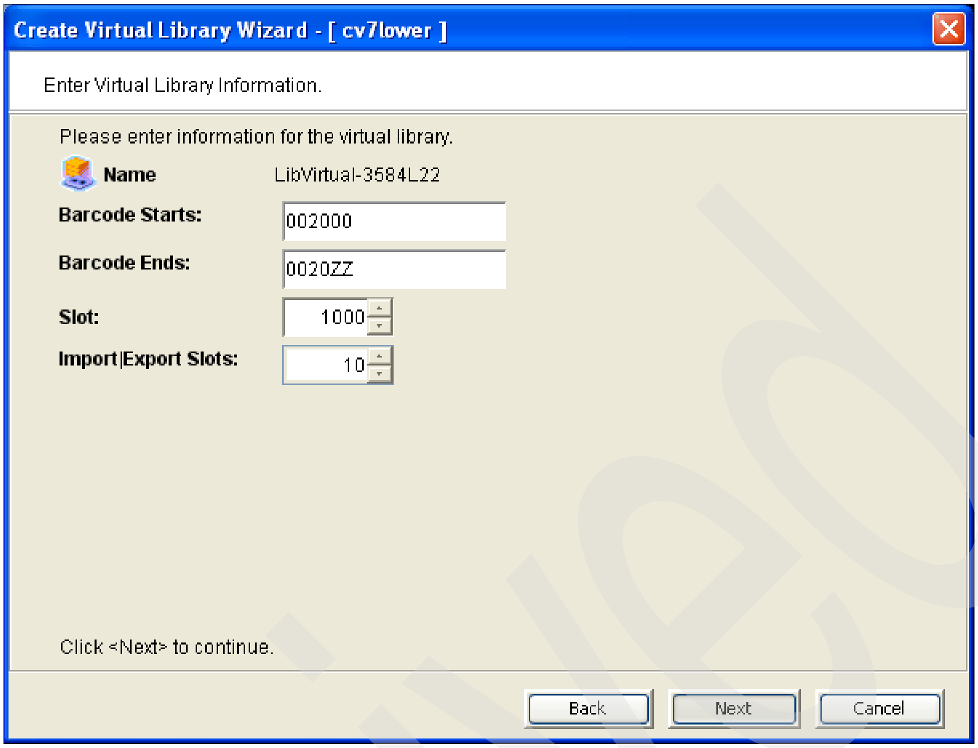



*Figure 6-40 Virtual library creation: Specify barcode range and slot attributes*

> **Warning:** Do *not* define virtual volumes that have the same barcodes as physical volumes in any physical library that you plan to attach to the TS7530 Virtualization Engine. The virtual volumes used with physical volumes are automatically created during library synchronization. Refer to 12.5.3, "Creating a cache for your physical tapes" on page 404, for details of library synchronization.

A virtual volume barcode must be six characters long. If more than six characters are entered in the Barcode Starts and Barcode Ends fields, the TS7530 Virtualization Engine Server generates nonstandard barcode labels.

To generate standard barcodes specify the barcode start and end range with exactly six characters, as shown in Figure 6-40.

8. You will be presented with an information window (Figure 6-41) whenever you exceed the TS7530 storage slot limit. The TS7530 storage slot maximum is typically the maximum number of storage slots in a single frame. To emulate a TS3500 library with expansion frames, you must override the maximum. To exit the window, click **OK**.


*Figure 6-41 Cached virtual library creation: Information window when maximum slots exceeded*

> **Recommendation:** Always create libraries in accordance with the terms and conditions of your backup software.

You will see a similar information window if you exceed the maximum number of tape drives for a library.

9. Verify the configuration of the library displayed in the panel similar to the one shown in Figure 6-42. Click **Finish** to create the library.

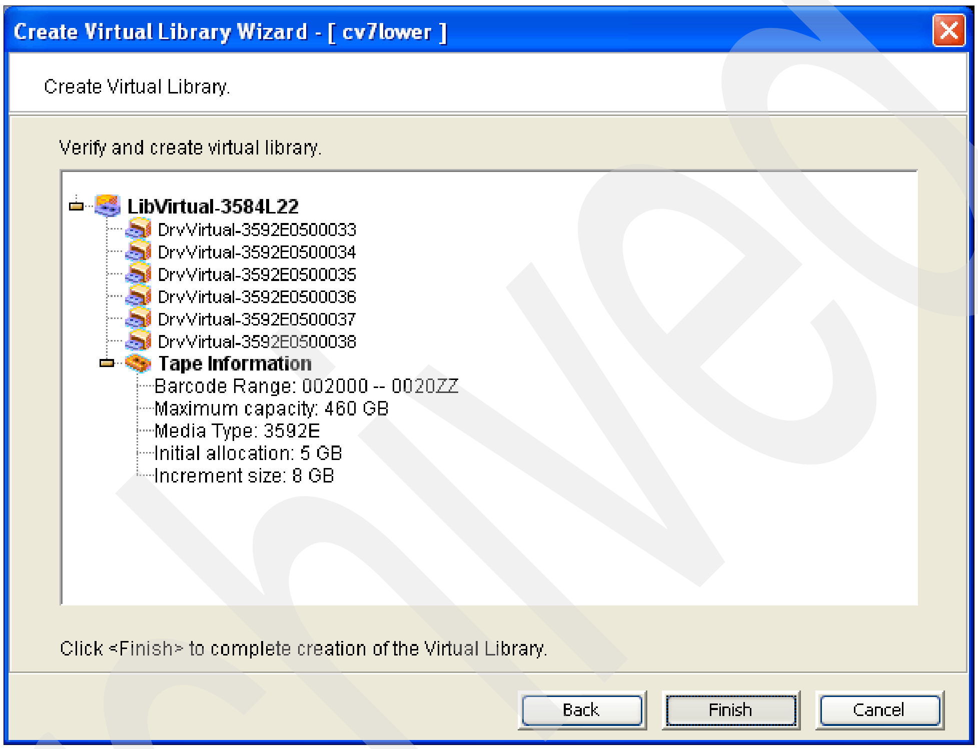



*Figure 6-42 Cached virtual library creation: Confirm library configuration*

10. You should be presented with a window displaying the status of the library creation as shown in Figure 6-43. Review the batch creation status and click **OK**.

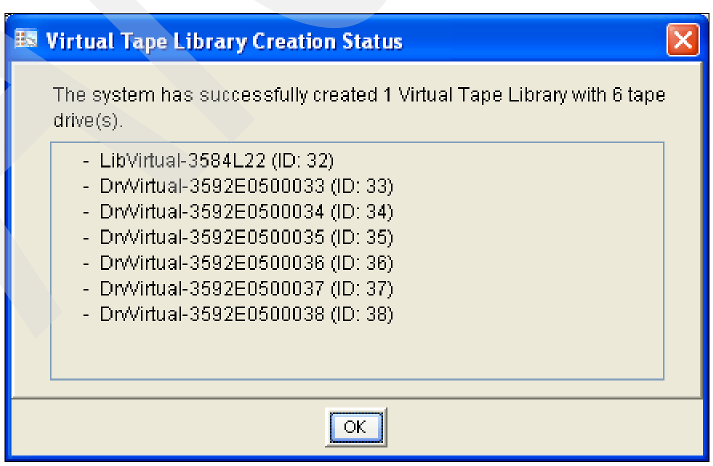



*Figure 6-43 Cached virtual library creation: Completion status*

11. To create virtual volumes, click **Yes** on the panel shown in Figure 6-44.


*Figure 6-44 Cached virtual library creation: create virtual volumes*

12. In the Specify Batch Mode Information panel (Figure 6-45), you can override default virtual tape attributes. Click **OK** to create the virtual tape volumes.

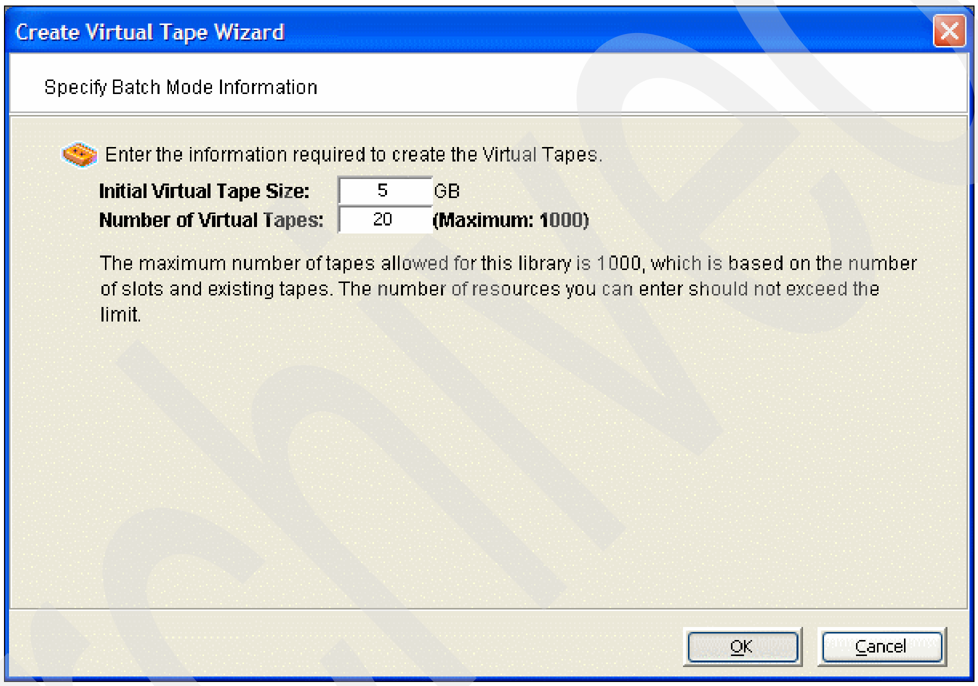



*Figure 6-45 Cached virtual library creation: specify the number of new virtual volumes*

Using capacity on demand, the default size for all media is 5 GB. This means that a minimum of 5 GB of space is required for all virtual tape volumes.

You can increase this value, but it is not necessary. When the TS7530 Virtualization Engine writes to a virtual volume, the volume is automatically expanded as required. The increase in virtual volume size is defined by the increment size. The default increment sizes are:

– LTO2 and 3592: 5 GB
– LTO3: 7 GB
– LTO4: 12 GB
– TS1120-E05: 8 GB

Refer to 6.9, “Advanced Tape Creation method” on page 228, for further information about modifying virtual volume attributes.

13.Click **OK** to exit the tape creation status message shown in Figure 6-46.

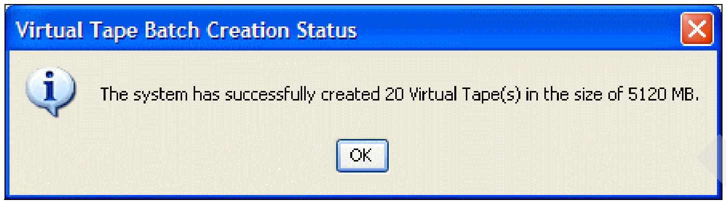



*Figure 6-46 Cached virtual library creation: Virtual tape batch creation status*

14.Review the status of the newly created library and drives (Figure 6-47).

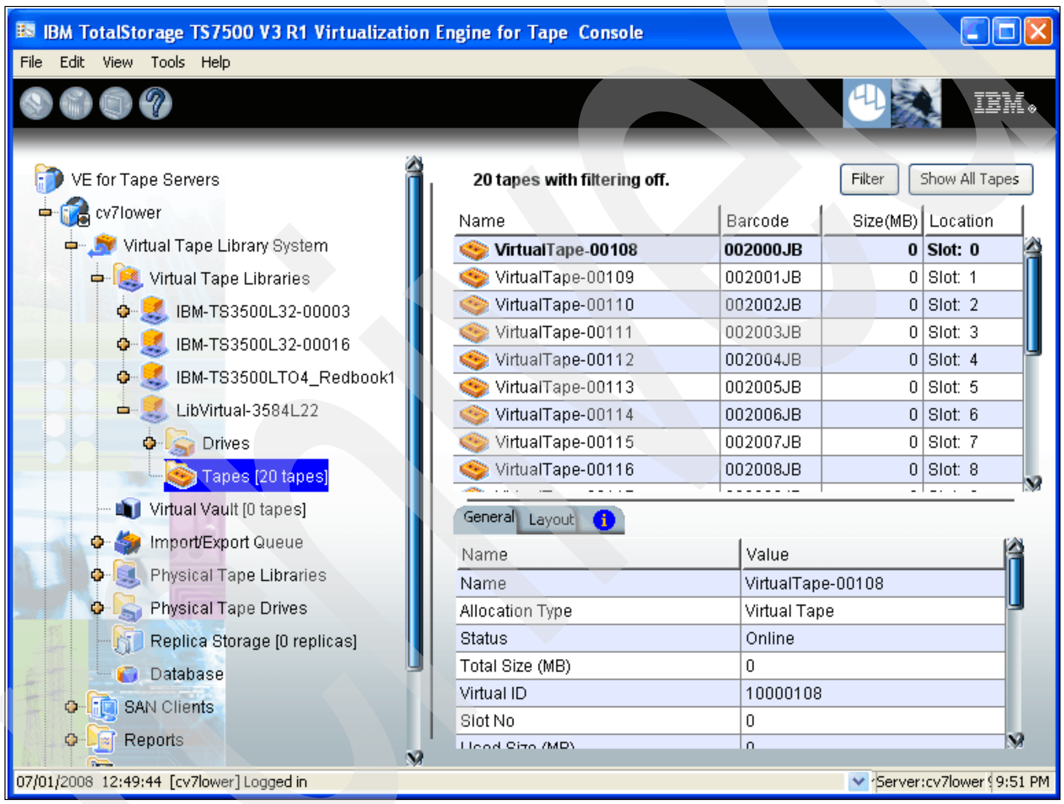



*Figure 6-47 Cached virtual library creation: Review newly created virtual library*

In Figure 6-47 notice that the size column shows a size of 0 MB. The TS7530 VE for Tape server only allocates space for a virtual volume when it is first mounted.

## 6.6.3 Creating additional virtual volumes

In this section we detail the steps to create additional virtual tape volumes.

You must not use these steps to create virtual volumes that have the same barcode label as any physical volumes in an attached physical library. That procedure is described in 6.10, “Physical libraries and Enhanced Tape Caching” on page 233.

You should not create more virtual volumes than you can store in the TS7530 Virtualization Engine Server. Use the following formula to calculate the maximum number of virtual volumes:

```
maximum virtual volumes = (total usable capacity on TS7530) / (virtual volume capacity)
```

To create additional virtual tape volumes in library LibVirtual:

1. In the panel shown in Figure 6-48, right-click **Tapes** and select **New Tape(s)**.

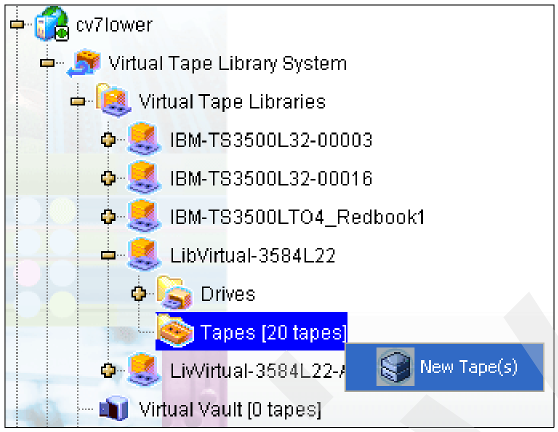



*Figure 6-48 Creating additional virtual volumes -start wizard*

2. In the Specify Batch Mode Information panel, you can override default virtual tape attributes. Click **OK** on the panel shown in Figure 6-49 to create the virtual tape volumes.

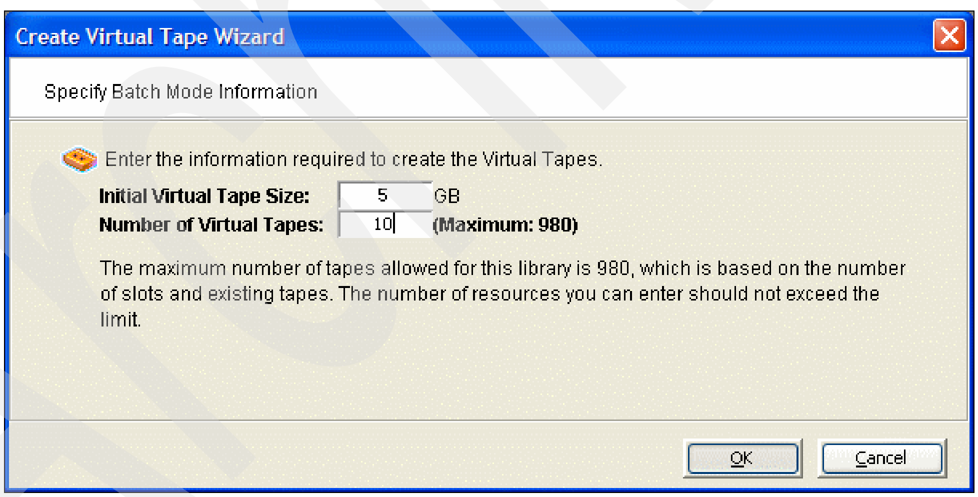



*Figure 6-49 Creating additional virtual volumes: specify volume attributes*

The default size for all media is 5 GB. This means that a minimum of 5 GB of space is required for all virtual tape volumes.

You can increase this value, but it is not necessary. When the TS7530 Virtualization Engine writes to a virtual volume, the volume is automatically expanded as required. The increase in virtual volume size is defined by the increment size. The default increment sizes are:

– LTO2 and 3592-J1A: 5 GB
– LTO3: 7 GB
– LTO4: 12 GB
– TS1120-E05: 8 GB

Refer to 6.9, “Advanced Tape Creation method” on page 228, for further information about modifying virtual volume attributes.

3. Click **OK** on the panel shown in Figure 6-50 to clear the tape creation status message.

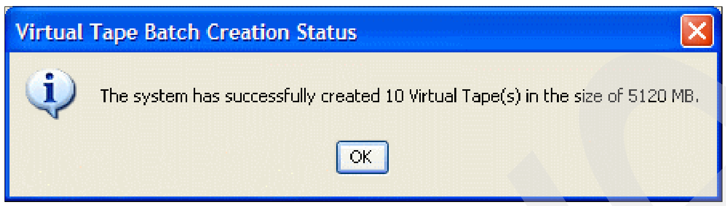
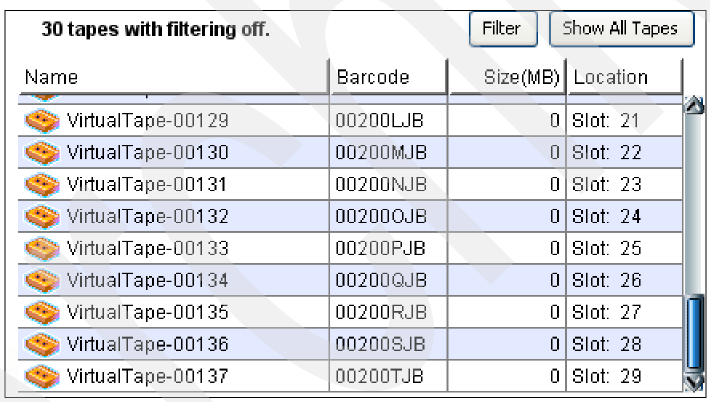



*Figure 6-50 Creating additional virtual volumes: tape creation status window*

Review the status of the newly created library and drives using the TS7530 Virtualization Engine for Tape Console. Notice that the size column shows a size of 0 MB. The TS7530 VE for Tape Server only allocates space for a virtual volume when it is first mounted (Figure 6-51).


30 tapes with filtering off.

| Name | Barcode | Size(MB) | Location |
|---|---|---|---|
| VirtualTape-00129 | 00200LJB | 0 | Slot: 21 |
| VirtualTape-00130 | 00200MJB | 0 | Slot: 22 |
| VirtualTape-00131 | 00200NJB | 0 | Slot: 23 |
| VirtualTape-00132 | 00200OJB | 0 | Slot: 24 |
| VirtualTape-00133 | 00200PJB | 0 | Slot: 25 |
| VirtualTape-00134 | 00200QJB | 0 | Slot: 26 |
| VirtualTape-00135 | 00200RJB | 0 | Slot: 27 |
| VirtualTape-00136 | 00200SJB | 0 | Slot: 28 |
| VirtualTape-00137 | 00200TJB | 0 | Slot: 29 |



*Figure 6-51 Creating additional virtual volumes: review new virtual tape volumes*

## 6.7 SAN clients

In a physical SAN, you assign tape drives and tape libraries to a host by creating appropriate SAN zones. With SAN zones, you decide which host(s) can access a tape library or tape drive.

### 6.7.1 SAN zoning

With tape virtualization, you can connect several tape drives or tape libraries through a single Fibre Channel port. SAN zoning based on Fibre Channel ports might not allow sufficient granularity for separating hosts. The TS7530 provides facilities to allow you define resource access on a host basis.

SAN clients are the backup servers that use the TS7530 Virtualization Engine and form the basis of TS7530 access control. The TS7530 ships with a default SAN client Everyone_FC.

The TS7530 comes preconfigured with two virtual IBM 3584 libraries. Each default library and the associated drives have been assigned for use by the Everyone_FC SAN client. In this way you can start using the default libraries and drives without any further configuration.

If you want to customize host access to TS7530 virtual resources, you will have to define additional SAN clients. In this way you can individually assign virtual tape libraries or tape drives to a specific host(s), or you can assign virtual tape libraries and tape drives to all connected hosts (Everyone_FC).

## 6.7.2 Adding SAN clients

Next we take you through the steps to create a TS7530 SAN client for backup server SAN346 running the Tivoli Storage Manager Server. Locate the WWPNs for SAN346-2 in the TS7530 in the Fibre Channel Backup Host Worksheet. For further information about the worksheet refer to Appendix D, “Installation and implementation checklists” on page 533.

We can see in Table 6-2 that the WWPN for SAN346-2 is 21-01-00-e0-8b-27-49-b8.

*Table 6-2 Adding SAN clients: sample Fibre Channel Backup Host Worksheet*

| Hostname | TS7530 SAN client | TCP/IP address | Adapter | WWPN |
|---|---|---|---|---|
| SAN346 | SAN346-2 | 10.10.10.10 | 1 | 21-01-00-e0-8b-27-49-b8 |
| SAN972 | SAN972_TSM | 10.10.10.66 | 1 | 21-01-00-0d-77-a8-89-d4 |

1. Right-click **SAN Clients** in <your TS7530 server> and select **Add** to start the Add Client Wizard. See Figure 6-52.

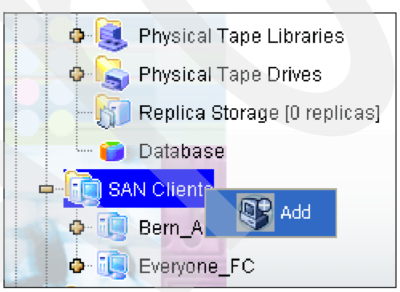



*Figure 6-52 Adding SAN clients: starting the Add Client Wizard*

2. In the window shown in Figure 6-53, select the access method to be used by the SAN client. We chose Fibre Channel. Click **Next**.

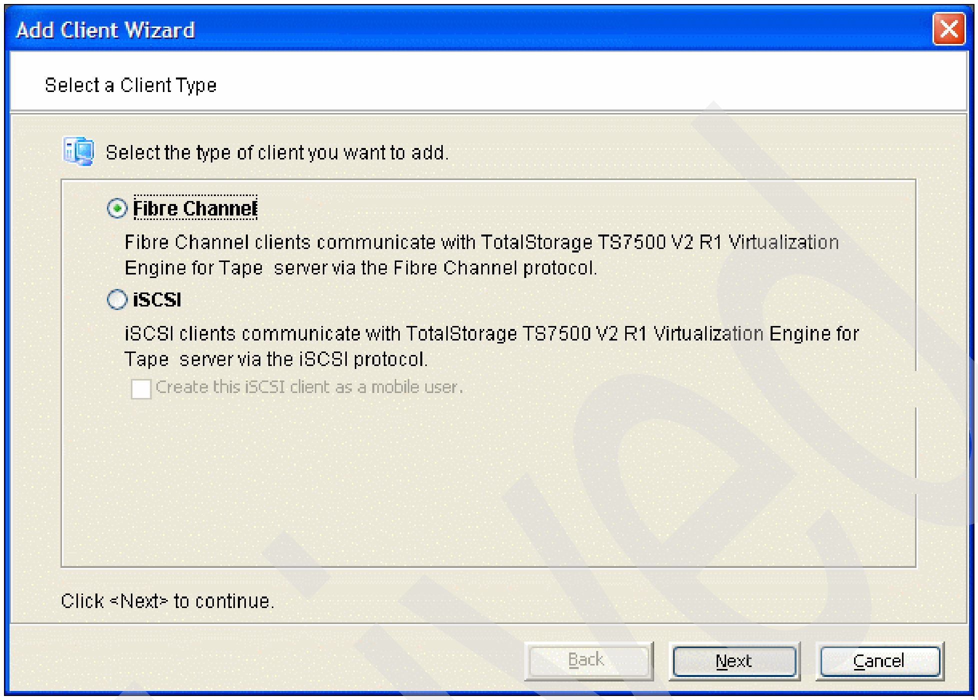



*Figure 6-53 Adding SAN clients: select client access method*

3. In the Enter the Fibre Channel Client Name panel (Figure 6-54), type the client name from the Fibre Channel Backup Host Worksheet. Click **Next**.

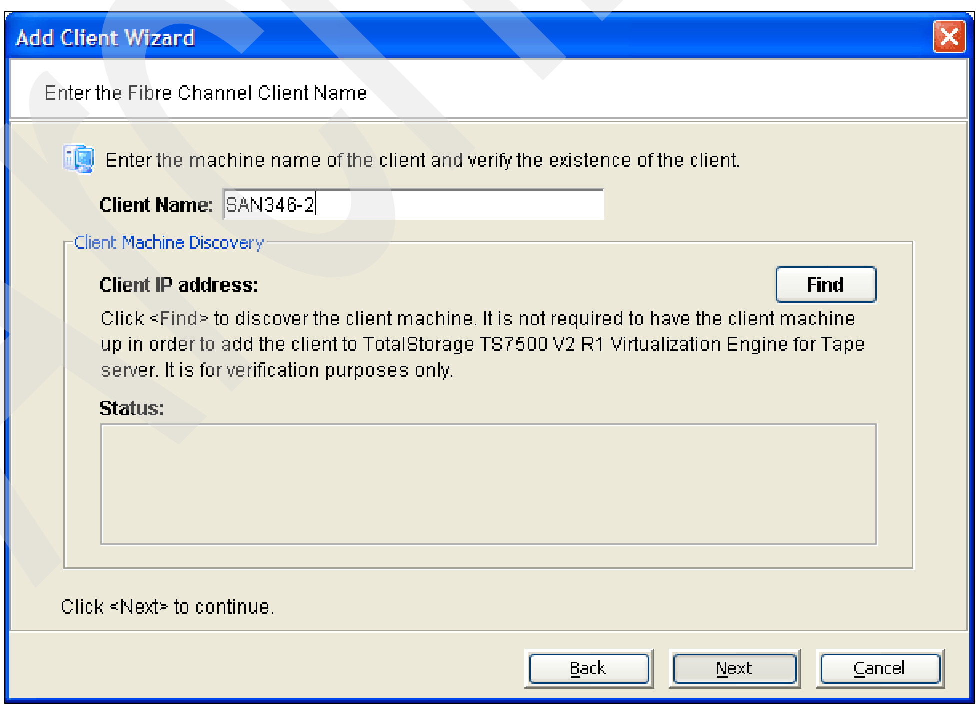



*Figure 6-54 Adding SAN client: name*

4. Using information from the Fibre Channel Backup Host Worksheet locate and select the WWPN or WWPNs for the SAN client (Figure 6-55). Click **Next**.

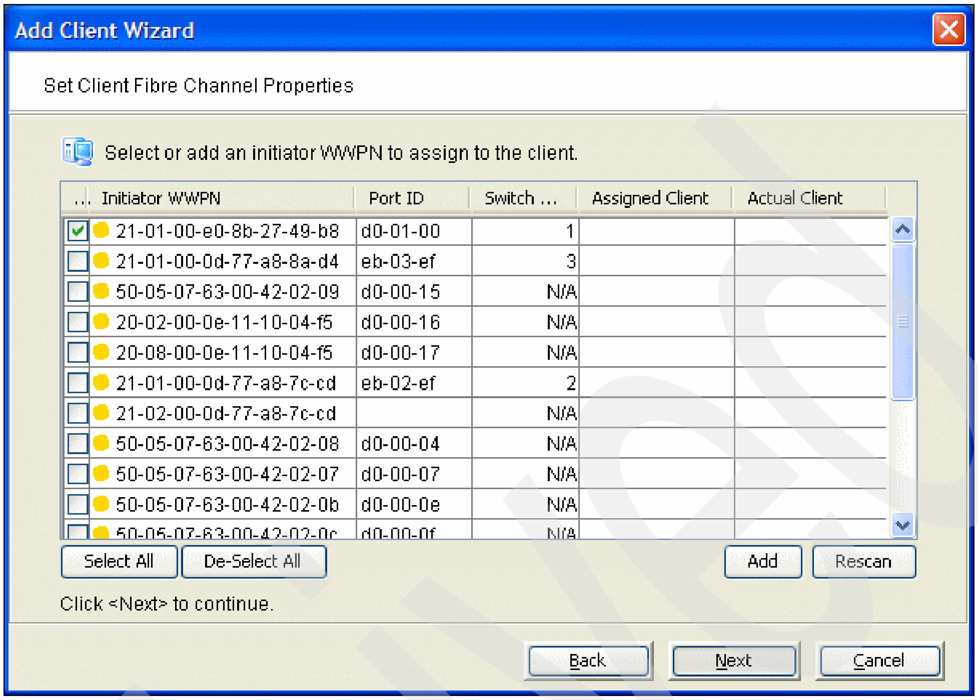



*Figure 6-55 Adding SAN client: Set Client Fibre Channel Properties*

5. Volume Set Addressing (see Figure 6-56) might be required for particular Fibre Channel storage depending upon the storage system's requirements. For example, storage that is connected to an HP-UX host with an HP Fibre Channel adapter requires VSA addressing. Similarly, storage that was formerly connected to HP-UX hosts usually has the VSA option turned on. Click **Next**.

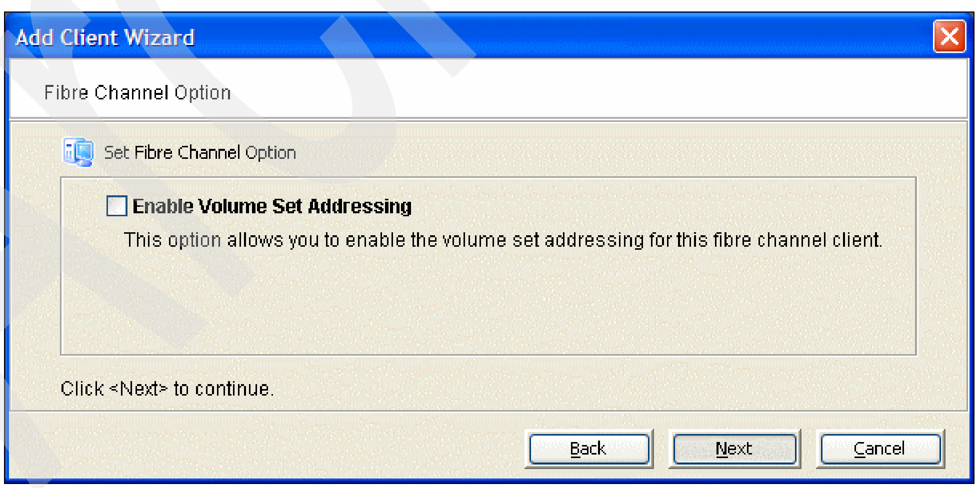



*Figure 6-56 Add SAN clients: Enable Volume Set Addressing*

6. The next window (Figure 6-57) shows you a summary of your selections. If the information is correct, click **Finish**.

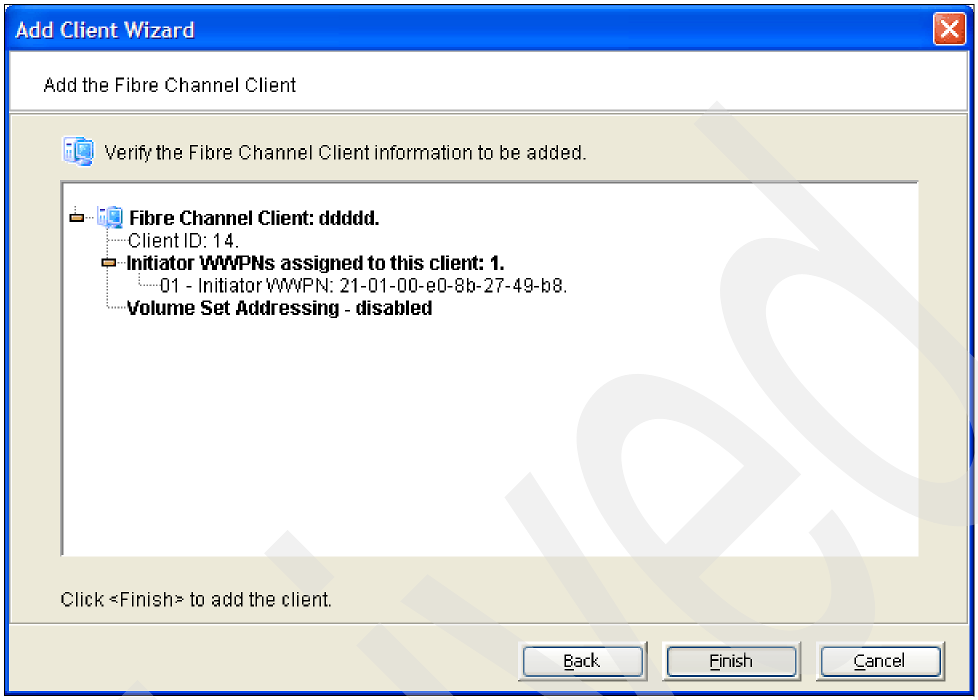



*Figure 6-57 Add SAN clients: Verify the Fibre Channel client information*

7. Verify the successful creation of SAN346-2 as shown in Figure 6-58.

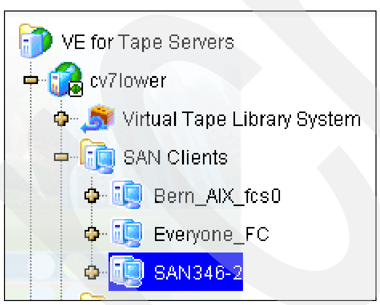



*Figure 6-58 Add SAN clients: verify successful client creation*

### 6.7.3 LUN masking: Assigning a host to a library and drives

Up to this point, we have created the library with drives and tape cartridges. Only the two libraries created during manufacturing were assigned to every host. All libraries that you create must be assigned to the host to enable its access to those libraries.

In addition to the assignment of a host to a virtual library and virtual drives, you can select which Fibre Channel target port from the TS7530 Virtualization Engine to use. With this option, you can balance the workload to different Fibre Channel HBAs (target ports) by assigning a couple of drives to one Fibre Channel HBA and other drives to other Fibre Channel HBAs on the TS7530.

We want to use the newly created library with one Tivoli Storage Manager server, ost36, and with one Tivoli Storage Manager LAN-free client, dst66. The Tivoli Storage Manager server ost36 should see the whole library including all six drives. The LAN-free client dst66 should only see three drives (drives 4 through 6), as shown in Figure 6-59.

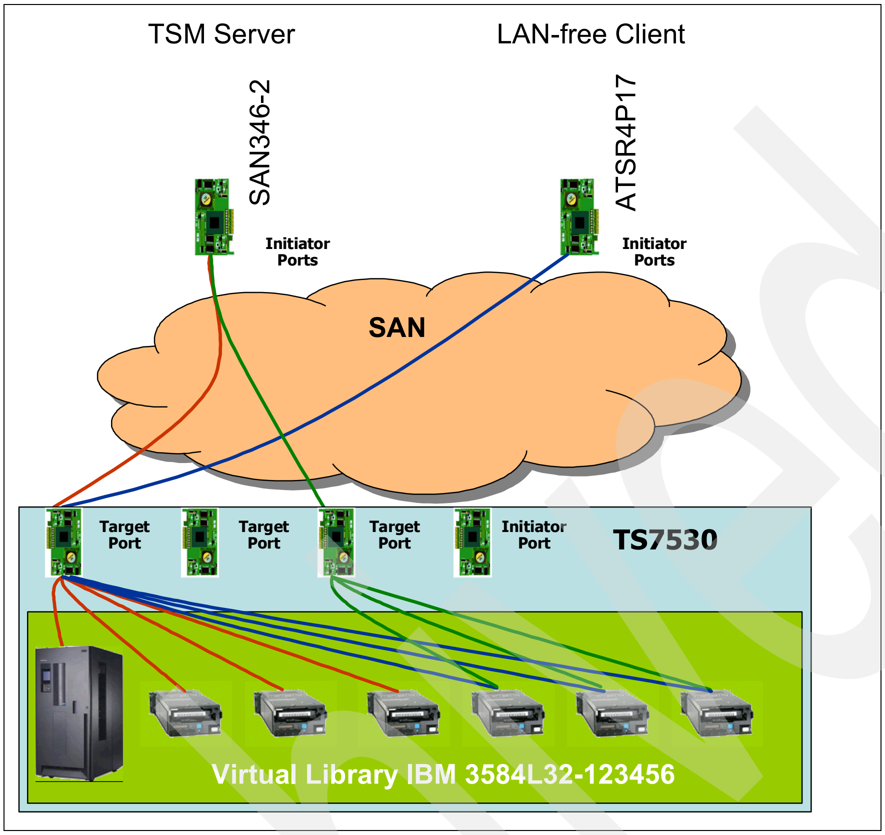



*Figure 6-59 SAN client assignment*

> **Note:** You must define backup servers as SAN clients before connecting them to virtual tape libraries. You must also first identify the server's Fibre Channel properties. For convenience, specify the server's network-resolvable hostname.

In this example we assign the Tivoli Storage Manager server SAN346-2 to the complete library. To assign a host to the library:

1. Right-click the SAN client host icon and select **Assign**, as shown in Figure 6-60.

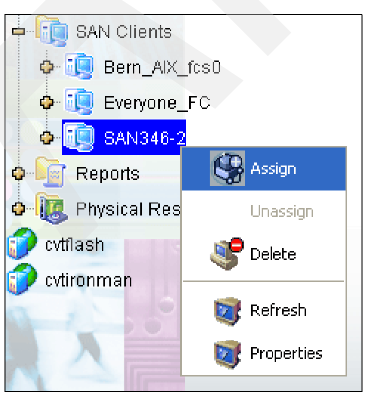



*Figure 6-60 Selecting Assign to assign a SAN client host to a virtual library*

2. In the Select Tape Libraries or Drives panel (Figure 6-61), you can select different access modes to assign libraries and drives. The access types are:
   - *Read/Write* access indicates that only one client can access the library or drive. If another host tries to access the library or the drive, this access is denied.
   - *Read/Write Non-Exclusive* access indicates that several clients can access the drive or library. Use this mode if the library or the drives will be shared. In our example, we want to share the drives between one Tivoli Storage Manager server and one LAN-free client.

   You can assign the complete library with drives over a Fibre Channel target port. Or you can assign the drives individually by selecting the Allow drive(s) in the library to be assigned individually check box. We select **Allow drive(s) in the library to be assigned individually** as well as the library and the first three drives. The other three tape drives will be assigned over a different Fibre Channel port.

   Click **Next**.

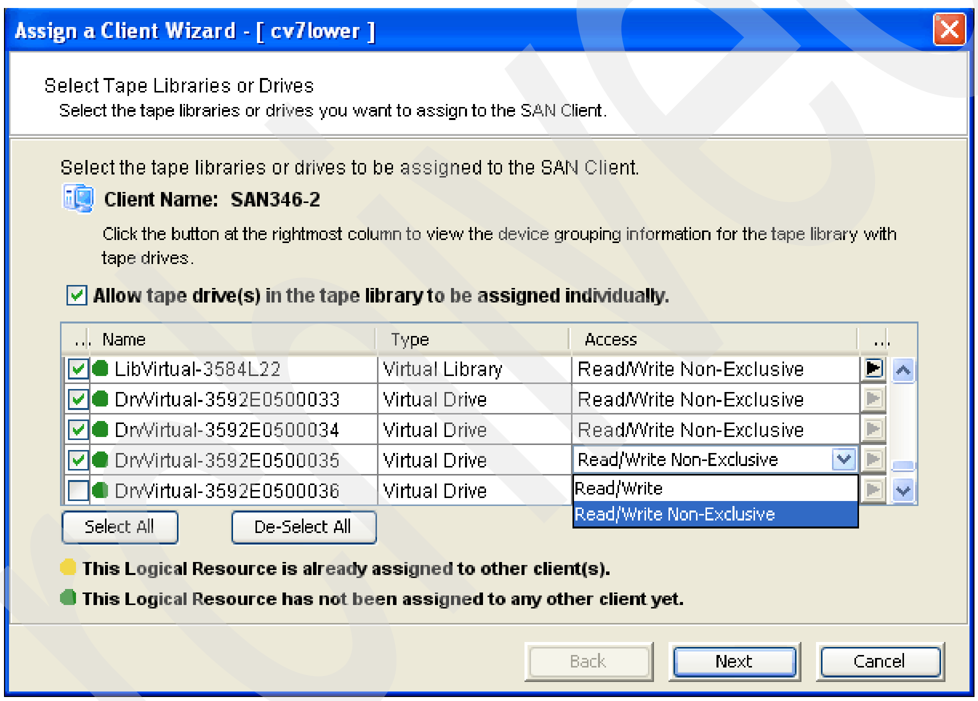



*Figure 6-61 Assigning a client to the library and drives*

3. If your server has several Fibre Channel HBAs for connecting to the TS7530, you must select each Fibre Channel HBA WWPN when you add the SAN client, as explained in 6.7.2, “Adding SAN clients” on page 217.

   If several paths from the host to the TS7530 exist, the Select a Fibre Channel Target panel is displayed and you must select the Fibre Channel HBA to use for the connection to the host. This means several zones must be created, because only one initiator and only one target should be in one zone.

   In our limited configuration for this publication, our server SAN346-2 only has one 4 Gb Fibre Channel HBA and the Select a Fibre Channel Target panel does not display and load balancing does not apply. By selecting the option to assign libraries and drives individually (see Figure 6-61), we can illustrate how to assign tape drives over different Fibre Channel targets by selecting the library and the first three drives.

In the Assign Tape Libraries or Drives to the SAN client panel (Figure 6-62), verify your selection before you make this assignment. If everything appears to be correct, click **Finish**. To make changes, click the **Back** button.

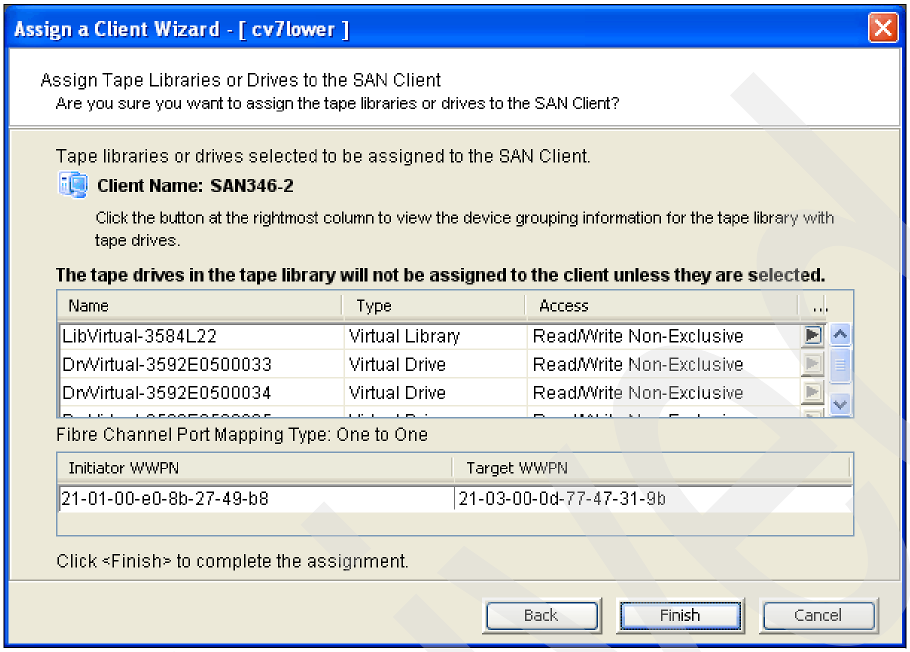



*Figure 6-62 Selecting a target WWPN*

We have now assigned the first three tape drives and the library to host SAN346-2. We repeat the steps and assign the other three tape drives to SAN346-2 and to our LAN-free client ATSR4P17.

## 6.8 Scanning and preparing new physical devices

For a TS7530 Virtualization Engine for Tape to be able to use newly added physical tape libraries or drives, you might have to run a utility to discover the newly added devices. This process is referred to as **Rescan**.

> **Note:** You do not normally have to reboot the TS7530 VE for Tape Server to discover new physical tape drives or libraries.

In the following example we take you through the steps to add a new TS3200 tape library and two LTO3 drives to a TS7530 VE for Tape Server. To discover the new devices:

1. Right-click **Physical Resources**, and select **Rescan,** as shown in Figure 6-63.

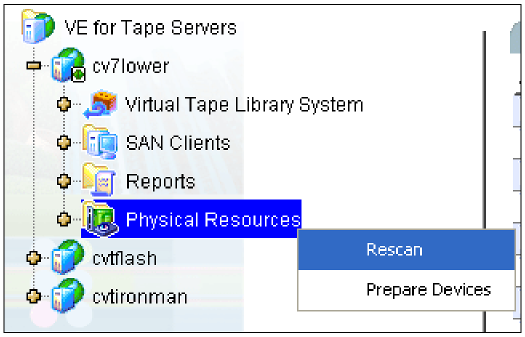



*Figure 6-63 Discover new devices: Rescan*

2. From the panel shown in Figure 6-64, select **Discover New Devices**, and click **OK**.

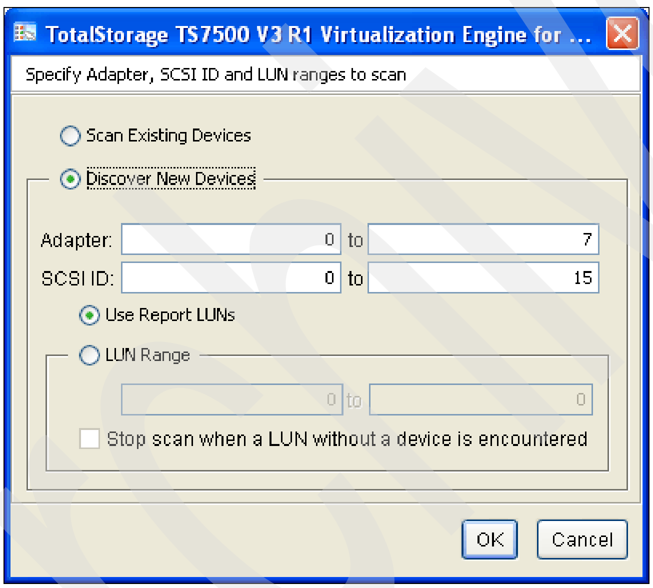



*Figure 6-64 Discover new devices: specify adapter, SCSI and LUN ranges*

3. On the next windows, right-click **Fibre Channel Devices** and select **Prepare Devices**. Change the Device Category to Reserved for Direct Device. Select all the tape resources that you want the TS7530 VE for Tape Server to system to use (drives and libraries). Click **OK**.
4. After the step completes, a little box with the green D will be added to the physical tape resources to indicate that they have been prepared for use by the TS7530 VE for Tape server. This is shown in Figure 6-65.

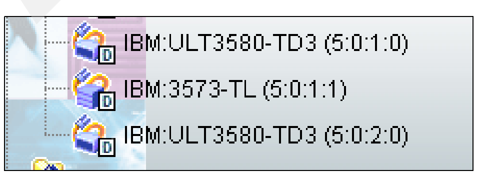



*Figure 6-65 Discover new devices prepared for use*

5. The newly discovered and prepared devices have to be assigned before they can be used. To assign new devices for use by a TS7530 VE for Tape Server, right-click **Physical Tape Libraries** and select **Assign**, as shown in Figure 6-66.

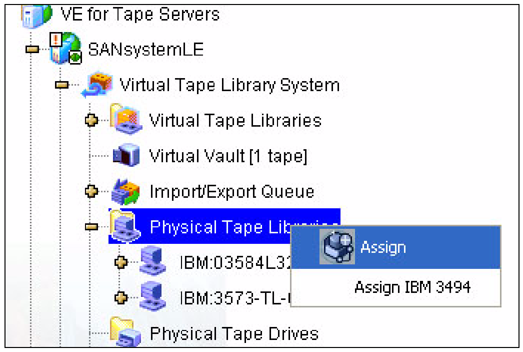



*Figure 6-66 Discover new devices: Assign library*

6. We referred to 6.6.1, "Library name cross reference" on page 205, to double-check that the SCSI string for a TS3200 is 3573-TL. From the panel shown in Figure 6-67, select **IBM3573-TL**, then click **Assign**.

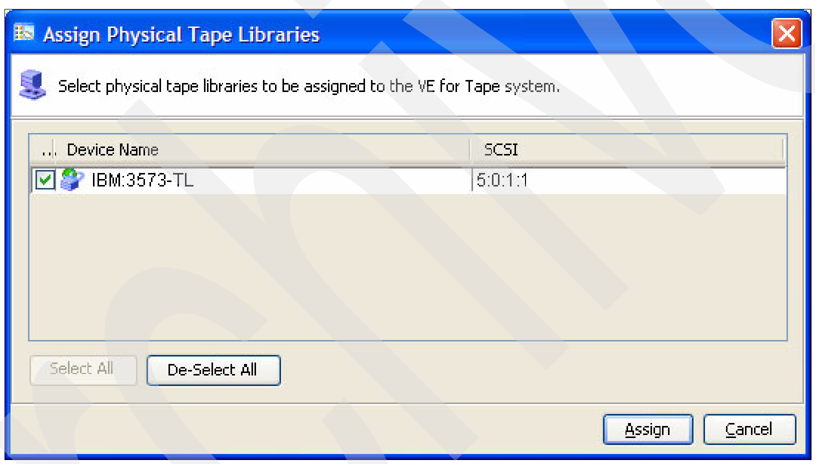



*Figure 6-67 Discover new devices: Select the library to assign*

7. In the panel shown in Figure 6-68, confirm the library assignment was successful. Click **OK**.

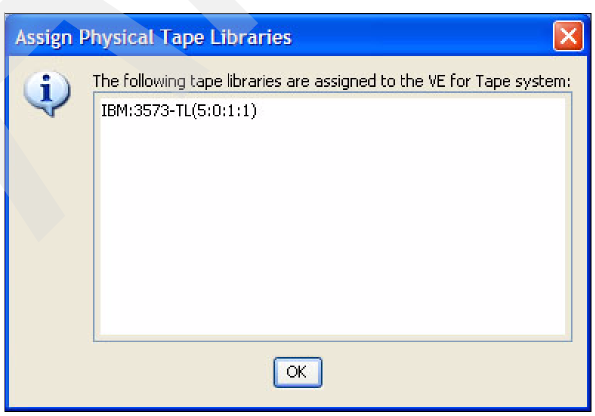



*Figure 6-68 Discover new devices: Confirm successful library assignment*

8. To assign the new TS3200 tape drives, right-click the TS3200 tape library (Figure 6-69) and select **Assign**.

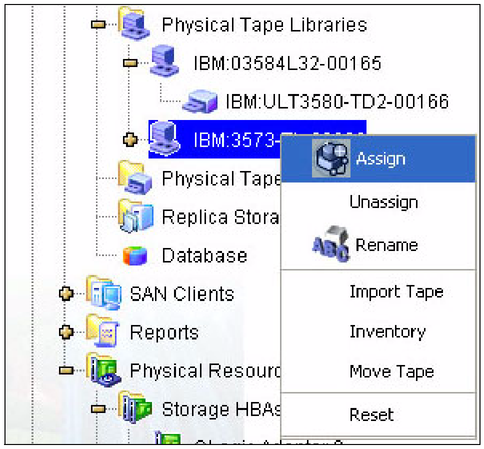



*Figure 6-69 Discover new devices: Assign tape drives*

9. As shown in Figure 6-70, select both LTO3 drives, then click **Assign**.

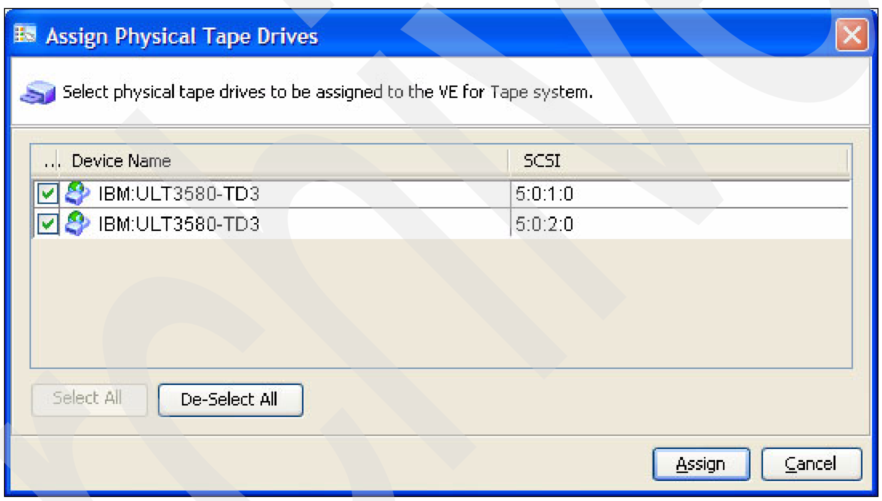



*Figure 6-70 Discover new devices: Select tape drives*

10. Confirm the tape drive assignment was successful (Figure 6-71). Click **OK**.

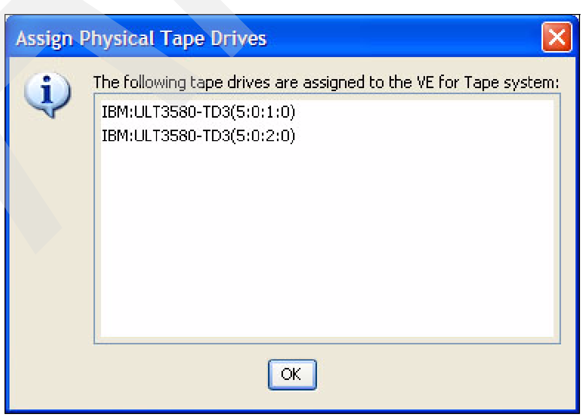



*Figure 6-71 Discover new devices: Confirm successful tape drive assignment*

The assigned TS3200 library and LTO3 drives should now visible under Physical Tape Libraries, as shown in Figure 6-72.

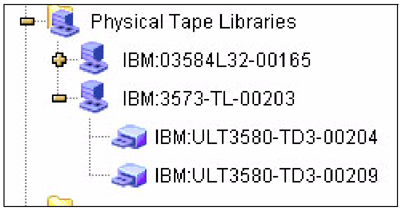



*Figure 6-72 Discover new devices: Physical tape libraries*

11. The physical library and drive names generated during the **Rescan** can be renamed to conform with standard naming conventions. To rename the library and drives, right-click each object and specify the new name as shown in Figure 6-73.

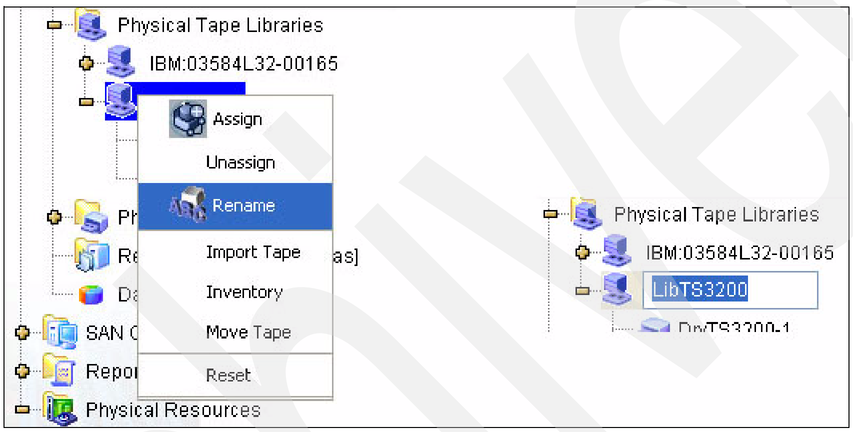



*Figure 6-73 Discover new devices: Rename physical library and tape drives*

12. As shown in Figure 6-74, the new names we chose were:

| | |
|---|---|
| **Library** | LibTS3200 |
| **Drives** | DrvTS3200-1 |
| | DrvTS3200-2 |

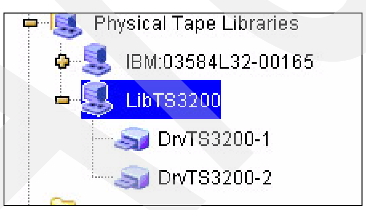



*Figure 6-74 Discover new devices: Renamed physical library and tape drives*

13. The next step is to obtain the inventory of tape cartridges in the LibTS3200 library. Right-click **LibTS3200** then select **Inventory,** as shown in Figure 6-75.

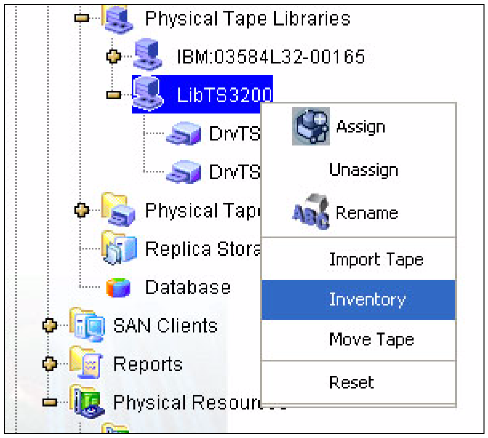
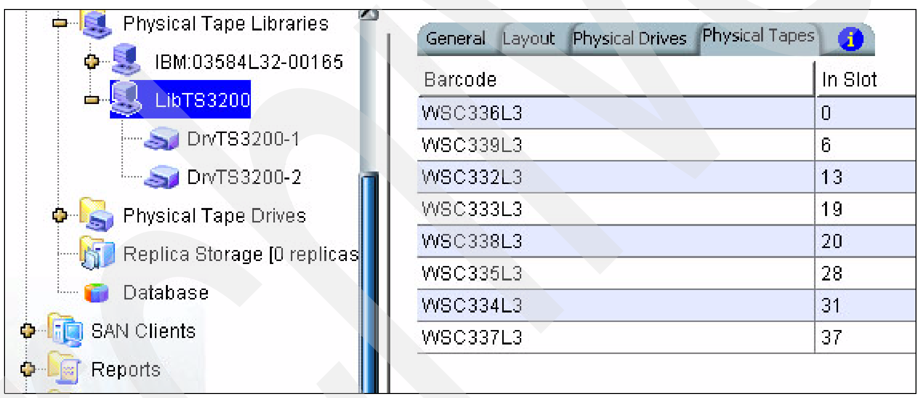



*Figure 6-75 Discover new devices: Inventory library*

14. After the inventory completes, left-click **Physical Tapes** to display the tape cartridges in the library. See Figure 6-76.




| Barcode | In Slot |
|---|---|
| WSC336L3 | 0 |
| WSC339L3 | 6 |
| WSC332L3 | 13 |
| WSC333L3 | 19 |
| WSC338L3 | 20 |
| WSC335L3 | 28 |
| WSC334L3 | 31 |
| WSC337L3 | 37 |

*Figure 6-76 Discover new devices: Library inventory*

**Tip:** If you are attaching multiple physical libraries of the same type or that contain the same type of tape drive, the library and drive selection panels only provide SCSI IDs for identification (see Figure 6-67 on page 225 and Figure 6-70 on page 226).

If possible, we recommend that you zone in one physical library at a time and follow the steps in this section for one physical library, before adding the next physical library, to make this process easier.

## 6.9 Advanced Tape Creation method

The Advanced Tape Creation method allows you to specify the attributes of the virtual volumes and override the default values.

**Important:** Using Advanced Tape Creation is not recommended unless the capacity on demand defaults are not suitable for your environment.

This section describes the steps required to enable Advanced Tape Creation:

1. You activate the advanced tape creation method from with the TS7530 VE for Tape Console Options window. Select **Tools** → **Console Options**, then select **Enable advanced tape creation method**, as shown in Figure 6-77. Click **OK.**

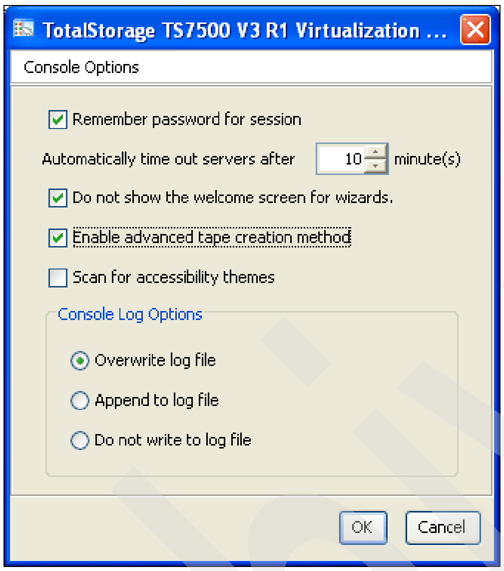



Figure 6-77 Activating the advanced tape creation method

2. After the advanced tape creation method has been activated, a new window (Figure 6-78) is displayed by the Virtual Library Creation Wizard.

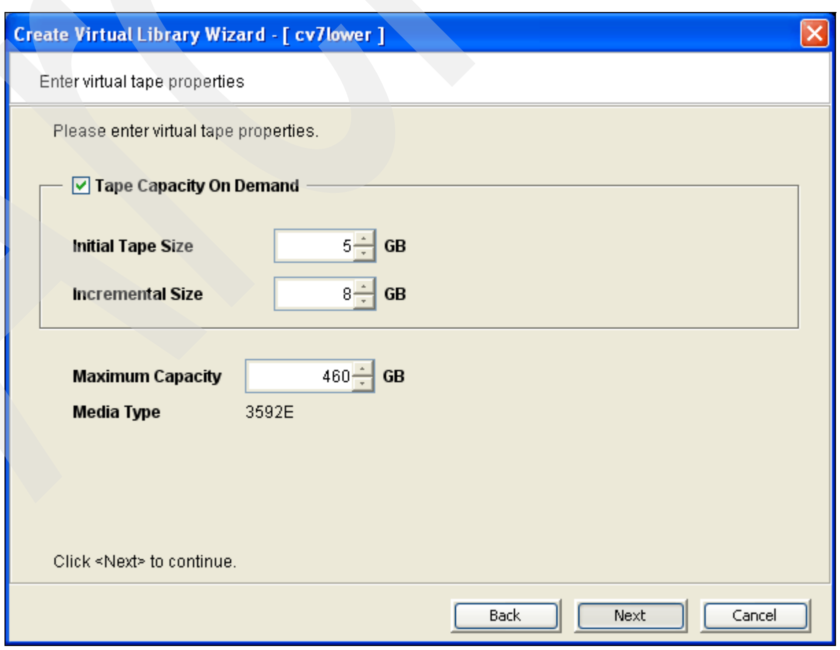



Figure 6-78 Advanced tape creation method virtual volume attributes

You can specify the following values:

**Tape Capacity On Demand**

Specifies that the TS7530 VE for Tape Server initially allocates a reduced amount of space for your virtual tapes and then automatically allocates additional space as required.

If you do not select this option, the TS7530 Virtualization Engine will allocate each virtual tape at its maximum capacity.

The space for each virtual volume is not allocated until the volume is mounted for the first time.

**Initial Tape Size** Specifies (in GB) the initial size of a virtual tape volume when Tape capacity on demand is being used.

**Incremental Size** Specifies (in GB) how much additional space will added to a virtual volume when the amount of data written exceeds the current allocation.

**Maximum Capacity** The maximum size (in GB) for the virtual volume.

> **Recommendation:** Use the default value for maximum capacity if you plan to use Enhanced Tape Caching.

3. In the Select Virtual Creation Method window (Figure 6-79) you can select one of two options:
   – Custom lets you select which physical devices to use and lets you designate how much space to allocate from each.
   – Express automatically creates the resources for you using available devices. If you select Express you can create multiple virtual tapes at the same time.

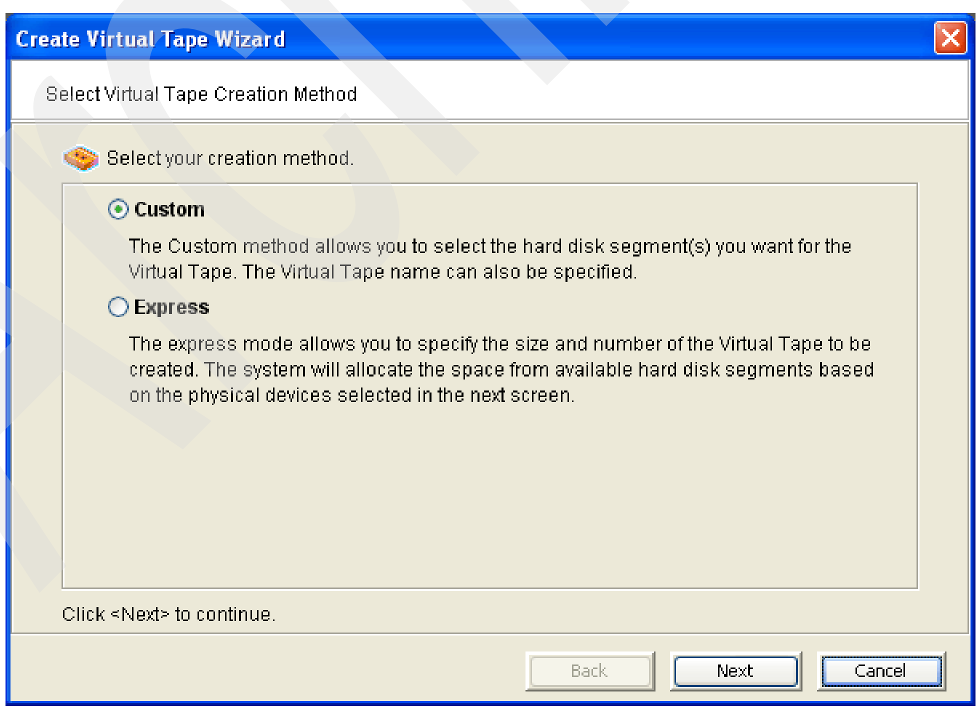



*Figure 6-79 Select creation method window*

4. At the end of the virtual library creation wizard, you are asked if you want to create tapes for this library. If you click **Yes,** the virtual tape creation wizard begins and the first panel displays the LUNs on which the tapes are created (Figure 6-80). Click **Next**.

> **Note:** The panels shown in Step 3 through Step 7 in this section are also displayed if you add tapes to an existing library with Advanced Tape Creation activated.

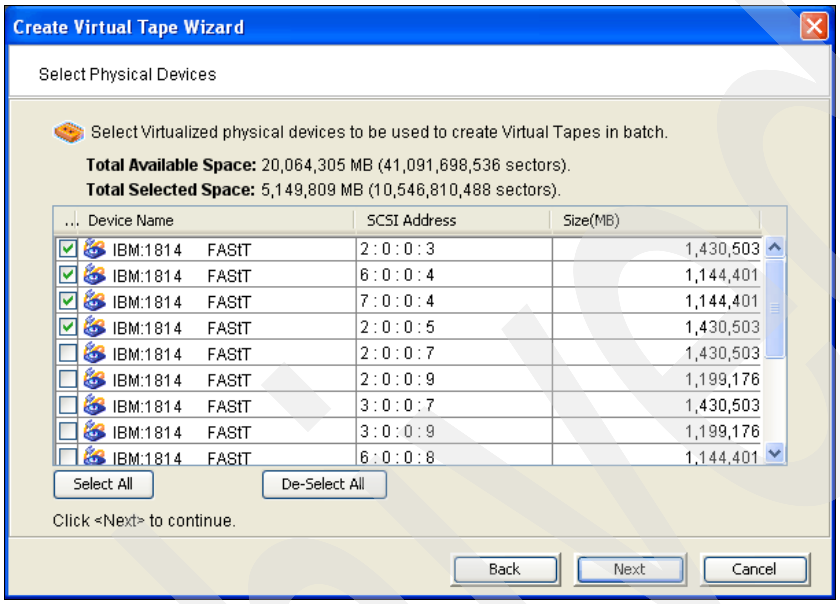



*Figure 6-80 Virtual tape LUNs*

5. You then enter the virtual tape prefix name, size of the starting increment and the number of tapes. The relative starting number for the tape barcode is set by the wizard unless you uncheck the box for **Let the wizard determine the starting number** (Figure 6-81).

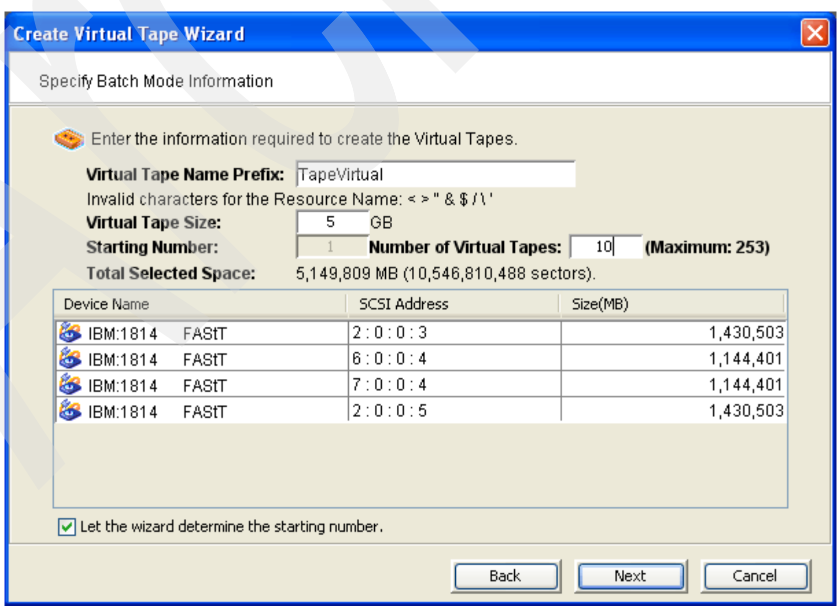



*Figure 6-81 Specify tape creation requirements*

6. The Set Barcode Range Option panel (Figure 6-82) allows you to create virtual tapes with a barcode range that does not start at the beginning of the range (initial batch of tapes), that is not contiguous (last tape created ended with 000010, new tape batch will start with 00100) or fill in gaps in a tape range created by virtual tape deletions (insert virtual tapes 000011 through 000020). If using this function to fill in gaps, you must not try to create more virtual tapes than available in the gap (a gap of 000011 through 000020 allows 10 virtual tapes). Click **Next**.

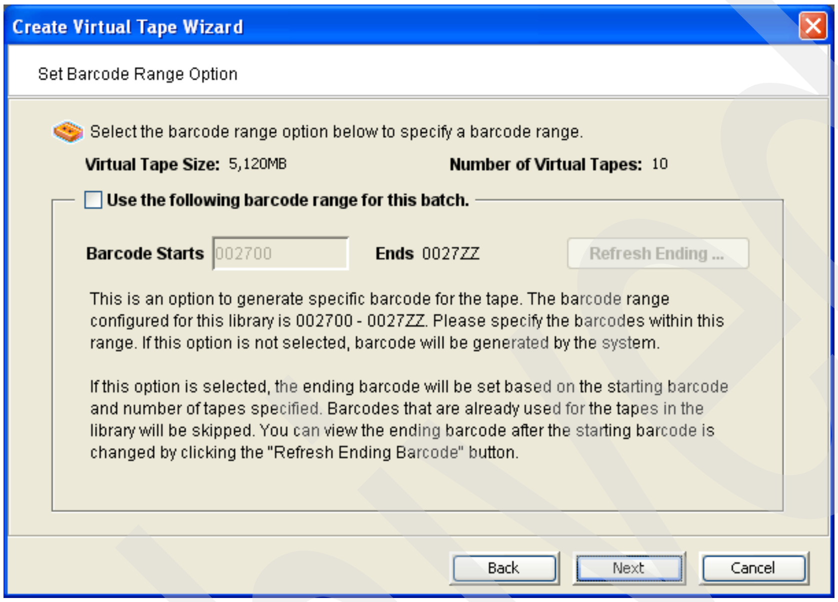



*Figure 6-82 Set Barcode Range Option panel*

7. Verify the information for the tapes created and click **Finish,** if correct, or **Back** to make changes (Figure 6-83).

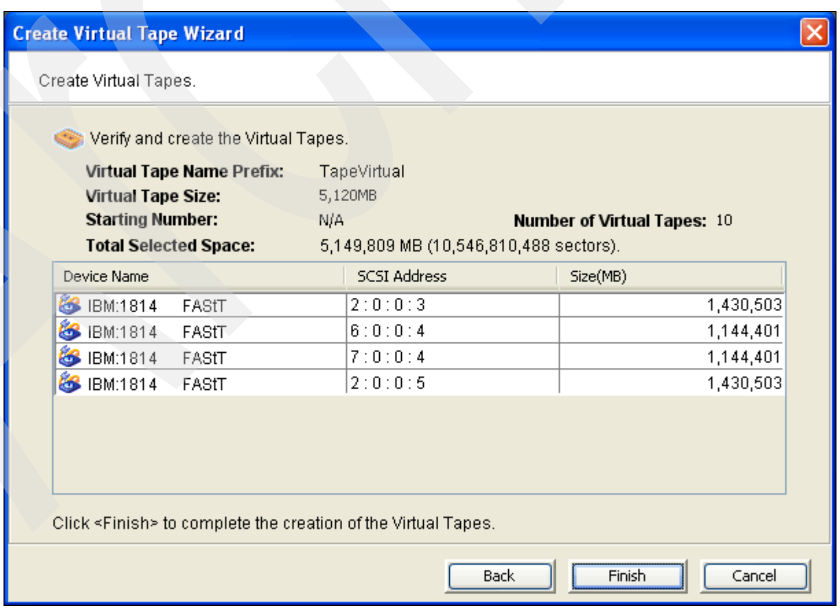



*Figure 6-83 Advanced Tape Creation verification panel*

8. When the virtual tapes are added, the completion box is displayed (Figure 6-84). Click **OK** to exit.

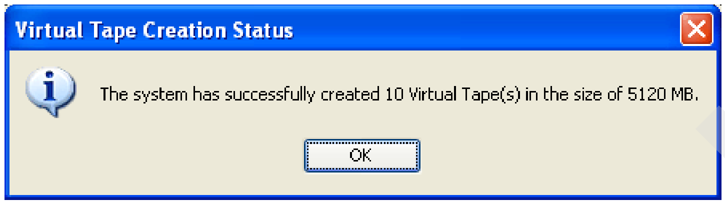



*Figure 6-84 Advanced Tape Creation completion*

## 6.10 Physical libraries and Enhanced Tape Caching

The Enhanced Tape Caching option allows the TS7530 VE for Tape Server to act as a cache to your physical tape libraries. With Enhanced Tape Caching enabled, tapes will always appear to be inside virtual libraries and will be visible to the backup application regardless of whether the data is actually on virtual tape (disk) or backend tape. This means that the backup application will always have direct access to data regardless of whether the data is on disk or on physical tape (see Figure 6-87 on page 234). This section describes the steps required to define a virtual library with Enhanced Tape Caching enabled.

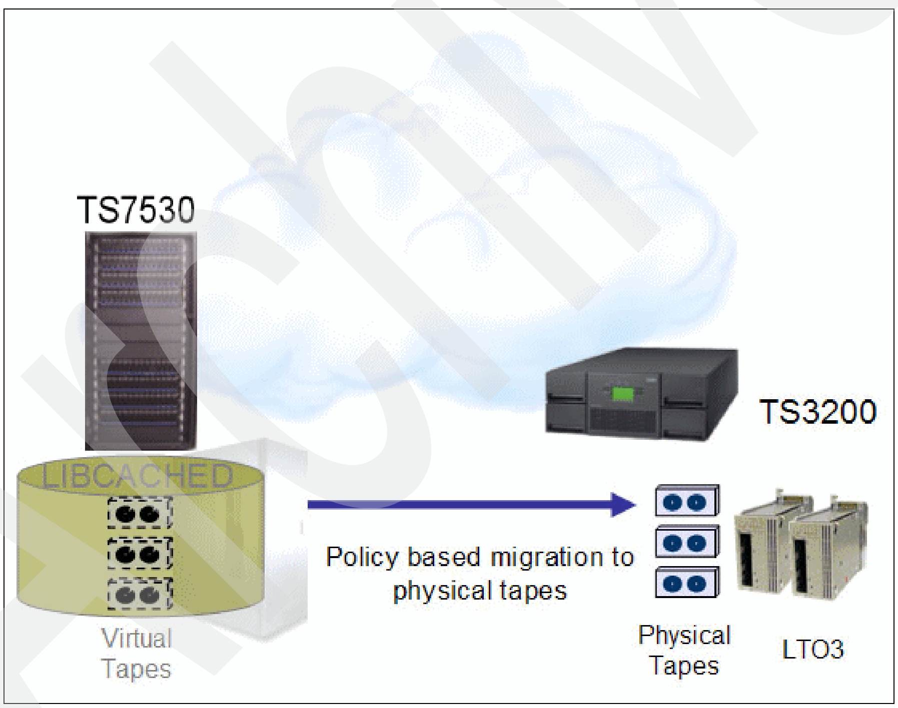



*Figure 6-85 Enhanced Caching setup: elements*

The following steps assume that the TS3200 and two LTO3 drives have been assigned to the TS7530 VE for Server as described in 6.8, “Scanning and preparing new physical devices” on page 223. We defined:

**Library** LibTS3200
**Drives** DrvTS3200-1
DrvTS3200-2

These are the steps to create a TS7530 virtual library with Enhanced Tape Caching enabled:

1. To start the wizard select **Virtual Tape Libraries** → **New,** as shown in Figure 6-86.

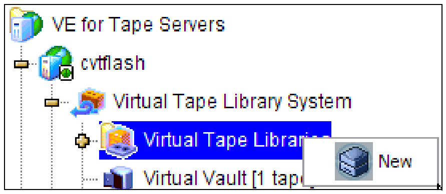



*Figure 6-86 Cached virtual library creation: Invoke wizard*

2. The Specify Equivalent Library Creation window appears only if:
   - There is a physical library attached, and,
   - No previous “equivalent” library has been created.

   If this item is selected, all physical drives and cartridges in the library will automatically assigned to a single virtual library. Deselect the option (Figure 6-87), and click **Next**.

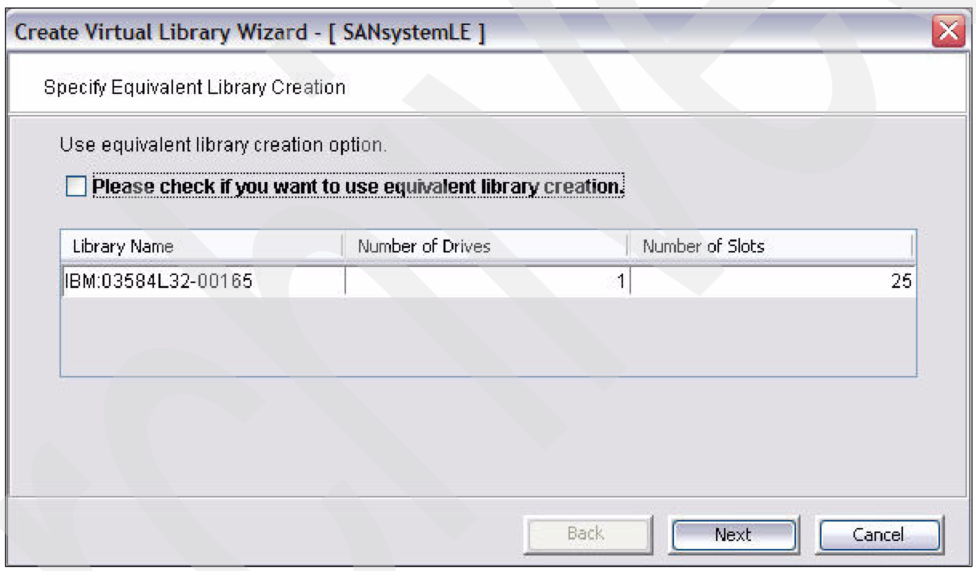



*Figure 6-87 Cached virtual library creation: Specify Equivalent Library Creation*

> **Recommendation:** Only activate this option if you only want to create one cached library that contains all the cartridges in the physical library.

3. We are creating a TS3200 virtual library with LTO3 drives. From the table in 6.6.1, “Library name cross reference” on page 205, you have to choose the library that returns the product ID 3573-TL. Specify the library and type as shown in Figure 6-88 on page 235. It is important to choose a library type supported by your backup application.

   You should establish and document the naming convention to be used for virtual tape drives and libraries.

> **Note:** The *Maximum Drives* and *Maximum Slots* columns of the Create Virtual Library Wizard shows the maximum number of drives and storage slots in a single frame. You can override the maximum number of drives and storage slots if you wish to virtualize a library with expansion frames.

Click **Next**.

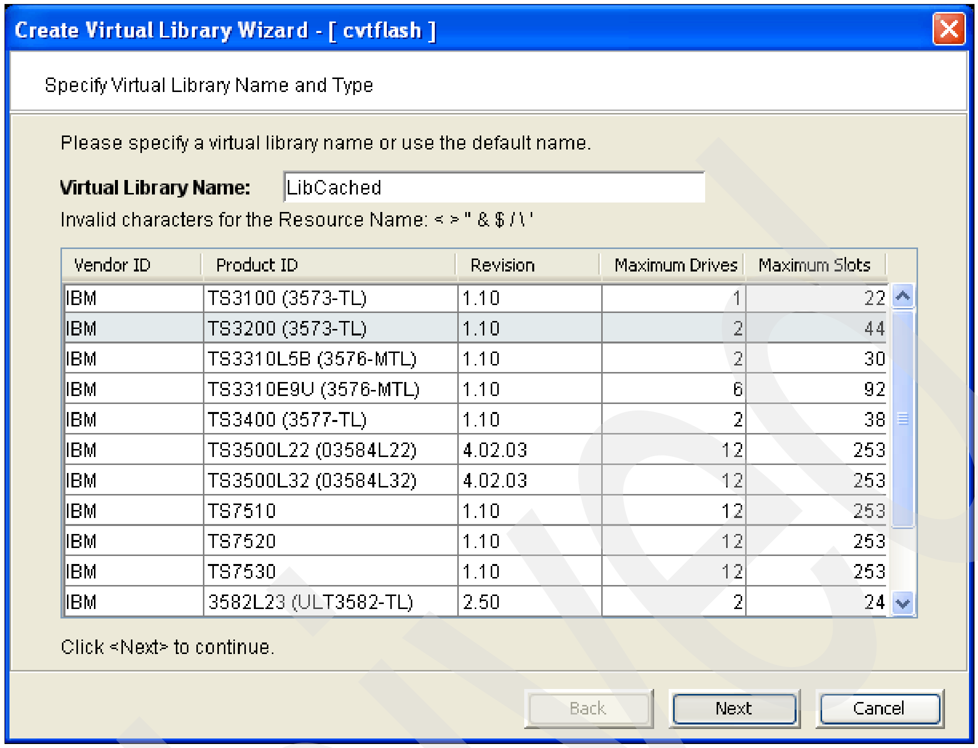



*Figure 6-88 Cached virtual library creation: specify virtual library name and type*

4. Within the window shown in Figure 6-89 on page 236, you specify:
   – Drive drive type you wish to virtualize LTO3: 3580-TD3
   – Drive prefix: DrvCached
   – Number of virtual drives to create: 4

   It is important to choose a drive type supported by your backup application.

   Click **Next**.

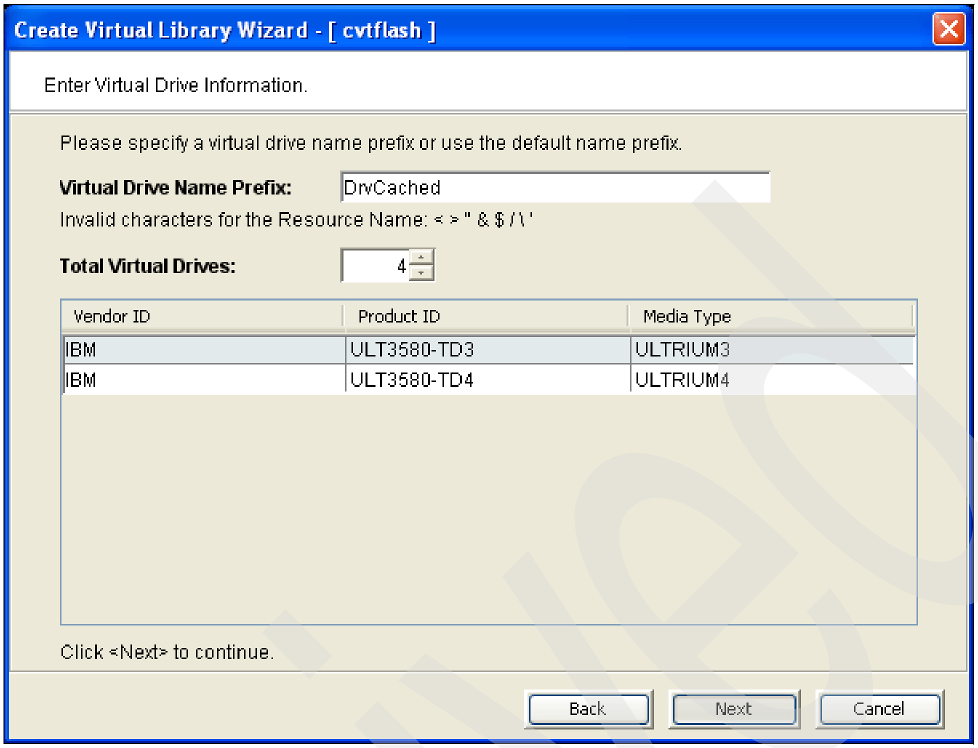



*Figure 6-89 Cached virtual library creation: specify virtual drive information*

5. As we chose to add four virtual drives to the library, we were presented with an information window (Figure 6-90), as we exceeded the *soft* limit defined within the TS7530 VE for Tape Server. To exit the window, click **OK**.

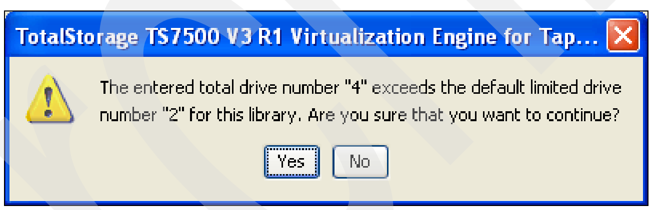



*Figure 6-90 Cached virtual library creation: information window when maximum drives exceeded*

For the TS7530 VE for Tape Server to act as a cache to the physical tape library, in the window shown in Figure 6-91 on page 237, select **Enable Automated Tape Caching**, and click **Next**.

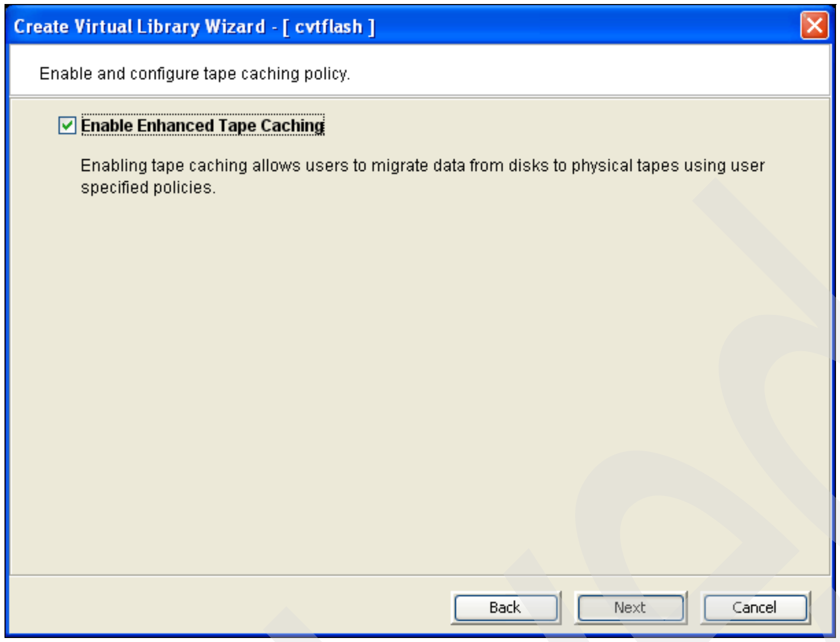



*Figure 6-91 Enable Tape Caching*

6. The Enhanced Tape Caching option provides flexibility that allows you to set up policies that automatically trigger data migration to physical tapes based on criteria, such as the number of days that data has been on disk or the amount of used disk space. With Enhanced Tape Caching, you cannot only determine which events will activate the action, but also when it will occur. For example, you can set the policy to migrate the data immediately or at a specific time or day as shown in Figure 6-92. Select **Policy Based**.

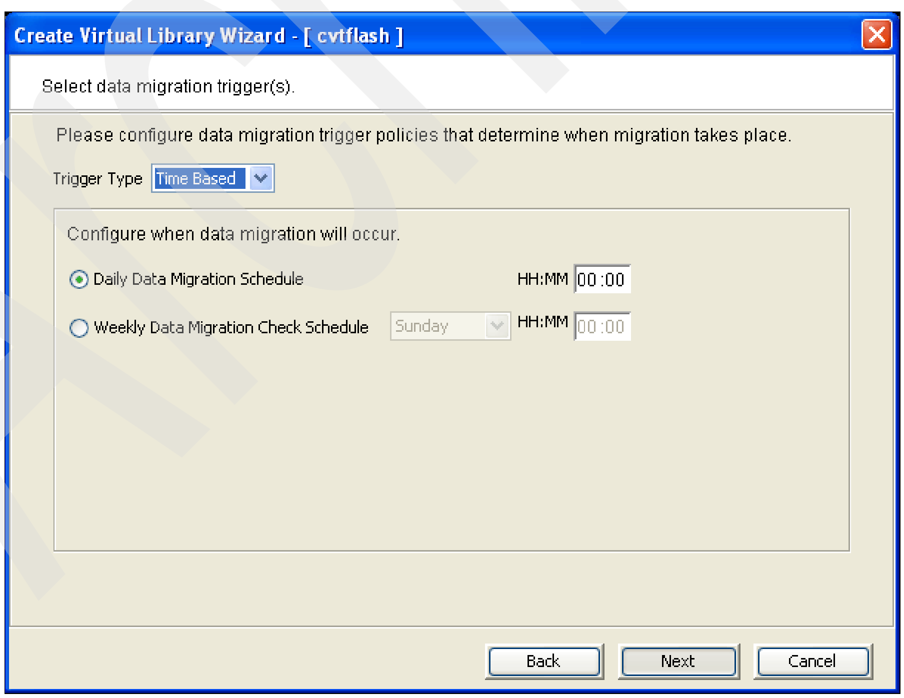



*Figure 6-92 Cached virtual library creation: time based migration trigger*

7. The contents of the window now display the policy based migration triggers.

   We select **Or,** deselected **Age Based,** selected **Disk Capacity Based** and selected **End of Backup**. This will result in data being automatically being migrated to disk if:

   – If disk cache usage exceeds 90%, or,
   – The backup completes.

   After the migration trigger policies have been specified (Figure 6-93) click **Next**.

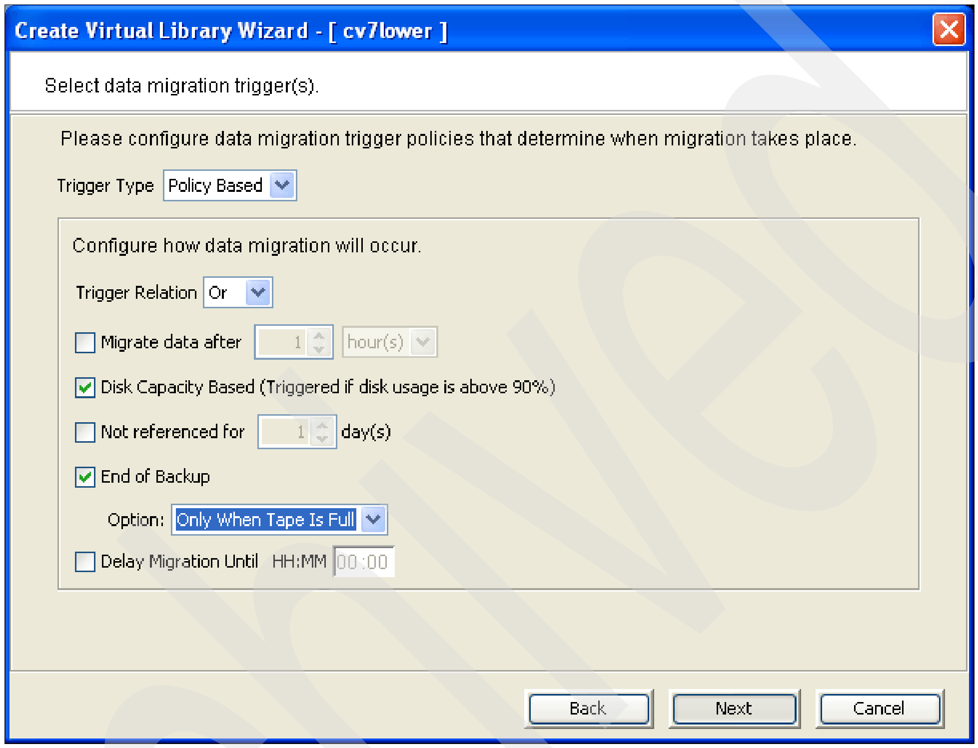



*Figure 6-93 Cached virtual library creation: Policy-based migration trigger*

Compared with the TS7500 Version 2, the TS7500 Version 3 provides a new option: Not referenced for O days. To migrate data that has not been referenced for a specified number of days:

a. Select the **Not referenced for** check box.

b. To migrate data when a backup operation completes, type or click the arrows to select the number of days.

**Hint:** End of backup occurs after data is written to a virtual tape and the tape is rewound and dismounted. Advanced backup applications such as IBM Tivoli Storage Manager stack data from multiple servers onto a single tape volume. The tape is not rewound or dismounted between the individual backups. In this situation the TS7530 VE for Tape Server only migrates the data on the tape when the last backup completes and Tivoli Storage Manager rewinds and dismounts the tape.

8. The next window allows you to specify when the cache used by the virtual volume will be reclaimed. Select **Immediate** on the window shown in Figure 6-94 to have the cache reclaimed immediately after a successful migration. Click **Next**.

> **Tip:** Only select **Immediate** if you have completed normal access to the virtual tape and will not have to access it for read or write append during normal operations. See Chapter 5, “Configuration and planning” on page 129, for more information about Enhanced Tape Caching.

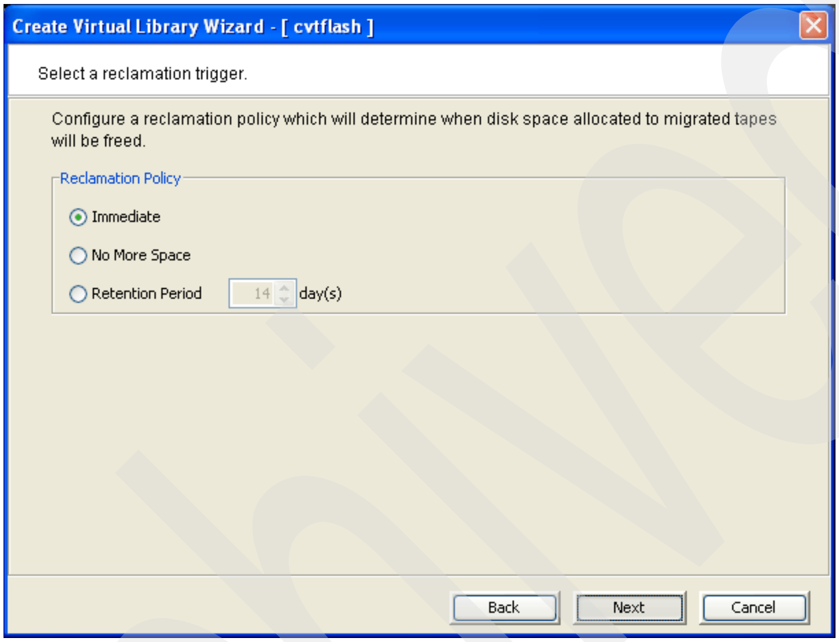



*Figure 6-94 Cached virtual library creation: Specify reclamation trigger*

9. If you purchased the tape duplication feature, refer to 7.7, “Tape duplication” on page 276. If you did not purchase the tape duplication feature, go to step 11. See Figure 6-96 on page 240.

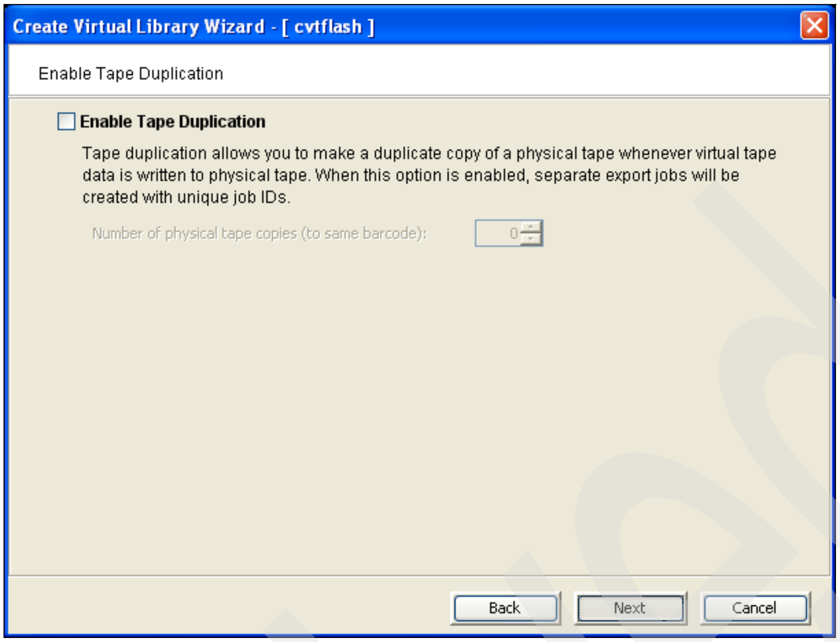



*Figure 6-95 Cached virtual library creation: Select Tape Duplication option*

10.Specify additional library attributes as shown in Figure 6-96. Click **Next**.

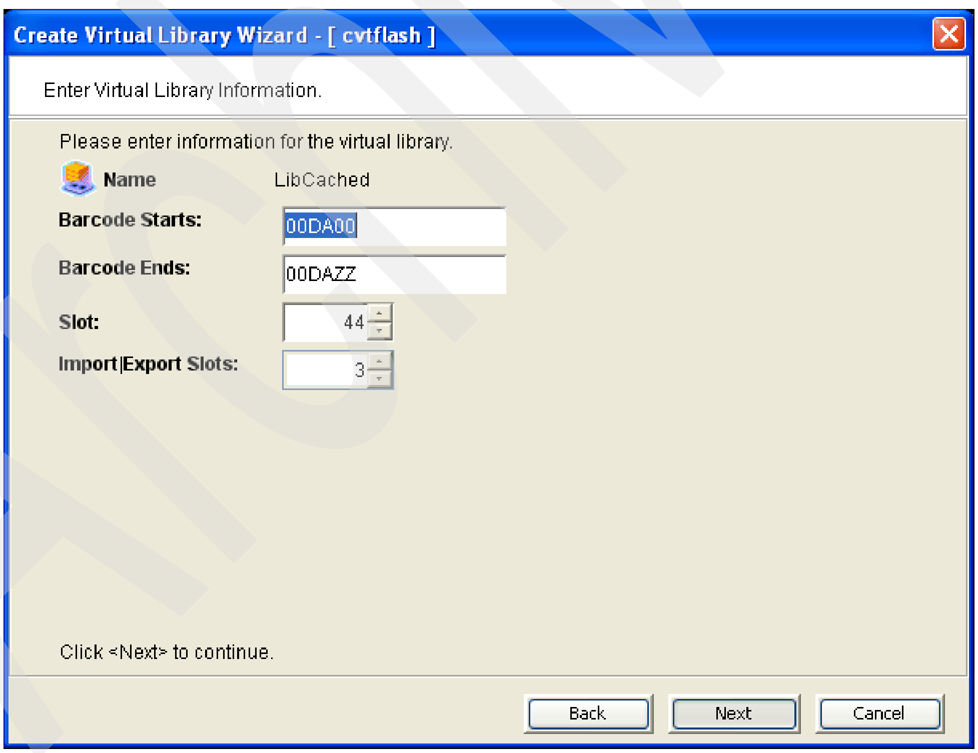



*Figure 6-96 Cached virtual library creation: specify barcode range and slot attributes*

These are the values you can specify:

**Barcode Starts/Ends** Specifies the range of barcodes that will be used when creating virtual tape volumes for this library. These option defines the barcode range for the virtual volumes, but does not create the virtual volumes. By default, barcodes increment in an alphanumeric sequence, for example, XXXX00 to XXXXZZ. To set the barcode to increment in a numeric sequence (XXXX01 to XXXX10), set the last three digits of the Barcode Ends field to 999, for example, XXX999.

**Slot** The maximum number of tape slots in your tape library.

**Import/Export Slots** Number of slots used to take tapes in and out of the library.

> **Tip:** The number of virtual volumes that you can define for a virtual library is limited by the number of slots defined for that library. The maximum number of slots that can be defined for a single virtual library is 65,536. For example, if you specify 1000 slots for a virtual library, the maximum number of virtual volumes in that virtual library will be 1,000. The number of slots cannot be changed after virtual library creation.

When a physical tape library is attached to the TS7530 VE for Tape Server, within any virtual library you may define a range of virtual volume barcodes with Barcodes Start/End which have no associated physical volumes with the same barcode label.

> **Warning:** Do **not** define virtual volumes which have the same barcodes as physical volumes in any physical library that you plan to attach to the TS7530 Virtualization Engine. The virtual volumes used with physical volumes are automatically created during library synchronization. Refer to 12.5.3, “Creating a cache for your physical tapes” on page 404 for details of library synchronization.

A virtual volume barcode must be six characters long. If more than six characters are entered in the Barcode Starts and Barcode Ends fields, the TS7530 Virtualization Engine Server generates nonstandard barcode labels.

To generate standard barcodes specify the barcode start and end range with exactly six characters as shown in Figure 6-96 on page 240.

11. Verify the library configuration (Figure 6-97 on page 242). Click **Finish** to create the library.

> **Attention:** If you have activated advanced tape creation, additional advanced tape creation panels will appear during this process. Refer to 6.9, “Advanced Tape Creation method” on page 228, for information about these panels.

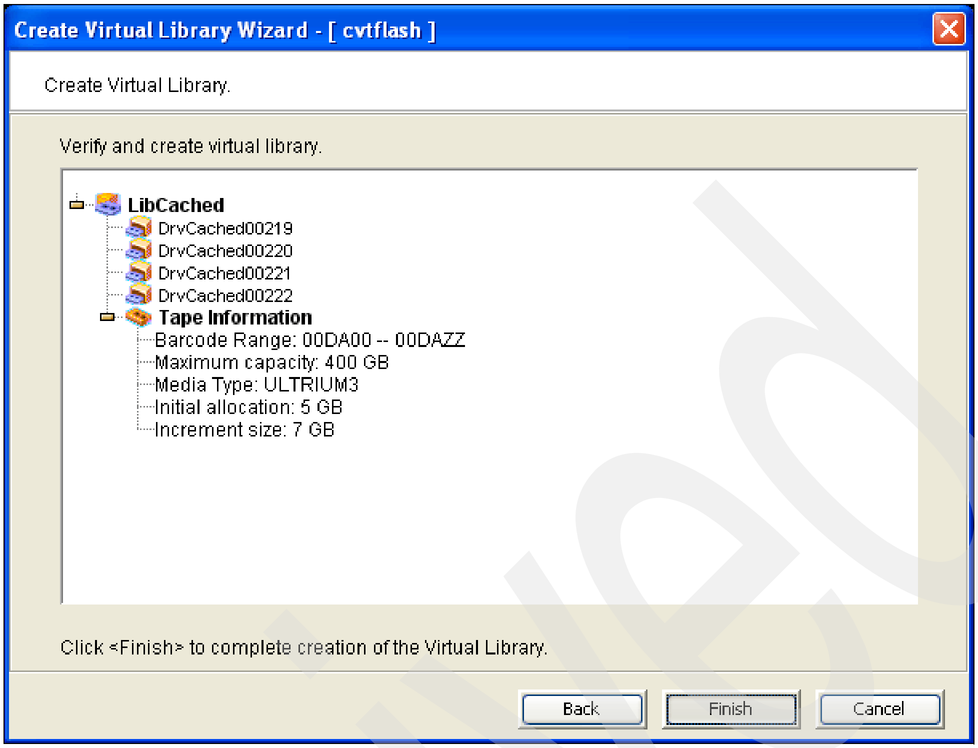



*Figure 6-97 Cached virtual library creation: Confirm library configuration*

12. Verify that the virtual library and drives were successfully created (Figure 6-98). Click **OK**.

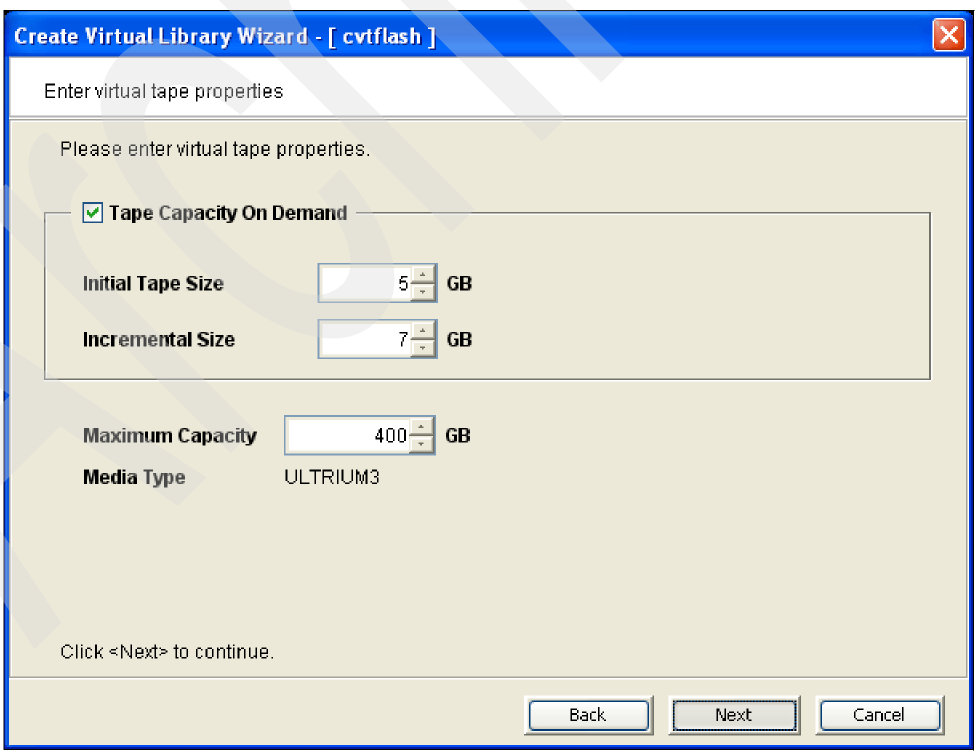



*Figure 6-98 Cached virtual library creation: Batch creation status*

13. Click **Yes** in the window shown in Figure 6-99 on page 243 to create the cache for the physical tapes.


*Figure 6-99 Cached virtual library creation: Create cache confirmation*

14. Select the physical library that contains the tape cartridges (LibTS3200) as shown in Figure 6-100. Click **Next**.

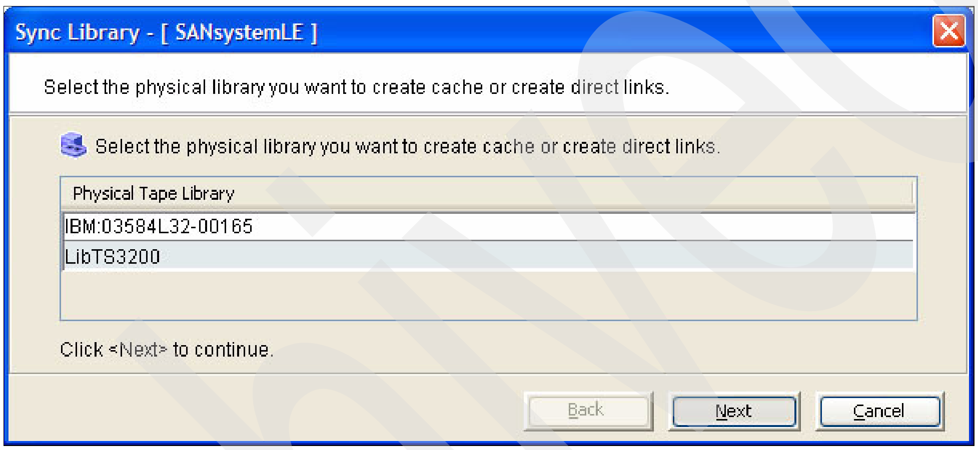



*Figure 6-100 Cached virtual library creation: Select physical library*

15.Select the physical tapes you wish to assign for use in LibCached. In the window shown in Figure 6-101, we selected WSC333L3 and WSC335L3. Click **Next**.

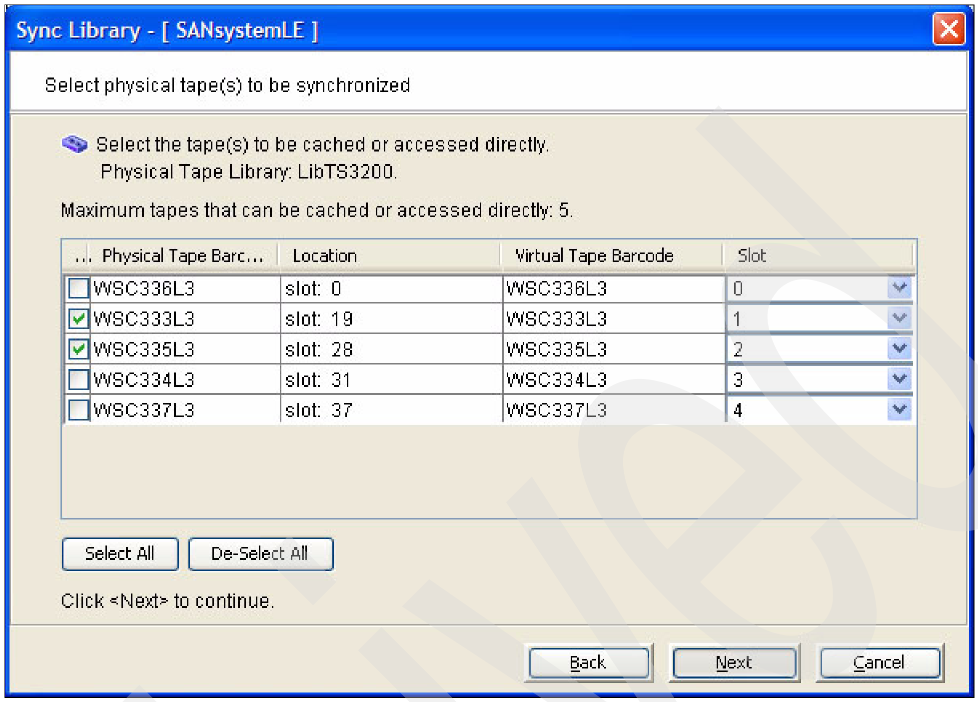



*Figure 6-101 Cached virtual library creation: select physical tapes*

16.Select the cache mode you wish to implement in the window shown in Figure 6-102. Click **Next**.

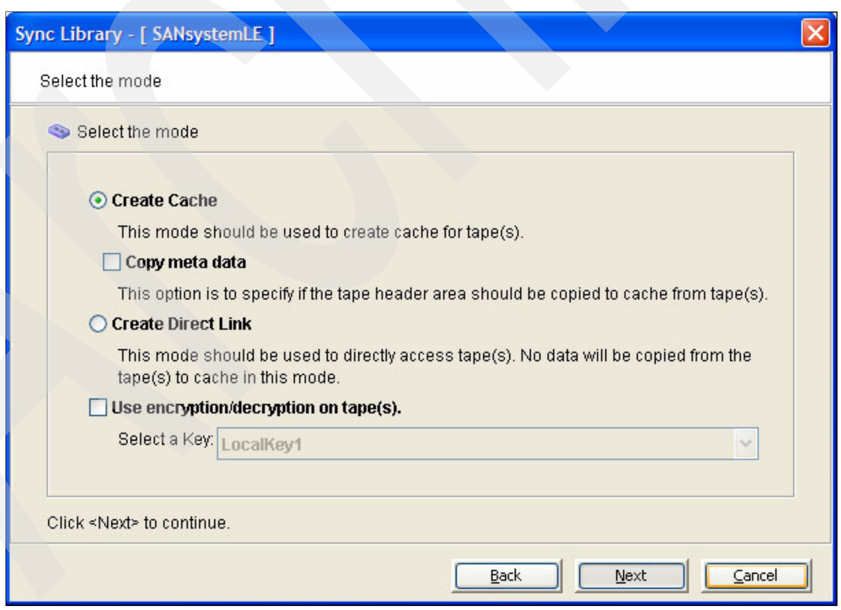



*Figure 6-102 Cached virtual library creation: Select cache mode*

**Important:** If you select Copy meta data, the physical tape volumes selected (Figure 6-101 on page 244) must each be mounted to read the physical cartridge and copy the meta data to the virtual volume tape cache.

17. In the window shown in Figure 6-103, verify the virtual volume cache configuration. Click **Next**.

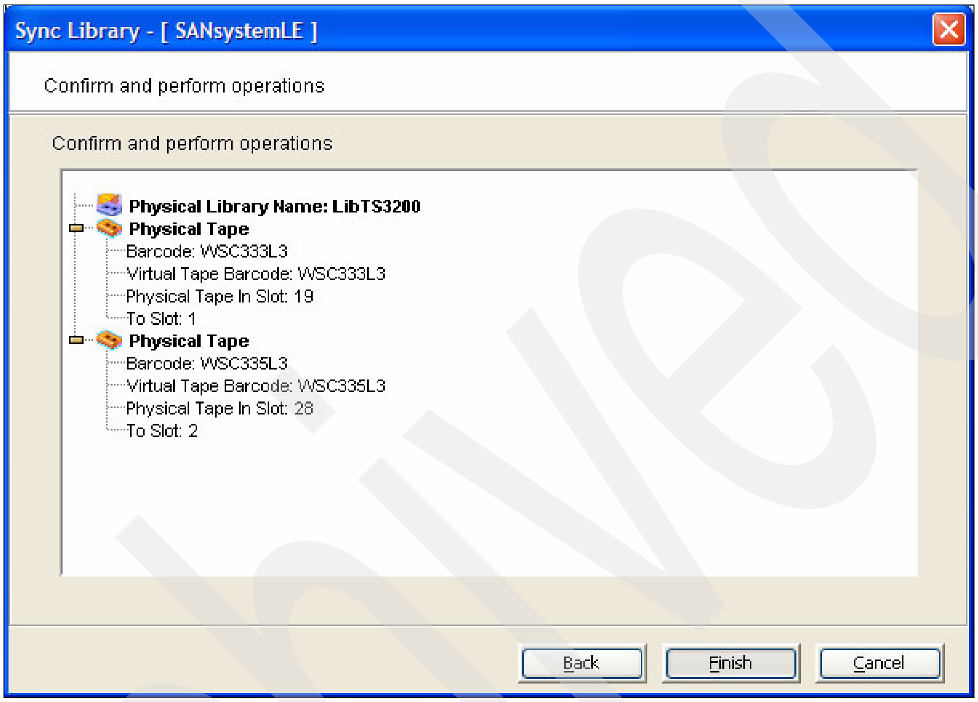



*Figure 6-103 Cached virtual library creation: Confirm cache creation*

18. LibCached should now be visible on the TS7530 VE for Tape Console status window (Figure 6-104).

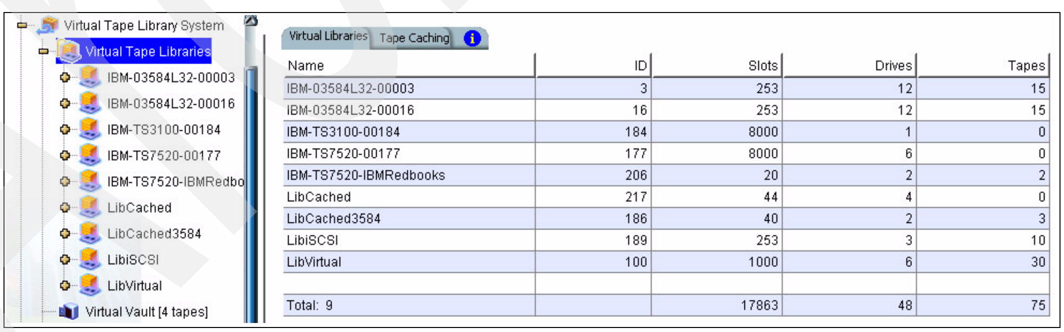



*Figure 6-104 Cached virtual library creation: TS7530 VE for Tape Console status window*

19. Expand **LibCached** on the TS7530 VE for Tape Console status window (Figure 6-105) to review the current status.

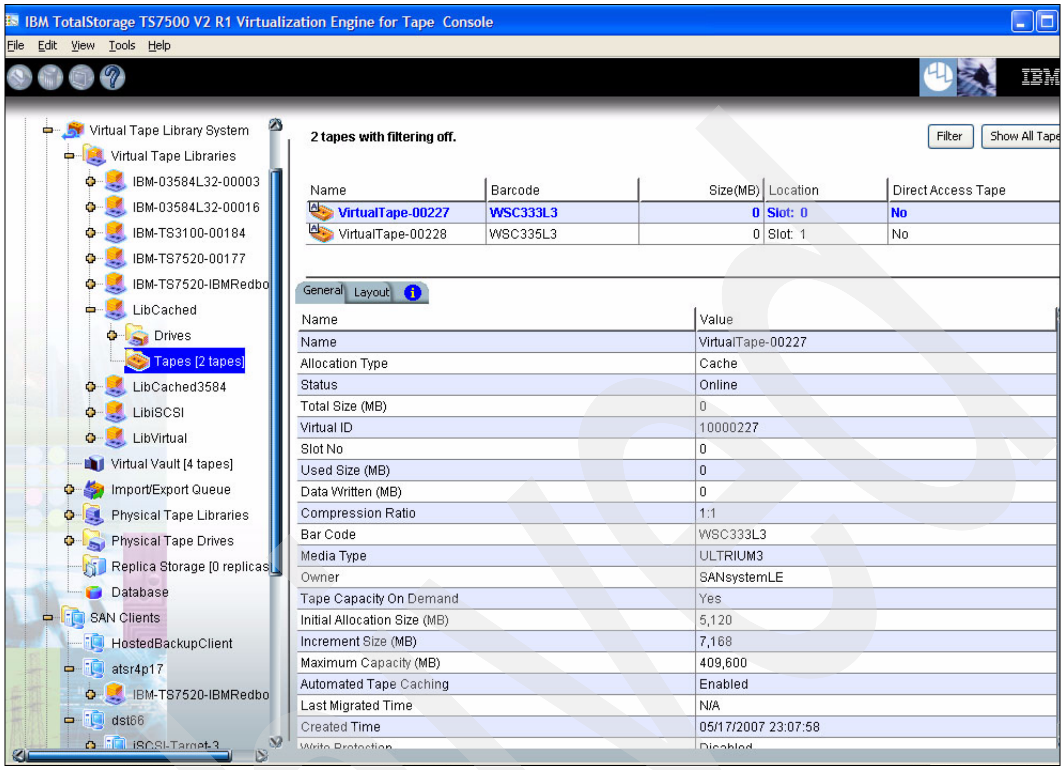


*Figure 6-105 TS7530 Virtualization Engine for Tape Console Status window*

> **Note:** On the second line in the bottom panel on the right, Allocation Type is “Cache”. Cache indicates this is a virtual volume that is a cache for a physical volume. If this were a virtual volume with no associated physical volume, “Virtual Tape” would display. If it were a cache volume and the cache had been reclaimed, “Direct Link” would be displayed, which indicates that all further reads or write appends to this volume will be performed with the physical tape with the same barcode.

# 6.11 Implementing the TS7530 with i5/OS

Most implementation tasks for TS7530 with i5/OS are the same as for the other operating systems and were described in earlier sections of this chapter. This section provides additional information specific to i5/OS.

## 6.11.1 Before you begin

Before you can use VE for Tape for IBM iSeries, your environment must meet the following criteria:

- The System i operating system must be at least i5/OS V5R2 or V5R3.
- There must be a Fibre Channel connection between the System i host and the VE for Tape appliance.
- The System i server must use either IBM 2765 PCI or IBM 5704 PCI-x Fibre Channel tape controller or equivalent.

- The VE for Tape appliance must use a QLogic QLA® 234x HBA as the Fibre Channel target mode server.
- In the VE for Tape Console, VE for Tape for IBM System i must be licensed.

## 6.11.2 Recognizing of a virtual tape library in the i5/OS partition

If the assignment of a virtual tape library in a TS7530 Virtualization Engine to the i5/OS partition is done correctly, i5/OS uses a virtual tape library as though it is a physical tape library. The following section explains how the i5/OS partition can recognize and use the virtual tape library in a TS7530 Virtualization Engine.

### Using i5/OS commands

If the virtual tape library is recognized, you can verify it with the Work with Storage Resources (WRKHDWRSC TYPE(*STG)) command. See Figure 6-106 on page 248; the example shows that CVTAQUAMAN and TAPMLB117 belong to one 5704 Fibre Channel Tape Controller Adapter.

**Note:** If WRKHDWRSC TYPE(*STG) does not show any TAPMLB devices, check if System Value QAUTOCFG is 1=On.

You might encounter a situation where you have to perform an *IOP-reset* to get i5/OS to recognize a new tape library. Contact IBM Support to get directions to perform IOP-reset if you need help do this.

You have to determine which virtual tape library on IBM Virtualization Engine TS7500 is TAPMLB117. The Work with Storage Resources window (Figure 6-106 on page 248) does not show exactly which virtual tape is TAPMLB117. The tape drive serial number shows which TAPxx device is the tape drive on the TS7530 Virtualization Engine. Select TAPMLBxx (04 in our example) with **9=Work with resource**. Press Enter.

In Figure 6-106, you see which TAPMLBnn tape libraries are associated with the Fibre Channel Tape Controller (DC05 5704, in our example). The associated IOP is shown as CMB03.

```
Work with Storage Resources
                                                            System:   WING1
Type options, press Enter.
  7=Display resource detail   9=Work with resource

Opt  Resource        Type-model  Status                Text
     CMB01            2844-001   Operational           Storage Controller
       DC01           2757-001   Operational           Storage Controller
       DC02           5702-001   Operational           Storage Controller
       DC04           5702-001   Operational           Storage Controller
     CMB02            268C-001   Operational           Combined function IOP
       DC03           6B02-001   Operational           Storage Controller
     CMB03            2844-001   Operational           Storage Controller
       DC05           5704-001   Operational           Tape Controller
       CVTAQUAMAN     3584-032   Operational           Tape Library
   9   TAPMLB117      3584-032   Operational           Tape Library
     CMB05            2844-001   Operational           Storage Controller
       DC06           5704-001   Operational           Tape Controller
       DC09           5704-001   Operational           Tape Controller
       DC16           280D-001   Operational           Tape Controller
       TAPMLB07       3584-032   Not detected          Tape Library
                                                                       More...
F3=Exit   F5=Refresh   F6=Print   F12=Cancel
```

*Figure 6-106 Virtual tape libraries as hardware resources*

In Figure 6-107, you see the TAPnn devices associated with a tape library, TAPMLBnn. Enter **7=Display resource detail** next to the TAPnn device (tape unit) and press Enter. This shows the tape unit resource details shown in Figure 6-108 on page 249.

```
Work with Storage Controller Resources
                                                            System:   WING1
Type options, press Enter.
  5=Work with configuration descriptions   7=Display resource detail

Opt  Resource        Type-model  Status                Text
     TAPMLB117        3584-032   Operational           Tape Library
 7     TAP159         3580-003   Operational           Tape Unit
       TAP158         3580-003   Operational           Tape Unit
```

*Figure 6-107 Virtual tape drives in HW resources*

The Display Resource Detail window (Figure 6-108 on page 249) shows the serial number of TAP device. This example shows 00-6317110 of the serial number on i5/OS. You want to correlate this serial number to a corresponding value shown using the Virtualization Engine for Tape Console interface.

We have to write down the last seven digits (6967842 in our example). You can confirm the association between the TAPnn device and virtual tape drive on the TS7530 VE for Tape Console by following the text after Figure 6-108.

```
Display Resource Detail
                                                            System:   WING1
Resource name  . . . . . . . :   TAP159
Text . . . . . . . . . . . . :   Tape Unit
Type-model . . . . . . . . . :   3580-003
Serial number  . . . . . . . :   00-6967842
Part number  . . . . . . . . :




Location:

Logical address:
 PCI bus:
  System bus                       14
  System board                     0
  System card                      36
 Library:
                                                                       More...
Press Enter to continue.

F3=Exit   F5=Refresh   F6=Print   F12=Cancel
```

*Figure 6-108 Tape resource details*

Check the tape drives using the TS7530 VE for Tape Console. Select **Virtual Tape Library System** → **Virtual Tape Libraries** → **your tape library** → **Drives** → ***your drive***. The General tab in the right panel in Figure 6-109 shows Serial No field for this virtual tape drive. Compare the last seven digits of this field with the last seven digits of the Serial number field from the Display Resource Detail 5250 window.

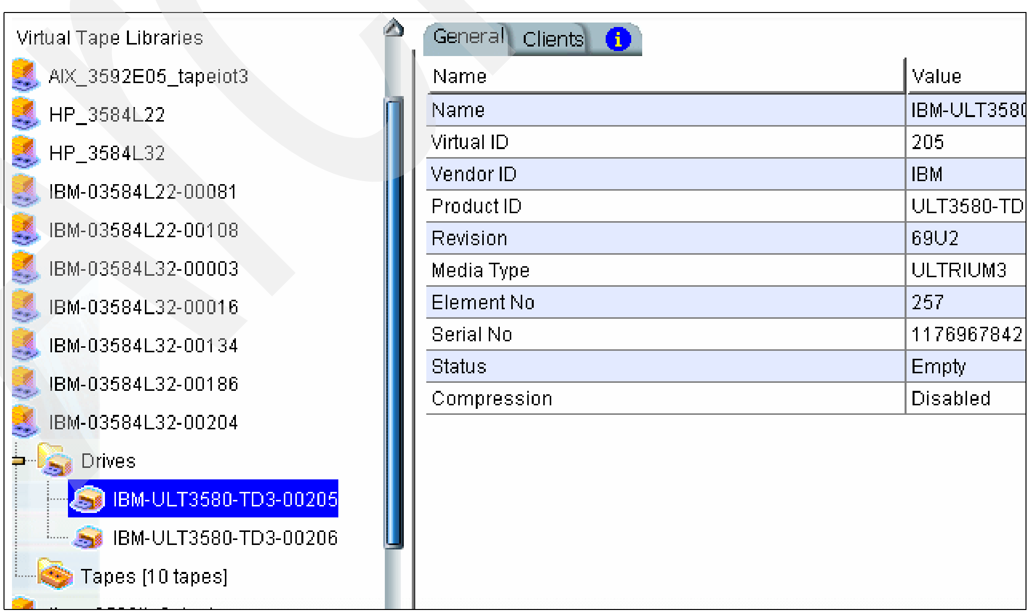



*Figure 6-109 TS7530 serial number of virtual tape drive*

**Important:** You might have to verify the i5/OS virtual library and tape name with the serial number more than once. If, for example, you have verified the virtual tape library and tape device names on the i5/OS partition, then, in your TS7530 environment, cables are moved among a set of Fibre Channel (FC) adapters. This might cause additional i5/OS virtual tape library and virtual tape device descriptions to be created. You should work with only one set of i5/OS virtual tape library and virtual tape device descriptions.

### Using iSeries Navigator

You can also use iSeries Navigator to recognize the virtual tape library and perform operations to it. If the virtual tape library is recognized, you can verify it using an iSeries Navigator interface rather than an i5/OS command-level interface.

See Figure 6-110. The example shows TAPMLB02, TAPMLB03, and TAPMLB04. Open your Server on iSeries Navigator and select **Configuration and Service** → **Hardware** → **Tape Devices** → **Tape Libraries**. iSeries Navigator shows the tape libraries on i5/OS partition.

**Important:** If iSeries Navigator does not show any TAPMLB devices, open **Configuration and Service** → **System Values** and double-click **Devices**. Confirm the check on **Local Controllers and Devices** in the Automatic configuration tab.

Sometimes you might have to perform IOP-reset to recognize the new tape library. Contact IBM Support and get the directions to perform IOP-reset.

You must recognize which virtual tape library on the TS7530 Virtualization Engine is TAPMLB04. The iSeries Navigator window does not directly show which virtual tape library on the TS7530 Virtualization Engine is the TAPMLBnn library. The tape drive serial number shown on i5/OS for TAPxx must be used to correlate this tape drive to one defined on the TS7530 Virtualization Engine. Right-click **TAPxx** and select **Properties**, as shown in Figure 6-110.

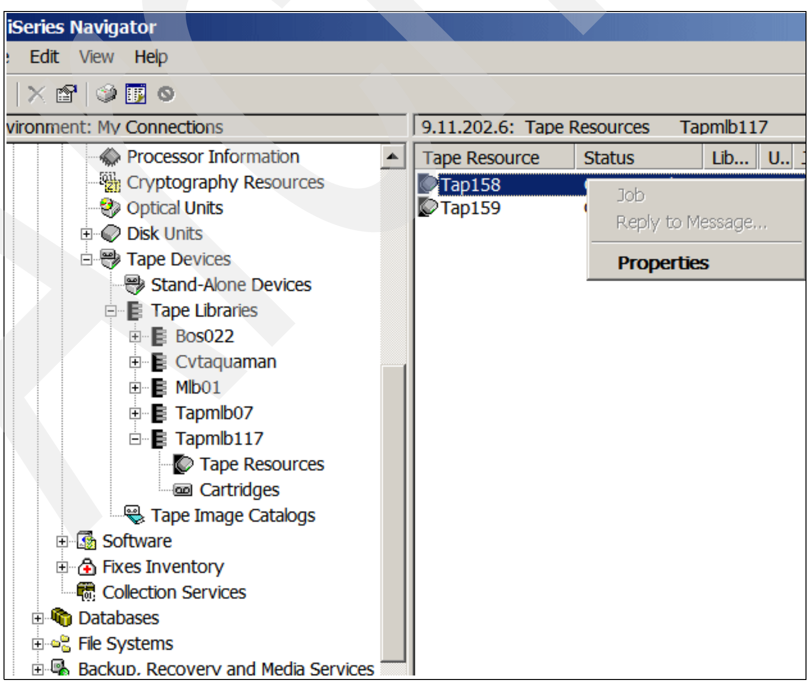



*Figure 6-110 Virtual tape libraries in iSeries Navigator*

See Figure 6-111. The properties of the tape device show its serial number. Use the last seven digits shown (6317110 in our example) to correlate with the corresponding serial number shown using the TS7530 VE for Tape Console interface.

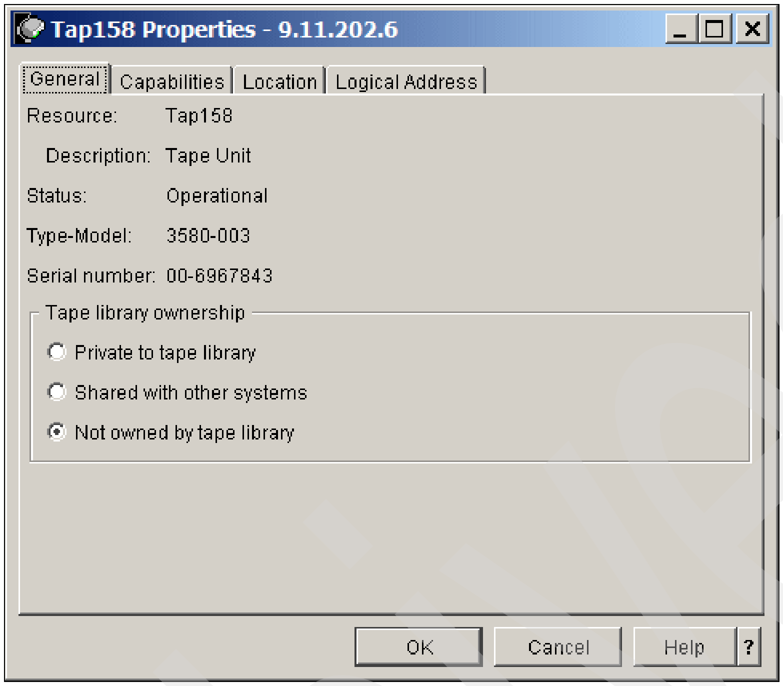



*Figure 6-111 Virtual tape drive details*

From the TS7530 VE for Tape Console, select **Virtual Tape Library System** → **Virtual Tape Libraries** → ***your tape library*** → **Drives** → ***your drive***. The General tab in the right window shows the Serial No field for this tape drive; see Figure 6-112. Compare the last seven digits of this window's serial number with the one shown in the iSeries Navigator window.

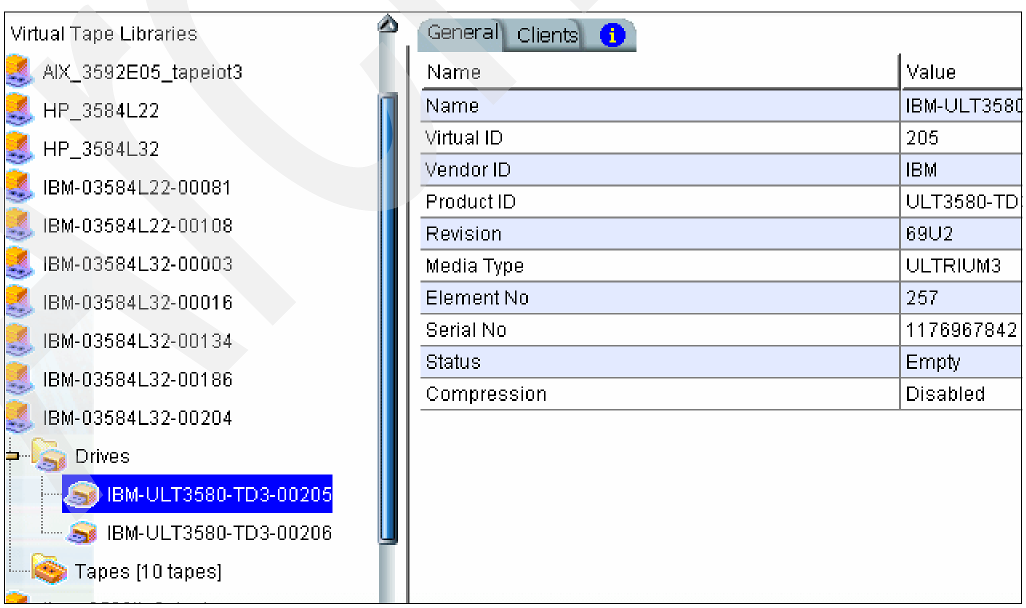



*Figure 6-112 TS7530 Virtual tape drive details*

**Note:** You use a virtual tape library with i5/OS and BRMS the same way as a physical tape library. For more information about usage, refer to the IBM Redbooks publication *Implementing IBM Tape in i5/OS*, SG24-7440.

7

# Enhanced setup

In this chapter we provide detailed setup information for the following TS7530 Advanced Functions:

- Failover/failback
- Network replication and Export Network Copy
- Tape encryption
- Hosted backup
- Network Data Management Protocol (NDMP)
- Path failover
- Four-node support
- Hardware compression
- Tape duplication
- Data shredding

# 7.1 Failover/failback

**Note:** Initial execution of the failover/failback wizard is normally performed by the IBM System Service Representative (SSR) at installation. The following information is provided for reconfiguration that might be required by a change in your environment.

The IBM TS7530 and TS7520 Virtualization Engine failover/failback option provides high availability by eliminating the downtime that can occur if a TS7500 Server (software or hardware) fails. IBM TS7500 Virtualization Engine uses a unique monitoring system for self-monitoring and intelligent heartbeat monitoring. Use the VE Console application to enable this feature code. No license key is required.

Failover/failback is available for the TS7520 and the TS7530. In the following sections we focus on the setup of the TS7530 Virtualization Engine. Unless noted otherwise, implementation steps are the same for TS7530 and TS7520.

## 7.1.1 Requirements

Follow these requirements when setting up a failover configuration:

- You must have two TS7530 Virtualization Engines (3954-CV7) servers in a single 3952 Tape Frame Model F05.

  Failover to another TS7520 Virtualization Engine Model CV6 or TS7530 Virtualization Engine Model CV7 in a different 3952 Tape Frame Model F05 is not possible because both TS7520 Cache Controllers (3955-SV6) must have access to the same disks.
- Feature Code 7420 Failover/Failback must be included in the initial order from the plant or installed with an MES.
- You must use static IP addresses.

  Two IP addresses are required for each adapter. One IP address is for management, which you use for your VE Console, called *server IP address*. The other IP address is used for a heartbeat connection, called *service IP address*:

  – Two IP addresses for the first heartbeat (service) connection and the management (server) connection on each node for eth0

  – Two IP address for the second heartbeat connection and the management connection on each node for eth1 (it must be on a different subnet than the first heartbeat connection)
- If a physical tape library is used, the SSR must connect it to both TS7530 Virtualization Engines' (3954-CV7) servers.
- No replication is allowed between two TS7530 Virtualization Engine servers in the same frame.

For additional information about the failover option see the *IIBM Virtualization Engine for Tape TS7500 User's Guide Version 3, Release 1*, GC27-2179, or the *IBM Virtualization Engine for Tape TS7500 Version 2 Release 2 - User's Guide,* GC26-2068.

## 7.1.2 Setup

To set up High Availability Failover, follow these steps:

1. Right-click one of the TS7530 icons in the VE Console and select **Failover** → **Failover Setup Wizard**, as shown in Figure 7-1.

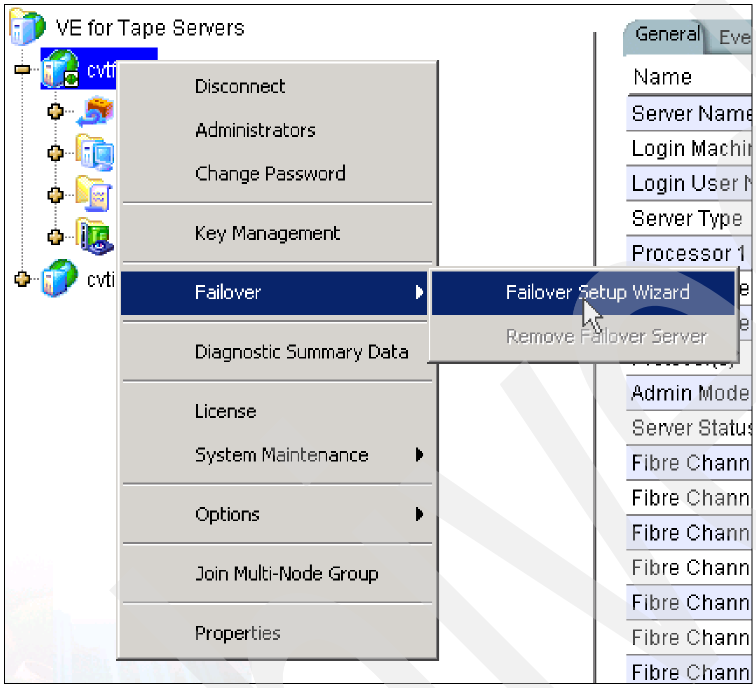



*Figure 7-1 Starting the Failover Setup Wizard*

2. In the panel that opens (Figure 7-2 on page 256), select the secondary TS7530 Server in the same frame, then click **Next**.

> **Tip:** If you have multiple TS7530 Virtualization Engine servers managed by the same TS7530 Virtualization Engine for Tape Console, all servers are displayed and you must select the server in the same frame as the server from which the Failover Setup Wizard was started.


*Figure 7-2 Selecting a secondary TS7520 server*

3. Confirm the server IP address of eth1 (adapter 1) for both TS7530 Servers, as shown in Figure 7-3. The addresses were set up during installation. See Chapter 6, “Initial setup” on page 181. Click **Next**.

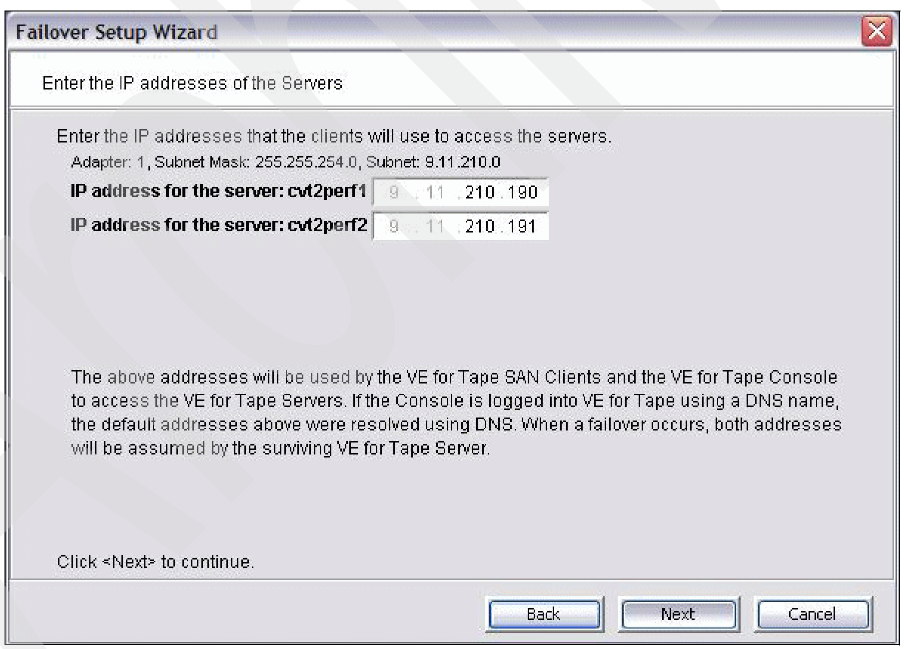



*Figure 7-3 Server IP address for eth1*

4. As shown in Figure 7-4 on page 257, type both *service IP addresses* for eth1. This connection is used for the first heartbeat. Click **Next**.


*Figure 7-4 Service IP address for eth1*

5. Confirm the server IP address of eth0 (adapter 2) for both TS7530 Servers, as shown in Figure 7-5. The addresses are set up during the installation. See Chapter 6, “Initial setup” on page 181. This address is normally used if you connect to the TS7530 with the VE Console. Click **Next**.

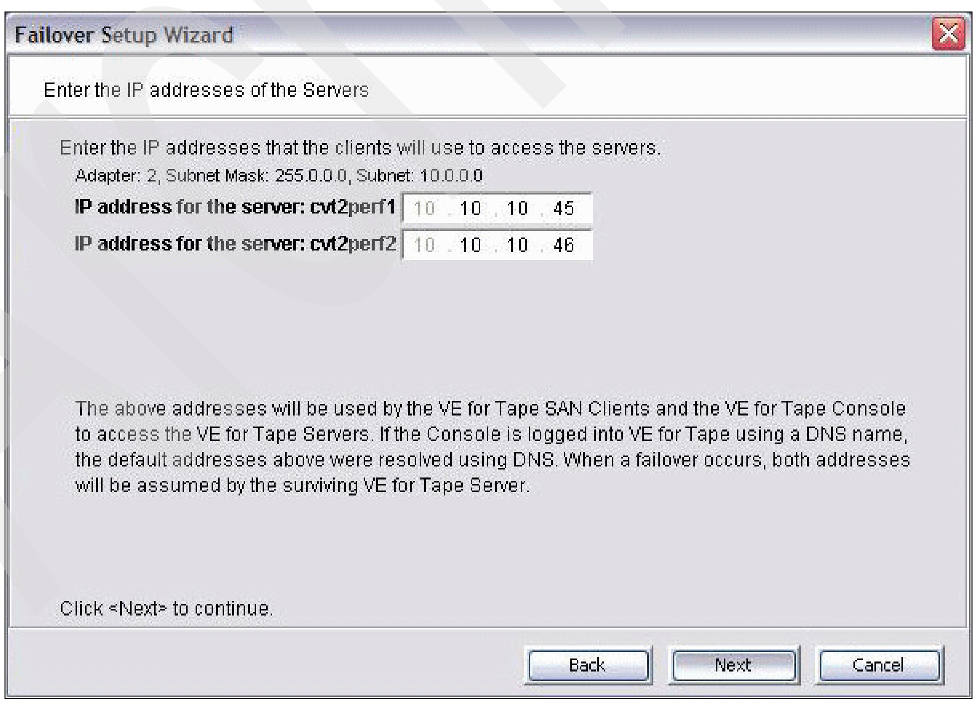



*Figure 7-5 Server IP address for eth0*

6. As shown in Figure 7-6, type both *service IP addresses* to be used for eth0. This connection is used for the second heartbeat. Click **Next**.

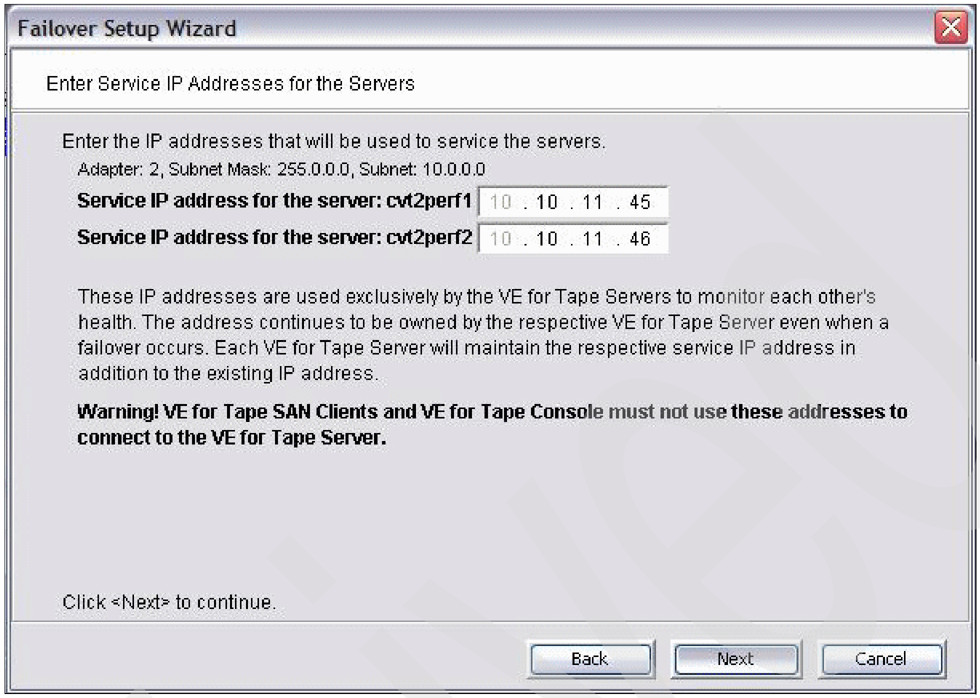



*Figure 7-6 Server IP address for eth0*

7. In the last panel, confirm the failover configuration. If you agree with the settings, click **Finish**. If not, click **Back** to make any necessary changes.

   A series of windows displays until the configuration completes. Upon successful completion, click **OK** on the window that is presented.

8. After a successful execution of the failover wizard, to view the failover configuration information select the TS7530 Server icon → **Failover** → **View/Update Failover Options**, as shown in Figure 7-7 on page 259.

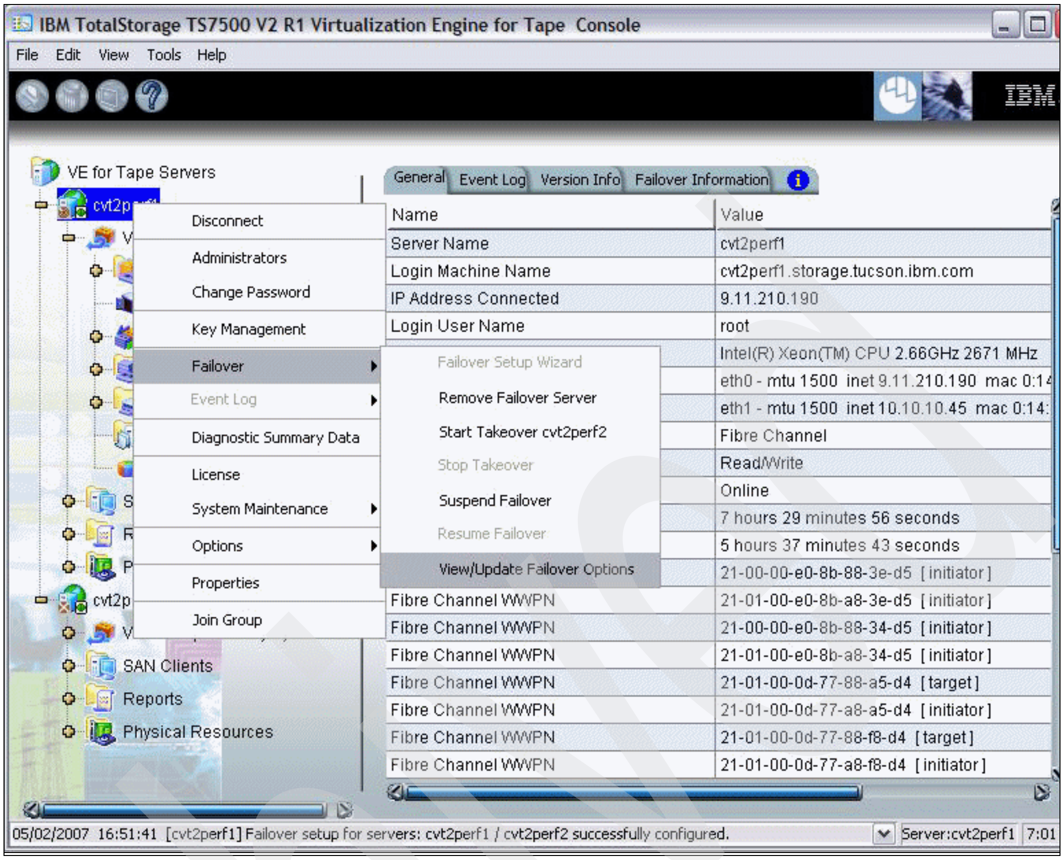


*Figure 7-7 Reviewing the failover settings*

The information displays on the Failover Information tab (Figure 7-8 on page 260).


*Figure 7-8 Failover information*

## AIX

For a transparent failover on AIX V5.2 and later, enable Dynamic Tracking on the Fibre Channel HBAs, which are used for a TS7530 connection. Select **smit** → **Device** → **FC Adapter** → **FC SCSI Protocol Device**. In the Change/Show Characteristics of a FC SCSI Protocol Device panel (Example 7-1), enable *Dynamic Tracking of FC Devices* by typing `yes`.

*Example 7-1 Enable Dynamic Tracking*

```
Change / Show Characteristics of a FC SCSI Protocol Device

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                    [Entry Fields]
  FC SCSI virtual device                          fscsi0
  Description                                     FC SCSI I/O Controlle>
  Status                                          Available
  Location                                        06-08-02
  Adapter SCSI ID                                 0xe9000c
  How this adapter is CONNECTED                   switch
  FC Class for Fabric                            [3]                    +
  Dynamic Tracking of FC Devices                  yes                   +
  FC Fabric Event Error RECOVERY Policy           delayed_fail          +
  Apply change to DATABASE only                   no                    +

F1=Help             F2=Refresh          F3=Cancel           F4=List
F5=Reset            F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

## 7.2 Setting up Network Replication

In 1.3.14, “Network replication” on page 29, we discussed the three different replication options:

- Replication
  - Copies changed data only
  - Replication repository
  - Policy managed
- Export Network Copy
  - Copies full contents
  - Replication repository
  - Initiated by move medium to I/O station
- Remote Copy
  - Copies full contents
  - Remote virtual library or virtual vault
  - Manual at management console

In this section we show you how to set up replication. To set up replication you must comply with the following requirements:

- Replication is an option that must be licensed. Both TS7530 Virtualization Engines must have the replication license enabled.
- The target IBM Virtualization Engine TS7530 must have enough disk space available for the replica resource.

### 7.2.1 Implementation steps

Replication copies data from a source virtual volume to another IBM Virtualization Engine TS7530 on a regular basis that is triggered by time schedules or by the amount of changed data. We want to enable replication on the newly created virtual library.

To enable the replication, follow these steps:

1. As shown in Figure 7-9, right-click the virtual library that you want to enable for replication, and select **Replication** → **Add**.

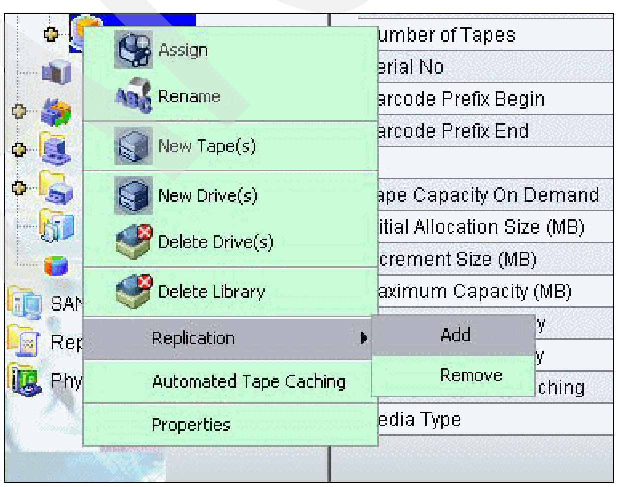



*Figure 7-9 Enabling replication*

**Tip:** You can also enable replication on a per virtual tape volume basis by right-clicking an individual virtual volume and selecting **Replication**.

2. Replication is based on the virtual tape volume. In the Select Virtual Tapes to enable Replication option panel (Figure 7-10), select the tapes that you want to replicate. We selected all available volumes. Click **Next**.

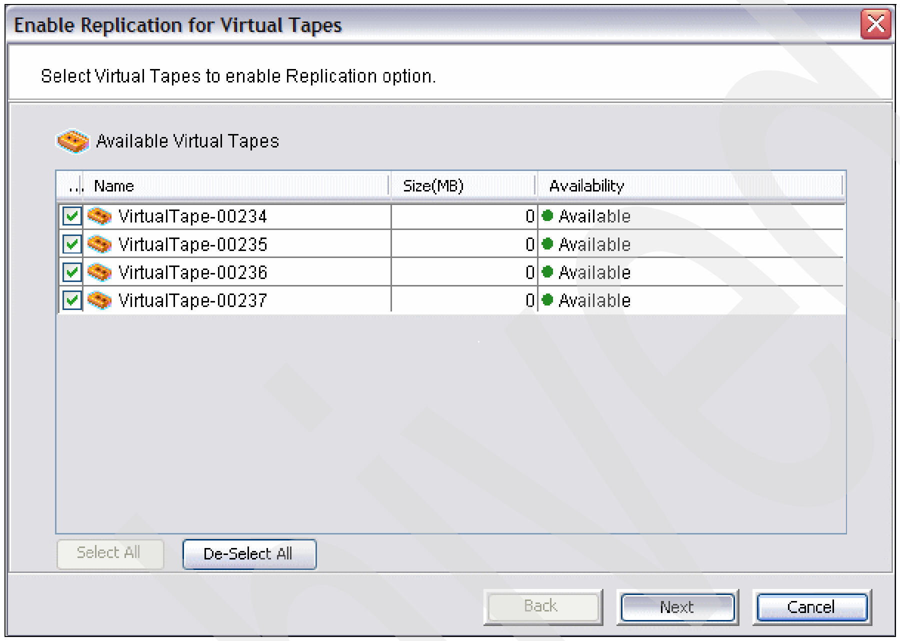



*Figure 7-10 Select tapes for replication*

3. Select **Remote Server** on the Specify Target server Type window (Figure 7-11).

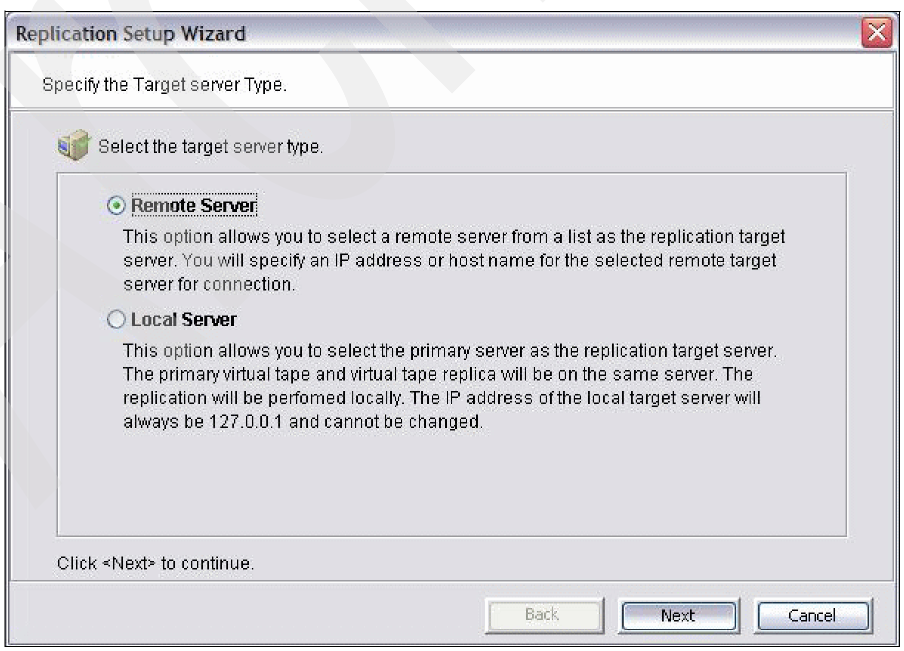



*Figure 7-11 Specify Remote Server*

4. Select the target server for replication on the Select the Target Server window (Figure 7-12) and click **Next**.

   If you manage multiple TS7530 Virtualization Engines from one TS7530 VE for Tape Console, all the TS7530 Servers are displayed in the list.

   **Note:** If the target TS7530 is not yet defined, click **Add** and define the target TS7530 Server.

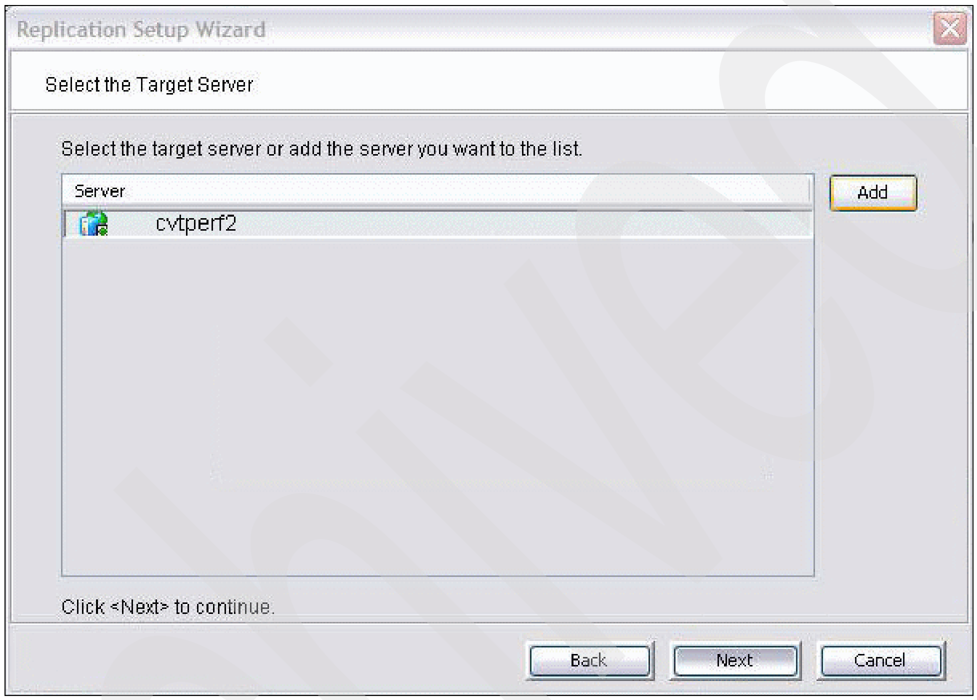



*Figure 7-12 Select target server*

5. Different triggers can be used for replication. In the Select the Replication Policy for the Virtual Tape display (Figure 7-13 on page 264), you can define the triggers for replication.

   You can specify for replication to start after a defined amount of data is changed on a volume. The replication then starts after the volume is dismounted from a virtual tape drive. You can also specify a trigger which either starts periodically or starts every day at the same time.

   Since we want to replicate periodically. We select **Schedule the replication every 10 hour(s)**. Click **Next**.

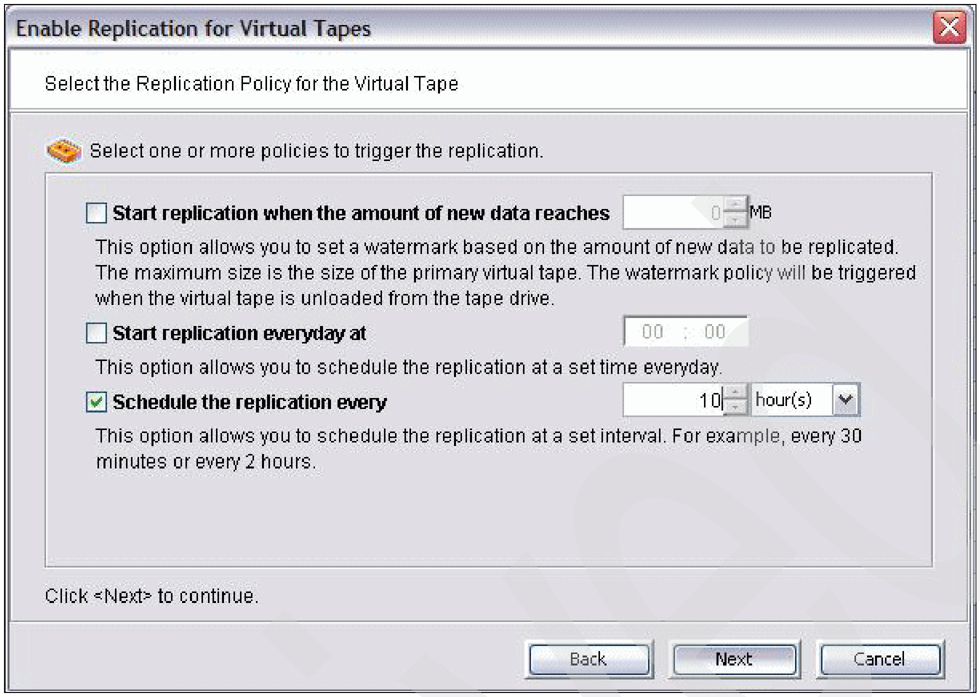



*Figure 7-13 Specifying a replication trigger*

6. In the Specify Replication Timeout and Retry Options window (Figure 7-14), you can select the replication timeout period, the replication retry period and the number of retries to attempt. We set a timeout and a replication retry period of 60 seconds and one retry.

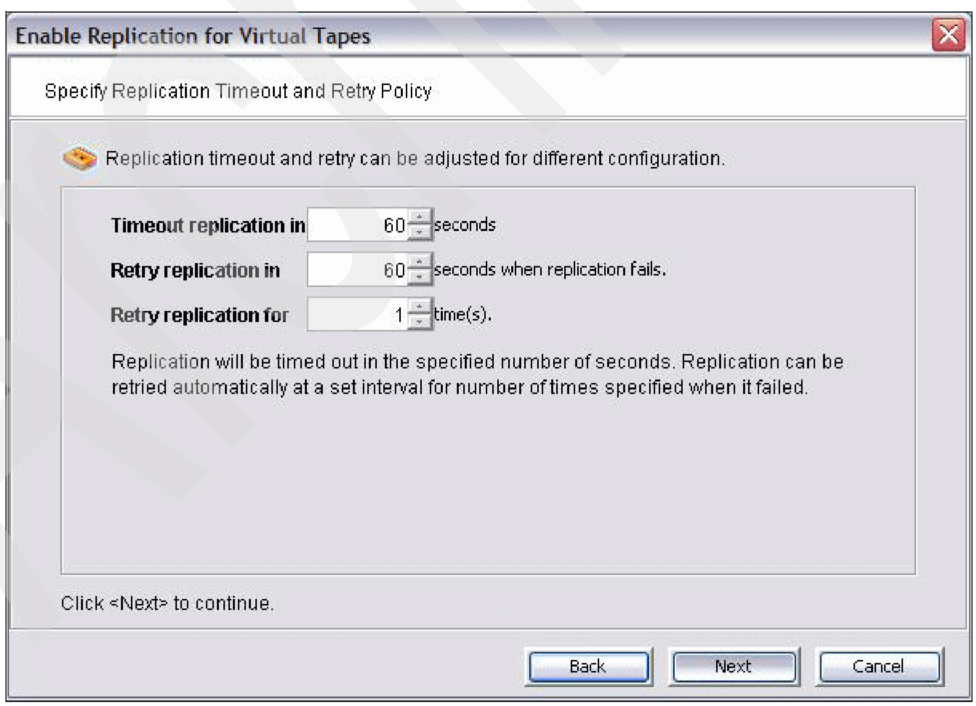



*Figure 7-14 Replication timeout and retry options*

7. In the Specify the Options for Data Transmission panel (Figure 7-15), you can select compression, encryption, or both options. Both of these options require that you have an additional license on both TS7530 Servers. Since we only have a replication license, we did not choose either option.

   Click **Next**.

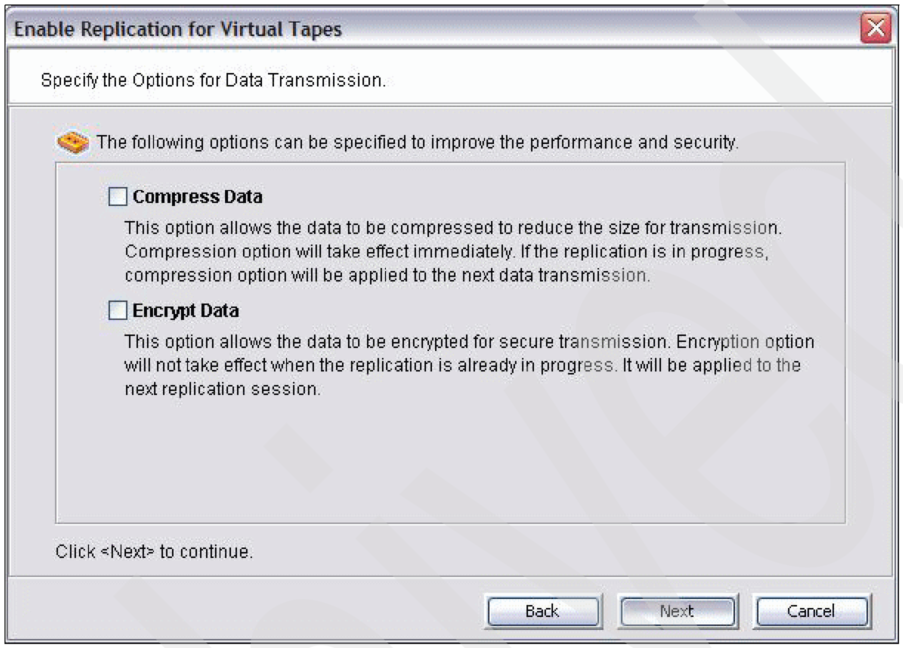



*Figure 7-15 Set replication compression or encryption*

8. As shown in Figure 7-16, the TS7530 displays the virtual volumes that were selected for replication. Click **Finish**.

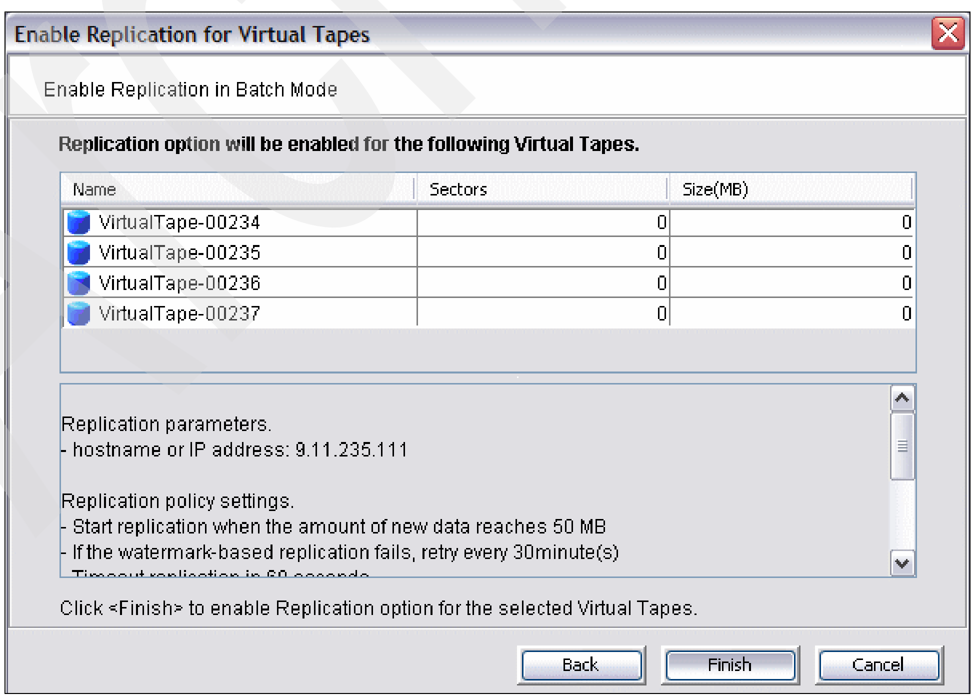



*Figure 7-16 Virtual volumes selected for replication*

9. The replication wizard completes with the window as shown in Figure 7-17. Click **OK**.


*Figure 7-17 Replication setup completion*

10. You can check the status of the replication, as shown in Figure 7-18.

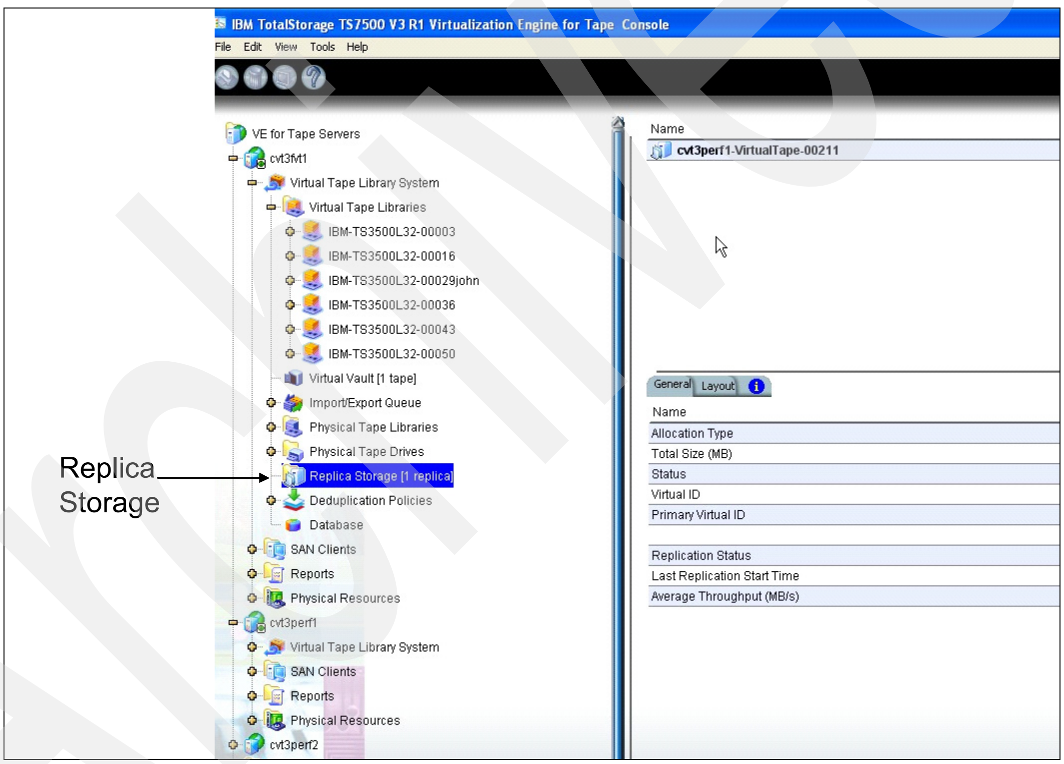



*Figure 7-18 Replication Status on source server*

On the target TS7530 Server, you see the replicated volumes under Replica Storage, as shown in Figure 7-19.

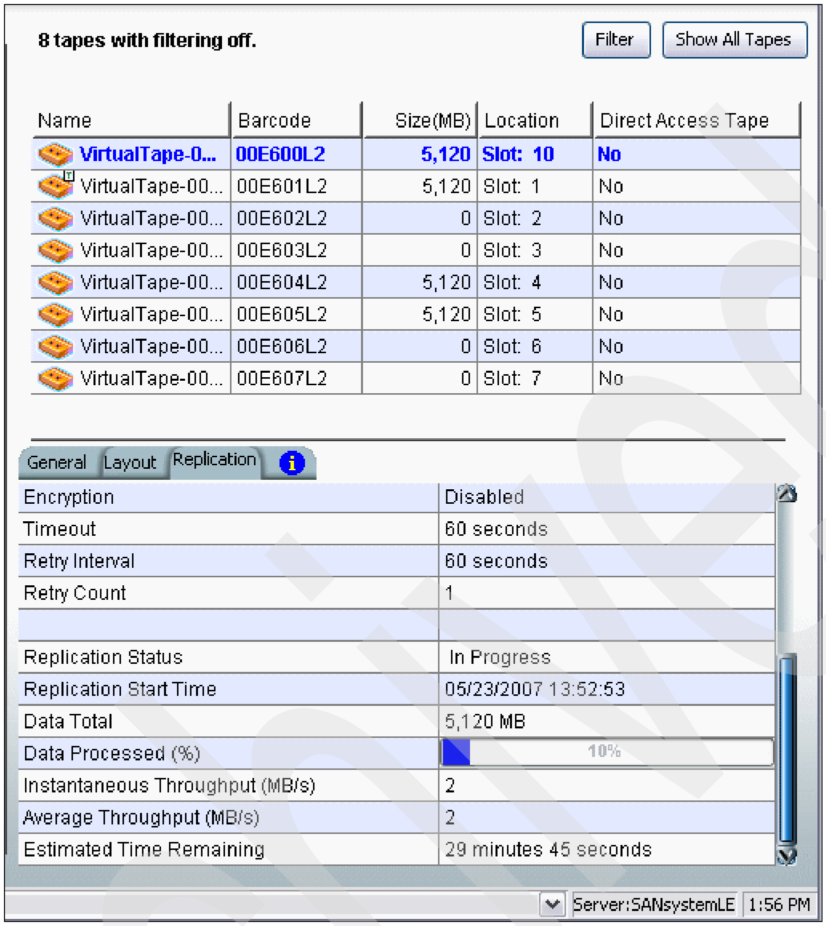



*Figure 7-19 Replication status on target server*

For more information, refer to Chapter 12, “Operation” on page 377.

## 7.2.2 Export Network Copy

Export Network Copy is similar to Export Physical Copy. The content of virtual volumes is replicated to a second TS7530 whenever this volume is moved to the I/O station of the virtual library. This option requires the Network Replication feature.

The entry point to enable and set up this options is by right-clicking a virtual tape library under **Properties**. See Figure 7-20.

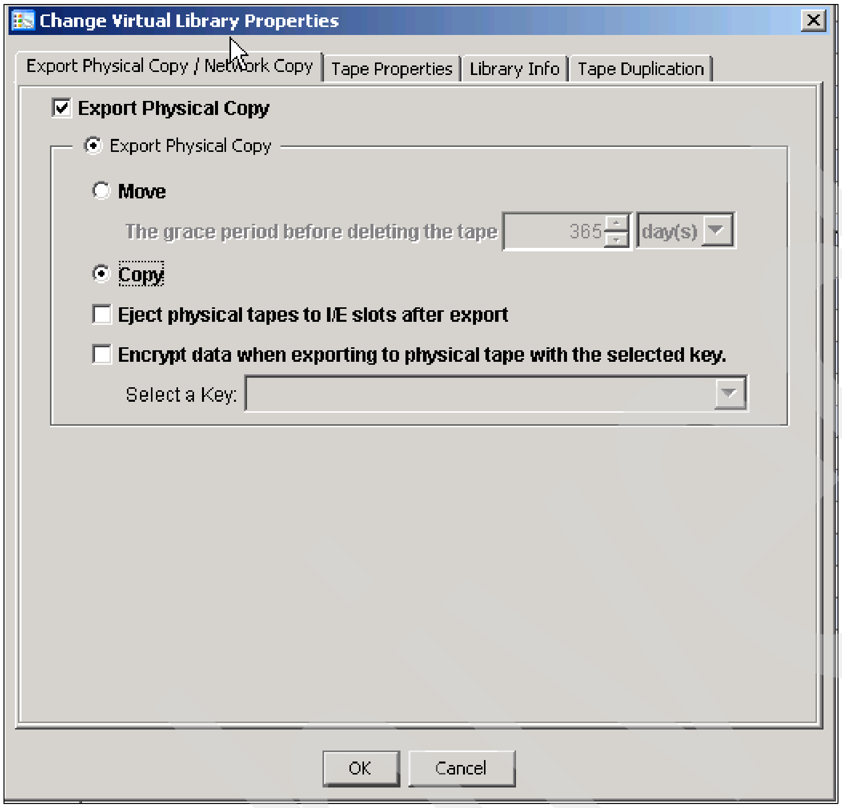



*Figure 7-20 Export Network Copy*

For information about setting up the Export Network Copy function, see the *IBM Virtualization Engine for Tape TS7500 Version 3 Release 1 User's Guide,* GC27-2179.

### 7.2.3 Remote Copy

This function allows you to copy the content of a single tape cartridge to a remote target server. It is only possible to copy a tape for which there is no virtual tape on the remote server with the same barcode existing.

For more information about setting up the Remote Copy function, see the *IBM Virtualization Engine for Tape TS7500 Version 3 Release 1 User's Guide,* GC27-2179.

## 7.3 Tape encryption

With physical tape libraries attached to the TS7530 Virtualization Engine, you can use three methods to encrypt your physical tape volumes:

- TS7530 Secure Tape function
- TS1120 Tape Drive native tape drive encryption
- LTO4 Tape Drive native drive encryption

## 7.3.1 Overview

You can use the TS7530 Secure Tape function (FC7427) to write encrypted data to TS7530 supported tape technologies that do not support native tape encryption. These physical tape drives must be in a supported physical tape library that is directly attached to the TS7530, referred to as backend tape.

If you have TS1120 Tape Drives or LTO4 drives attached to the TS7530 as backend tape, you can use the native tape encryption capabilities of the TS7530 using the Library Management Encryption method.

The TS7530 Secure Tape function and TS1120 or LTO4 drive native tape encryption are mutually exclusive functions. We recommend that you use native tape encryption if you are using TS1120 or LTO4 Tape Drives as backend tape.

The following section describes the setup of the TS7530 Secure Tape function.

For information about TS1120 native tape drive encryption, refer to the*IBM System Storage Tape Encryption Solutions*, SG24-7320, and to the *IBM Encryption Key Manager component for the Java platform Introduction, Planning, and User's Guide*, GA76-0418.

## 7.3.2 Secure Tape software encryption

The Secure Tape function uses the Advanced Encryption Standard (AES 128) algorithm published by the National Institute of Standards and Technology, an agency of the US government. With this option, you can create one or more keys that can be used to encrypt the data when it is exported to physical tape and decrypt when it is imported back to virtual tapes. The data on the tape cannot be read or be decrypted without using the appropriate key.

### Managing tape encryption keys

With Secure Tape function, you can create one or more keys that can be used to encrypt the data when it is exported to physical tape and decrypt it when it is imported back to virtual tapes. The data on the tape cannot be read without being decrypted using the appropriate key.

Each key consists of a secret phrase. For additional security, each key is password-protected. You must provide this password to change the key name, password or password hint, or to delete or export the key.

> **Note:** If you apply an incorrect key when importing a tape, the data imported from that tape will be indecipherable.

You must perform two steps to use the Secure Tape feature to encrypt/decrypt a virtual volume. You must first create the keys to use for encryption and then you must assign those keys to virtual volumes.

You can assign the key(s) to virtual volumes when:

- Creating a cached library
- Performing library synchronization
- Renewing cache for a physical volume
- Setting your Export Physical Copy options.

For more information about these functions, refer to Chapter 12, “Operation” on page 377.

## Adding a key

To add a key to use for Secure Tape data encryption:

1. Right-click the server name and click Key Management as shown in Figure 7-21.

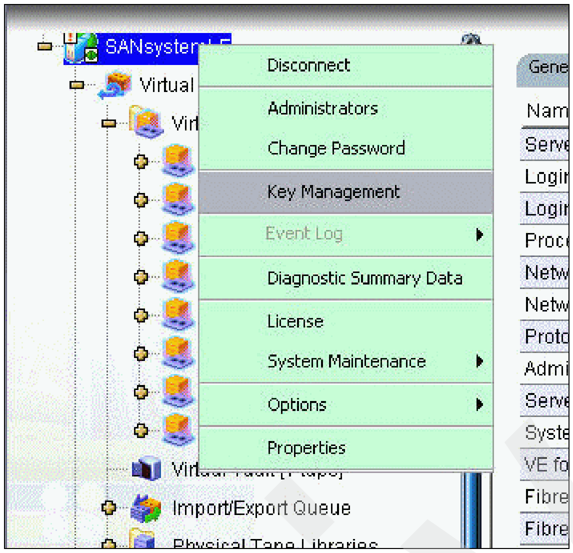



*Figure 7-21 Starting the key management process*

2. Click **New** on the Key Management window to add a key. See Figure 7-22.


*Figure 7-22 Initial key management window*

3. As shown in Figure 7-23 on page 271, type:

a. A unique name for the key (1–32 characters) in the Key Name text box.

Type the phrase (25–32 characters, including numbers and spaces) in the Secret Phrase text box that will be used to encrypt the data.

> **Important:** We recommend that you save your secret phrase somewhere because once you have created a key, you cannot change the secret phrase associated with that key.

b. Type a password for accessing the key (10–16 characters) in the New Password and Confirm Password text boxes.

You do not have to provide a unique password for each key. If you use the same password for multiple keys, you have to provide the password only once when you export multiple keys that all use the same password.

> **Attention:** You must provide the password to change the key name, password or password hint, or to delete or export the key.

c. Type a hint (0–32 characters) in the Password Hint text box that will help you remember the password. This hint appears when you type an incorrect password and request a hint.

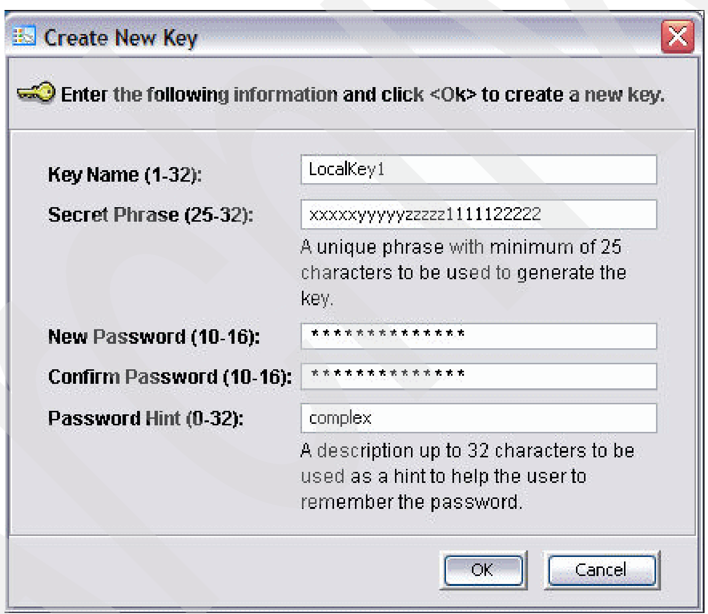



*Figure 7-23 Create New Key window*

In our example we created a key named LocalKey1, with a secret phrase of xxxxxyyyyyzzzzz1111122222, password of complicatedkey, and hint of complex.

4. In the window shown in Figure 7-24, click **OK**. Your new Key Name is displayed on the Key Management window.


*Figure 7-24 Key Management window with one key*

For information about changing a keyname or password, deleting, exporting or importing keys, refer to Chapter 12, “Operation” on page 377.

## Assigning keys to virtual volumes

After you have created your keys, there are multiple ways to assign a key to a virtual volume.

You can assign a key to the all the virtual tape volumes in a virtual library during the execution of the Create Virtual Library Wizard as shown in Figure 7-25. Select the **Use encryption/decryption on tape(s)** option and select the appropriate key from the drop-down box.

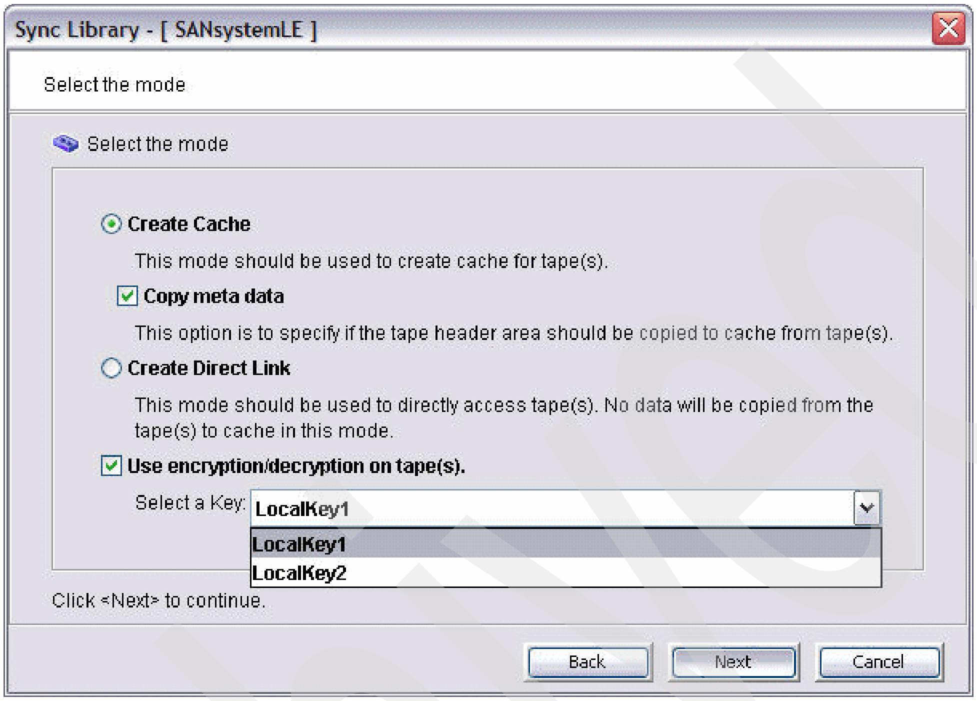



*Figure 7-25 Add encryption key to virtual tapes during library creation*

Refer to Chapter 12, “Operation” on page 377, for information about adding keys when:

- Performing library synchronization
- Renewing cache for a physical volume
- Setting your Export Physical Copy options.

## 7.4 Hosted Backup

The Hosted Backup function (FC7425) allows you to install your own backup application on the TS7530 Virtualization Engine server. For this function, a separate LUN with a size of 200 GB is preconfigured.

Hosted Backup can save a dedicated backup application server, reduce sources of error, and save current consumption.

> **Note:** Currently, IBM Tivoli Storage Manager is the only supported backup application. At least one additional AMD Opteron Card with 4 GB RAM is needed (FC3454).

Before you start to install the backup application on the TS7530 Virtualization Engine Server you must enable Hosted Backup.

## 7.4.1 Enable Hosted Backup

Right-click **<your TS7530 server>** and select **Options** → **Enable Hosted Backup**, as shown in Figure 7-26.

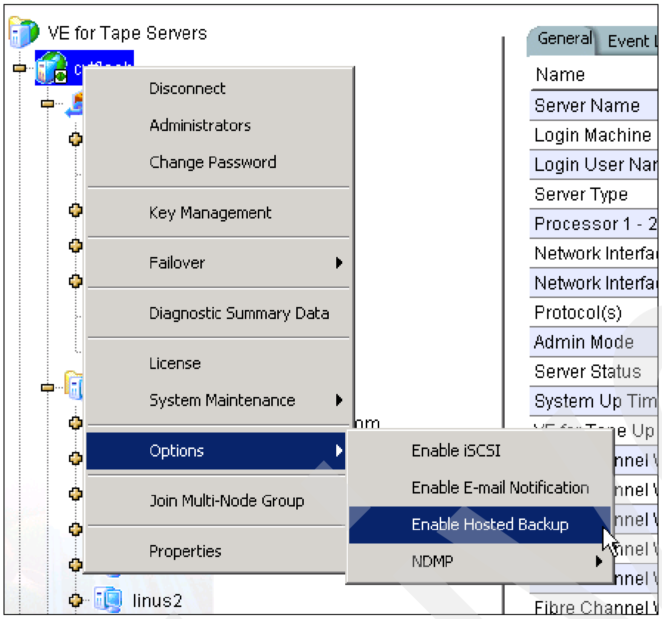



*Figure 7-26 Enable Hosted Backup*

A new dedicated SAN client (HostedBackupClient) will be created after you insert the licence key.

## 7.4.2 Assign virtual library

Assign one or more of the created virtual libraries to this special client and write down the serial number of the virtual library/libraries, as you see in Figure 7-27 on page 275.

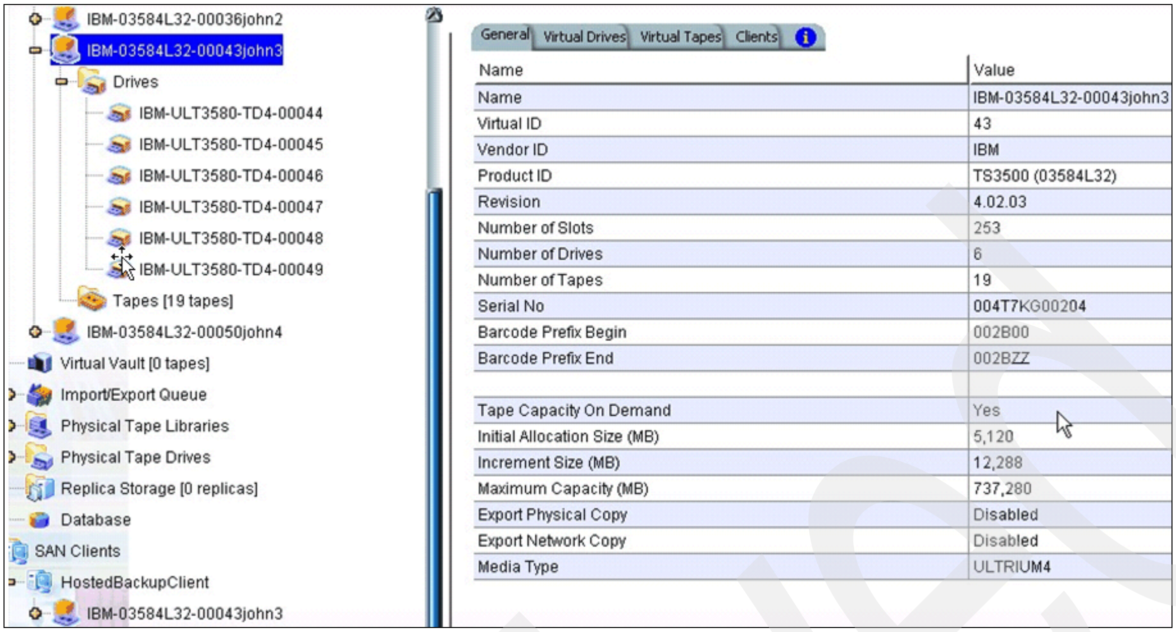



*Figure 7-27 HostedBackupClient*

### 7.4.3 Install backup application

Install the backup application as described in the installation instructions for the application. Use the serial number of the virtual libraries assigned previously to configure the drive and library inside the application.

## 7.5 Network Data Management Protocol (NDMP)

The NDMP Backup Support option allows certified backup applications and industry standard NAS devices (that is, NetApp® filers) to perform backup and restore using the NDMP protocol over an IP network. Check with your backup application vendor to determine what functions have been certified for use with the NDMP function on the TS7530 Virtualization Engine.

> **Note:** With the TS7520 Enterprise Edition, the NDMP Backup Support option requires the Hosted Backup feature.

To configure NDMP Backup Support:

1. If Hosted Backup is not already enabled, enable it now.
2. Right-click your TS7530 Server and select **Options** → **NDMP** → **enable NDMP**.
3. Enter the username and password, which must be the same for the NDMP module in your backup application.

4. Right-click **HostedBackupClient** and select **Assign** to assign virtual libraries to this client.
5. Confirm all information and click **Finish**.

## 7.6 Path failover

Starting with the TS7500 V2 R1 software, Control Path Failover and Data Path Failover (CPF/DPF) are available as an additional function called Path Failover. This function adds the ability to utilize multiple physical paths from the host system to a TS7500 with Path Failover enabled, and allows the device drivers at the host to seamlessly utilize remaining paths if a primary path fails.

Path Failover requires hardware feature code number 1682 and the corresponding software features. Software feature codes vary by geography. See Appendix C, “Feature codes” on page 507.

Path failover requires no setup on the TS7530 VE for Tape Console. Path failover is available when the host server has at least two Fibre Channel HBAs connected to target ports on the TS7530. The path failover feature also provides load balancing. For more information about path failover and load balancing refer to 5.3.6, “Fibre Channel ports and host assignment equals load balancing” on page 163.

Figure 1-11 on page 28 is an example of a correct configuration for path failover.

Path failover also requires use of the appropriate IBM tape device driver (Atape, IBMtape, IBM Windows device driver). Path failover for the TS7530 Virtualization Engine does not require a separate Data Path Failover (DPF) key for device driver installation.

For detailed information about the installation of the IBM device drivers, refer to the *IBM Tape Device Drivers Installation and User’s Guide*, which can be downloaded from:

http://ftp.software.ibm.com/storage/devdrvr/Doc

## 7.7 Tape duplication

Tape duplication allows you to make a duplicate copy of a physical tape whenever virtual tape data is written to physical tape. That is a feature that allows enhanced auto export or caching. This means that the first copy of a virtual tape to the assigned physical tape in first physical library is duplicating to another physical tape in a second physical tape library. Figure 7-28 on page 277 summarizes the tape duplication method.

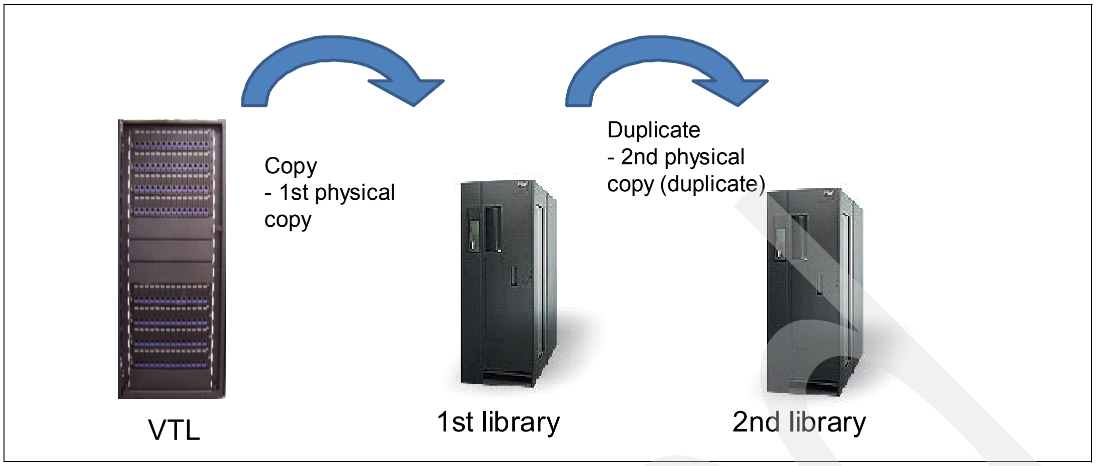



*Figure 7-28 Tape duplication method*

> **Note:** Both physical tapes must have the same barcodelable and must have the same physical parameters, but they must be located in different physical libraries.

To enable tape duplication with a new installation use the configuration wizard for virtual tape libraries.

It is also possible to enable this option in the properties section for virtual tape libraries. Right-click the library that you created and select **Properties**. On the next panel use the Tape Duplication panel to enable tape duplication, as shown in Figure 7-29.

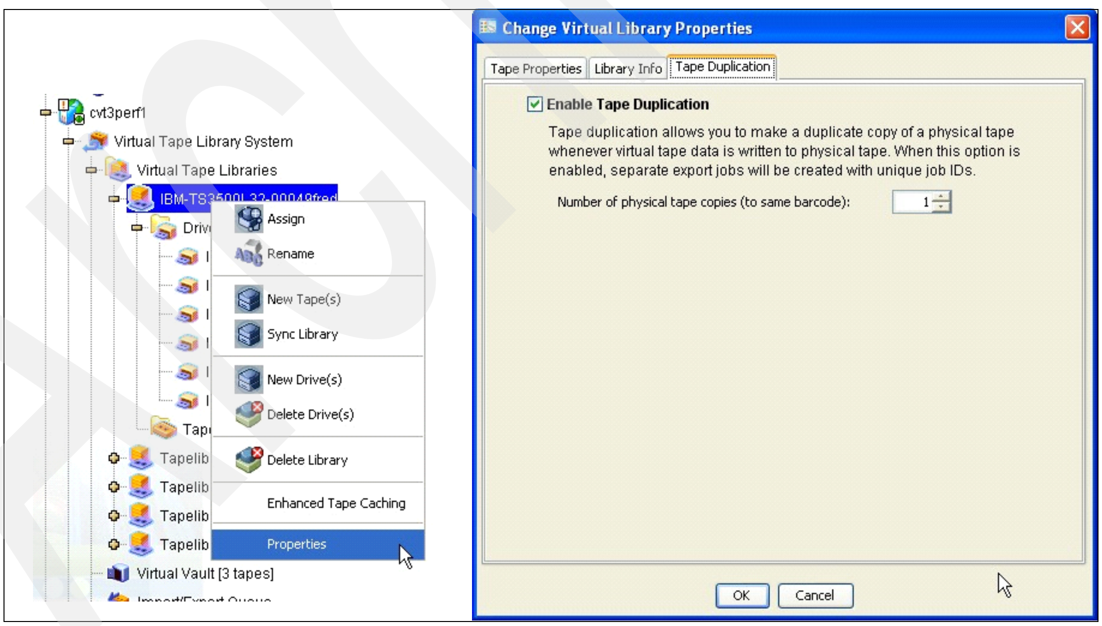



*Figure 7-29 Enable Tape Duplication option*

> **Note:** You can only create one secondary copy of the virtual volume.

For each tape duplication a separate export job is created with a unique job IDs (Figure 7-30).

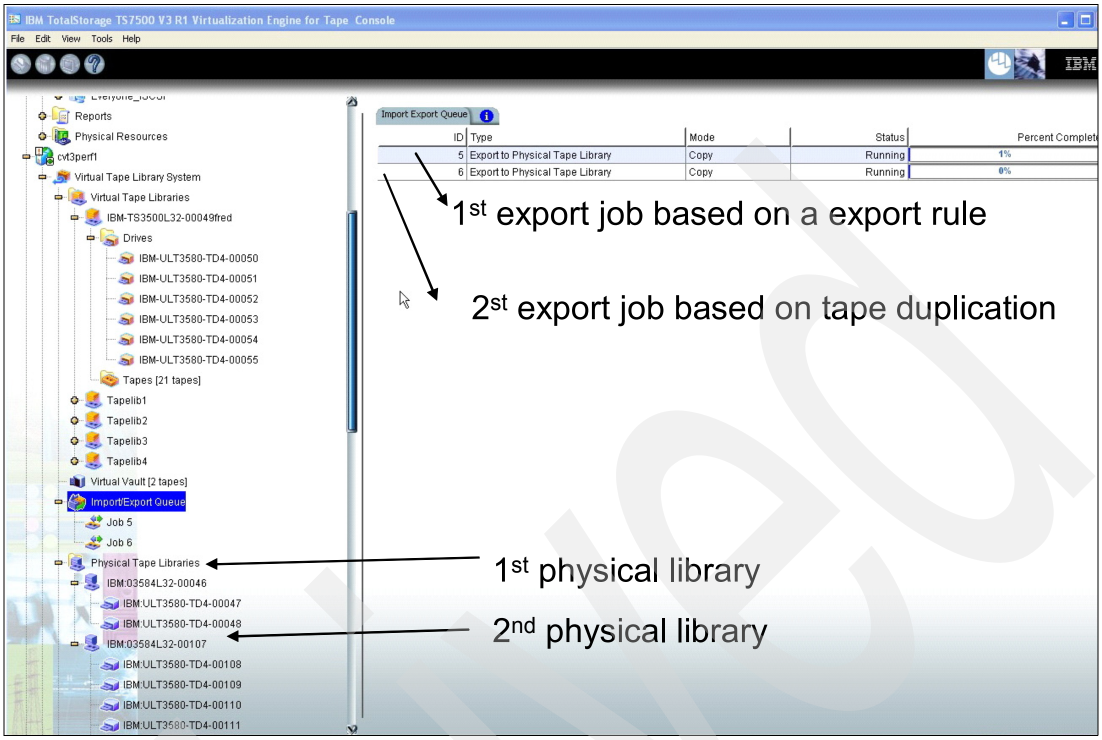



*Figure 7-30 Separate export job with tape duplication*

## 7.8 Data shredding (virtual)

With this option it is possible to shred the data on virtual tape resources. There is no way to restore this data. The triple-pass algorithm prevents any trials to restore the data. This option only exists in the vault, so the volume to be deleted must first be moved to the vault (Figure 7-31 on page 279).

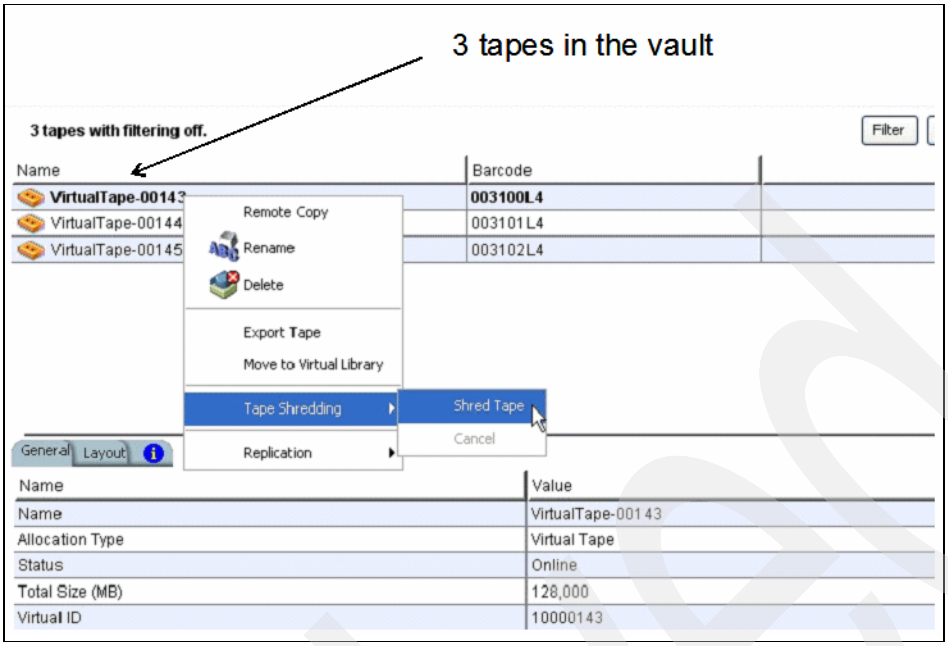



*Figure 7-31 Tape shredding option from the vault*

You must confirm the tape shredding. This is the last step before all data are gone. The Delete After Shredding option allows us to keep the virtual tape resource or to also delete the virtual tape.

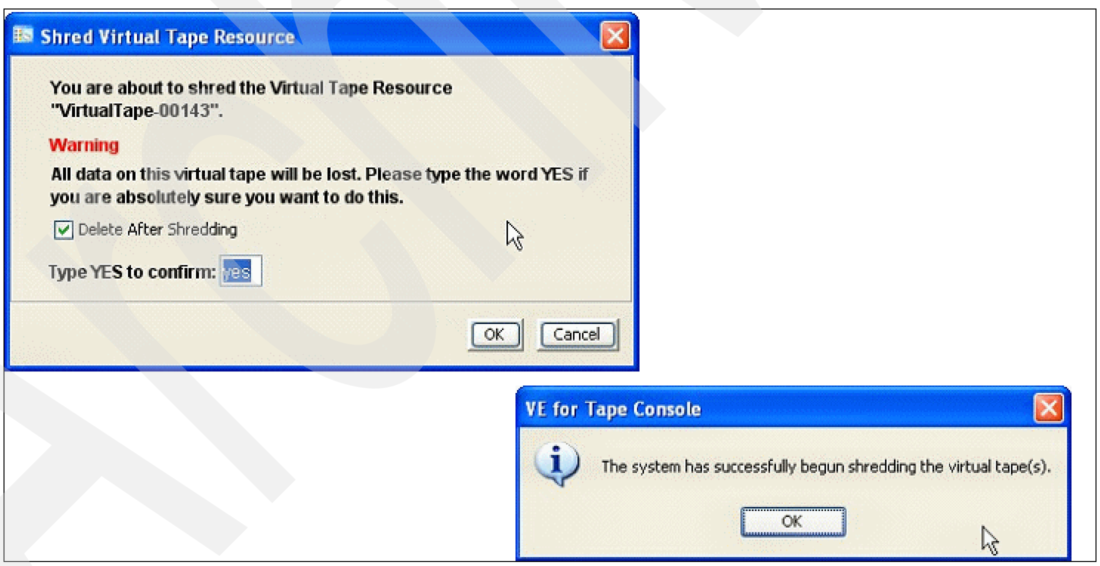



*Figure 7-32 Last warning before data will be deleted*

# 7.9 Four-way node support

The multi-node support provides the possibility to group multiple servers together for global tape cartridge access. This means that any group member has access to any tape cartridge from any other server in the group via virtual vault.

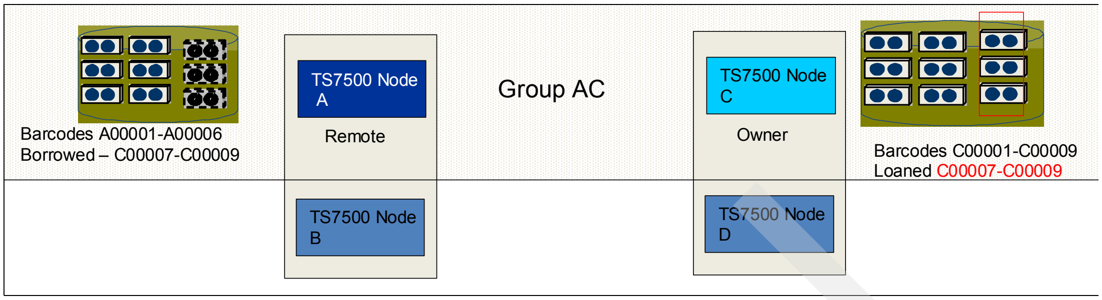



*Figure 7-33 Scheme cartridge access from another server*

Each group can contain a maximum of four nodes. It is also possible to add failover pairs to one group. But beware, failover must be enabled and configured before adding to the group.

After grouping, all servers can be managed and administrated together, for example, you can log in to all grouped servers at the same time.

This function is available by right-clicking **VE for Tape Serves** root in the Tape Console, as shown in Figure 7-34.

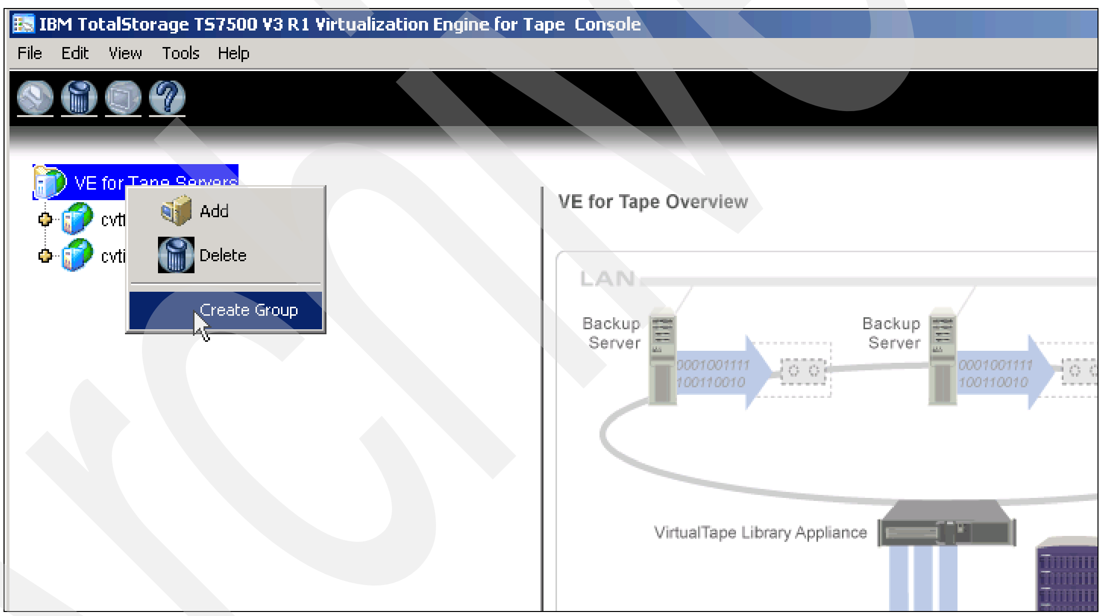



*Figure 7-34 Create group*

For more information see *IBM Virtualization Engine TS7500 Users Guide, Version 3 Release 1,* GC27-2179.

# 7.10 Hardware compression

IBM Virtualization Engine TS7520 provides only software-based compression. This decreases the performance of the system. The new TS7530 Virtualization Engine hardware provides hardware-based compression if FC3455 is installed. The software compression option is still available.

The compression option is found in the properties of the virtual tape library and can be enable toggling between hardware and software. However, if a hardware compression card is present, the hardware compression option is the best.

**Note:** In a multiple-node configuration like HA or four-node, each node needs the same number of installed hardware compression cards.

# 7.11 3494 support

IBM TotalStorage 3494 Tape Library is an automated tape library that multiple backup servers can share. The 3494 Tape Library option for the TS7500 Virtualization Engine does not emulate the tape library, but it does emulate the tape drives inside, such as 3592- 1A or E05 tape drives. This makes it possible to import data from physical tape cartridges and to export data on virtual tape cartridges to physical tape cartridges. Figure 7-35 shows the 3494 Tape Library configuration.

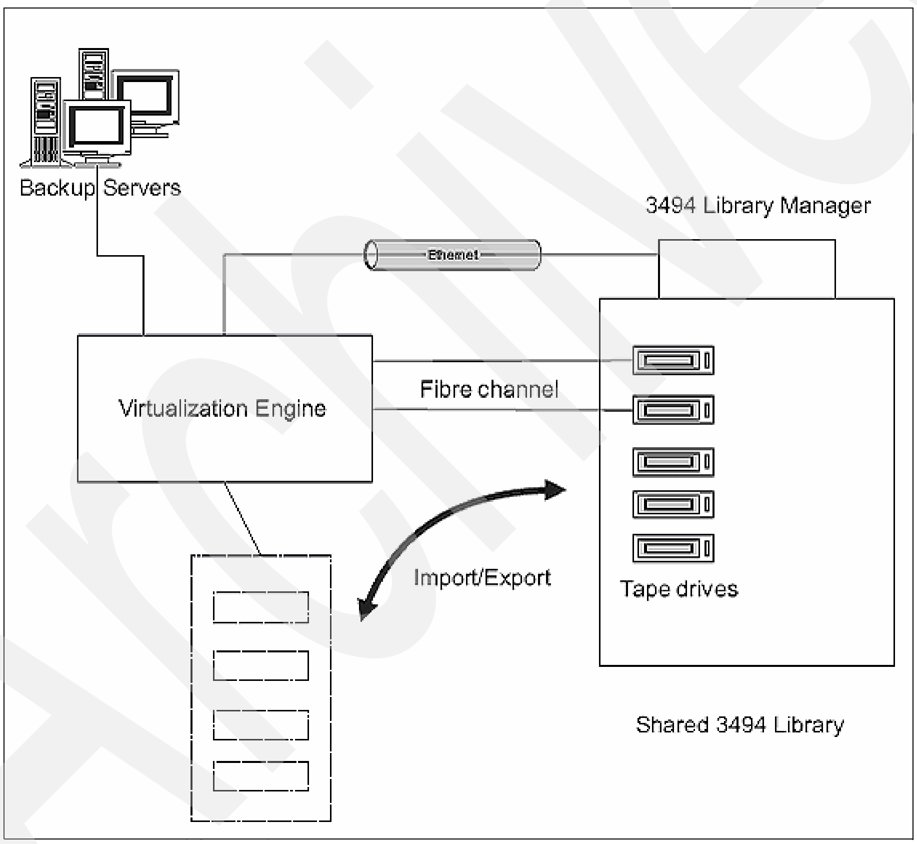



*Figure 7-35 IBM 3494 Tape Library configuration*

To configure a TS7500 Virtualization Engine for a 3494 Tape Library:

1. Before starting with the 3494 library configuration on the TS7500, ensure that the IP addresses of the TS7500 servers are added to the list of hosts that are allowed to communicate with the 3494 Library Managers. From the Library Manager Console, select **Commands** → **LAN options** → **Add LAN Host**.

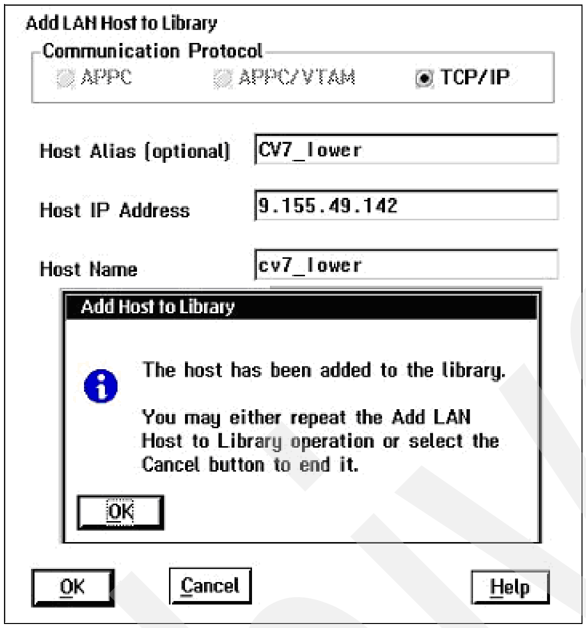



*Figure 7-36 Add TS7530 on 3494 Library Manager Console*

2. On the VE console, expand the server icon and then expand **Virtual Tape Library System**. Right-click **Physical Tape Libraries** and then click **Assign IBM 3494**. See Figure 7-37.

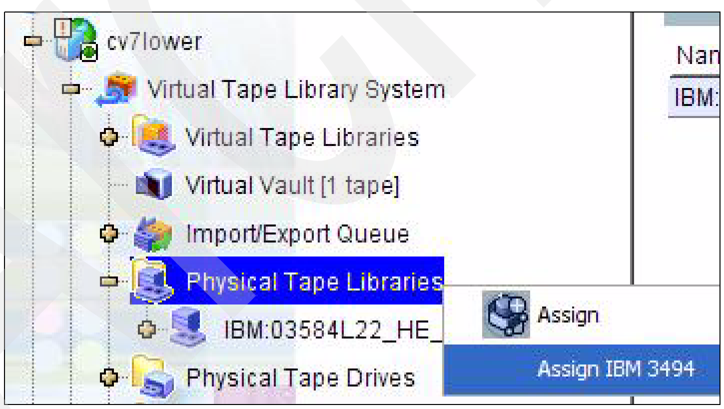



*Figure 7-37 Assign IBM 3494*

3. Complete the following steps in the Set IBM 3494 library configuration window (Figure 7-38):

   a. In the IP Address of Library Manager field, type the primary Library Manager's IP address.

   b. If there is a standby Library Manager:

      i. Select the **IP Address of Standby Library Manager** check box.

      ii. In the IP Address of Standby Library Manager field, type the IP address of the standby Library Manager.

   c. In the Category field, type the category of media assigned to the TS7530 Server and to the 3494 Tape Library.

   d. In the Library Name field, type the name of the 3494 Tape Library.

   e. Click **OK** to complete the LM configuration

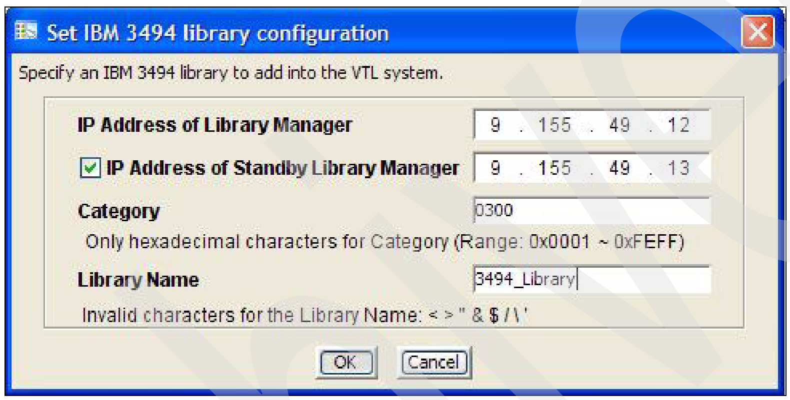



*Figure 7-38 IBM 3494 library configuration using the VE console*

4. On the VE console, verify that the 3494 Tape Library appears in the Physical Tape Libraries list, as shown in Figure 7-39.

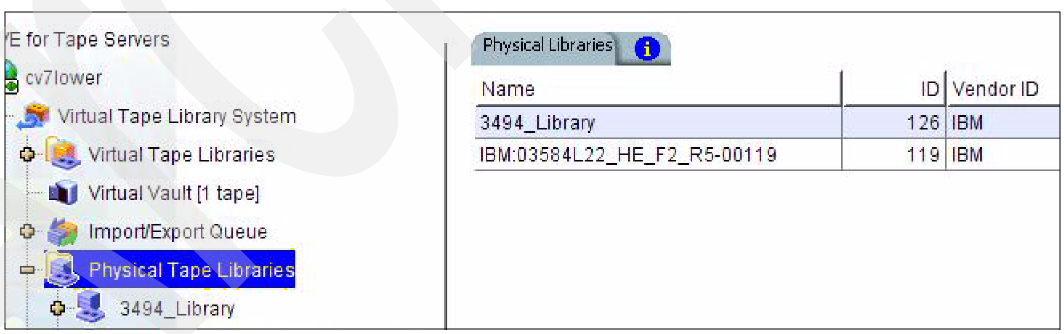



*Figure 7-39 Physical tape library list*

5. Ensure that the physical tape drives in the 3494 library are correctly connected to an initiator port on the TS7500 server. The drives can be either connected directly or via switched environment. After the drives are correctly connected to the TS7500 HBA, perform a rescan on the appropriate HBA to discover the tape devices. See Figure 7-40.

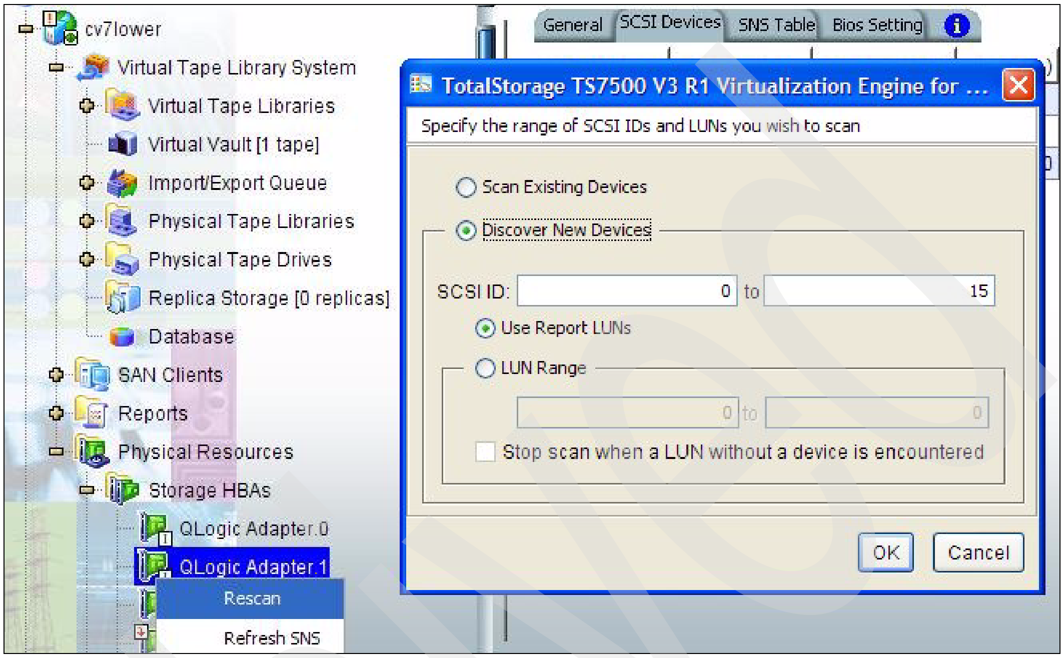



*Figure 7-40 Discover new devices*

6. Verify that the tape devices have been discovered successfully (Figure 7-41).

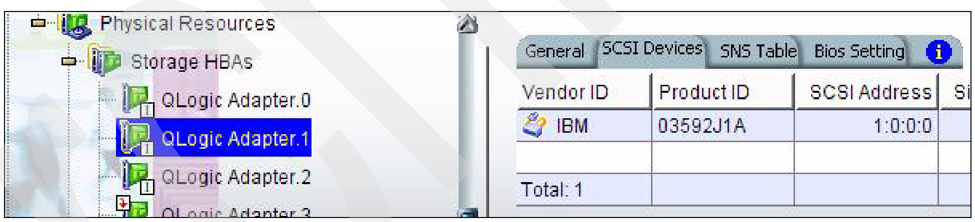



*Figure 7-41 Verify that discovered devices are connected to the proper HBA*

7. From the VE Console, select **Storage devices** → **Fibre Channel devices** and enlist the new tape drive. After successful enlistment, right-click the newly created 3494 Tape Library and then click **Assign**, as shown in Figure 7-42.

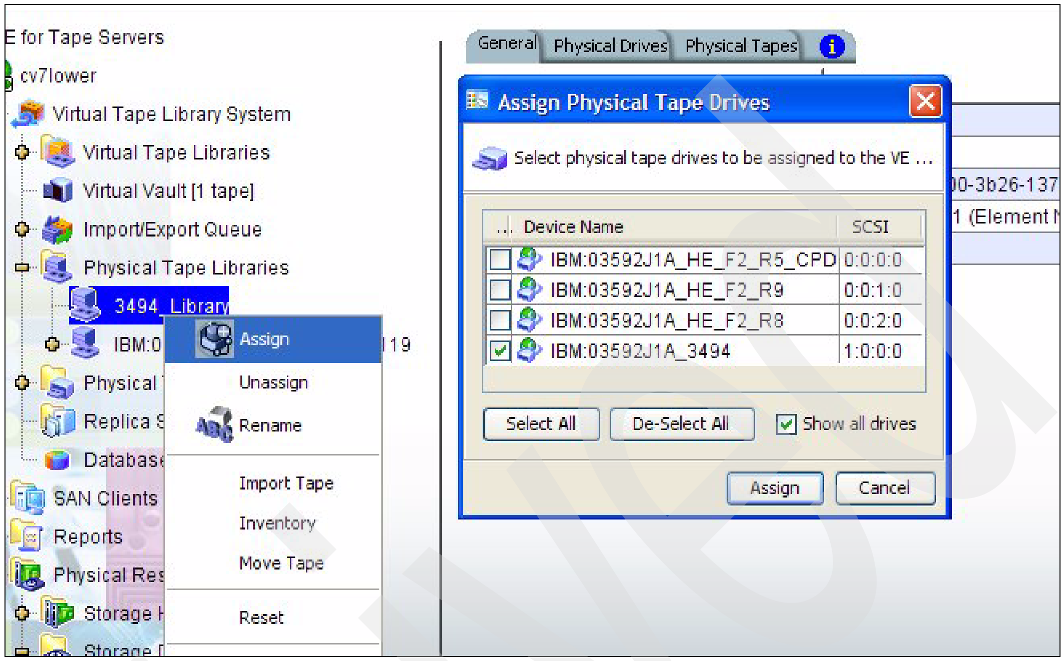



*Figure 7-42 Assign drives to 3494 library*

8. Right-click the **3494 Tape Library** and then click **Inventory**. To view the available tape drives, click the **3494 Tape Library** and then click the **Physical Drives** tab. To view the available tape cartridges, click the **3494 Tape Library** and then click the **Physical Tapes** tab.

9. To use the newly configured 3494 Tape Library for automated tape caching follow the steps described in 12.5, “Enhanced Tape Caching” on page 399.

For additional information see *IBM Virtualization Engine TS7500 Users Guide, Version 3 Release 1,* GC27-2179.

# Part 4

# Using, operating, and upgrading TS7500

In this part of the IBM Redbooks pubication we describe TS7530 and TS7520 usage considerations with backup applications such as Tivoli Storage Manager, Veritas NetBackup, and EMC Legato Networker. We also explain operating procedures and describe monitoring and reporting options for the TS7530. Finally, we introduce the upgrade and migration options that are available for the TS7530 and TS7520 Virtualization Engine.

8

# Using TS7530 with Tivoli Storage Manager

In this chapter we explain how to use IBM Virtualization Engine TS7530 together with IBM Tivoli Storage Manager and with a physical tape library. We discuss the differences, the advantages, and the disadvantages of disk and tape backup.

Furthermore, we explain how to use IBM TS7530 Virtualization Engine and a physical tape library together in different environments:

- TS7530 and tape library connected to Tivoli Storage Manager server
- LAN-free clients with access to the TS7530 tape drives
- Tape library directly connected to a TS7530

## 8.1 Tivoli Storage Manager and the TS7530

IBM Tivoli Storage Manager is a storage software suite that addresses the challenges of complex storage management in distributed heterogeneous environments. It protects and manages a broad range of data, from workstations to the corporate server environment.

Most virtual tape libraries on the market are only disk backup devices with tape emulation. Vendors claim that there are advantages of disk backup over tape backup, but compare old tape technology with lower throughput and less reliability than the currently available tape technology from IBM.

IBM tape drives, Linear Tape-Open (LTO) Ultrium 4, and TS1130 have such a high throughput (120 MB/s and 160 MB/s (native)) that they can easily handle all backup or restore streams. Not many disk subsystems and servers are available that can deliver a higher single throughput. Also, most virtual tape libraries do not have a higher throughput than approximately 160 MB/s for a single stream. In addition, IBM tape drives use highly efficient compression algorithms that make the throughput of LTO Ultrium 4 and IBM 3592 even higher. Finally, tape has the lowest cost for storing large amounts of data.

The advantage of disk compared to tape is fast and random access to data. This means that all incremental and differential backups can be restored faster on disk than on tape. Incremental and differential backups tend to create fragmented tape cartridges. Tape is a sequential media, and to access a file on tape media, the tape drive has to locate the file. To restore a total server that was incrementally or differentially backed up, the tape drives spend most of the time locating to the next file. Having incremental or differential backups on disk can reduce the time for restore, compared to tape.

Figure 8-1 illustrates how the restore of incremental or differential data works. On the first day, files 1, 2, and 3 were backed up and stored on tape in continuous order. On the second day, files 1 and 2 were modified and backed up. Files 1 and 2 on the tape are now invalid. On the third day, file 1 was backed up, which made file 1 from the second day invalid on the tape.

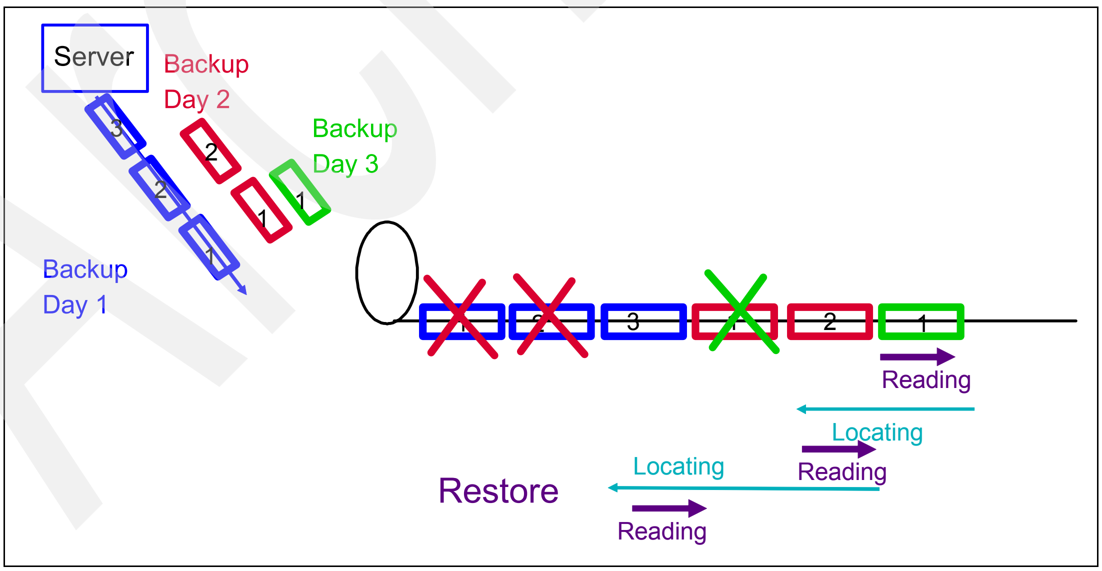



*Figure 8-1   Restoring incremental or differential backup*

If a restore starts now, the tape drive has to locate file 1 first before it can restore. Another locate of file 2 is then required before it can be read. A final locate for file 3 is performed from the tape drive before file 3 is restored. A random locate takes an average of 44 seconds for an

LTO Ultrium 4 drive. In our example, the total data transfer time is a couple of seconds, but the total restore takes a couple of minutes due to the tape drive file locate time.

In most cases, incremental and differential backups are not sufficient for disaster recovery for a large amount of data, even it is stored on disk. For a fast restore of a large amount of data, a full image backup is the appropriate method. For an image backup, there is no difference between restoring from tape or from disk.

Another advantage for a disk subsystem, when compared to a tape drive, is that multiple input/output (I/O) operations can run simultaneously. For a tape device, you can have one single stream. This is the biggest advantage for a disk subsystem compared to tape, especially if you have many slow streaming backups running at the same time. For this reason, we recommend that you use a large disk buffer and keep at least one daily backup on the disk.

Tivoli Storage Manager has handled disk base backup very well for many years. Why should you use the TS7530 Virtualization Engine? The TS7530 Virtualization Engine is a disk backup device with tape emulation. All advantages of disk compared to tape are also valid for the TS7530. Compared to the Tivoli Storage Manager disk storage pool, the advantage of the TS7530 is the tape emulation, which enables LAN-free backup to disk without having a shared SAN file system, such as SANergy® or SAN File System (SFS).

There is some advantage, although small, for some large environments with several Tivoli Storage Manager servers in place in that you do not need to assign a dedicated disk pool for every server. With the TS7530 Virtualization Engine, you can either share a virtual library or you can create several virtual libraries for every server. You do not need to assign a specific capacity to every server because the TS7530 assigns capacity as required.

How do you use TS7530 Virtualization Engine with Tivoli Storage Manager? You use it like your disk pool and as a replacement of your disk pool. As mentioned already, the TS7530 Virtualization Engine has one big advantage over a native Tivoli Storage Manager storage pool. LAN-free backup to TS7530 is possible. If you have many LAN-free clients, then you might see the biggest benefit from the TS7530 Virtualization Engine.

The TS7530 Virtualization Engine does not replace real, physical tape drives and tape libraries, because tape media is much cheaper on a per-GB price point of view than any available disk. The TS7530 is a complementary backup device to the tape environment, which may give your tape drives better bandwidth utilization. In a small to medium environment you may replace your tape library and your Tivoli Storage Manager disk pool and use only a TS7500. With just a TS7500 you have the benefit that migration from disk to tape is no longer needed. However, keep in mind that disk and Volts are more expensive as tape and especially the TCO is much higher for disk and VTLs as for tape.

If you are using high-performance tape drives, such as LTO Ultrium 4 or TS1120, then use the TS7530 Virtualization Engine for all backup streams that may not fully utilize the tape drive. This releases the physical tape drives and makes them available for really high-speed backups, which fully utilize the tape drive.

Migrate your data from the TS7530 to physical tape after most of the backups are done. This means that you migrate the data from the TS7530 Virtualization Engine to physical tape in a time frame with low workload on the Tivoli Storage Manager server. Before you migrate the data from the TS7530 Virtualization Engine to physical tape, consider creating the copy pools, if desired, from the TS7530.

For better restore performance for some kinds of data, consider keeping data on the TS7530 Virtualization Engine longer. As explained in 8.4, “TS7530 and physical tape library connected to Tivoli Storage Manager server” on page 304, since you might not want to use different data paths for backup and restore, you might want to keep data longer in your TS7530 Virtualization Engine.

There are different ways to use an TS7530 Virtualization Engine and real physical tape library together with Tivoli Storage Manager. You might connect the physical tape library to the TS7530 and use the Import/Export function from the TS7530 (Figure 8-2). As discussed in 8.5, “Using Import/Export with Export Physical Copy for vaulting” on page 309, this is a rudimentary approach and should be used for vaulting reasons only.

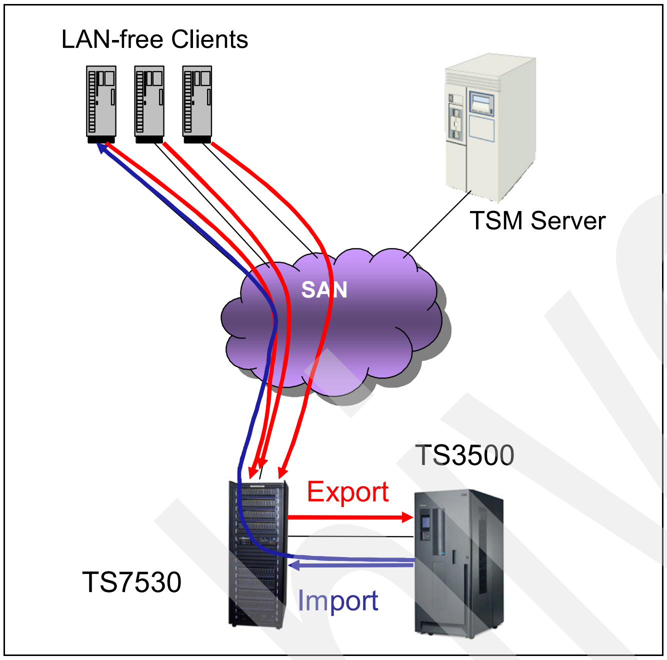



*Figure 8-2 TS7530 with a direct attached tape library*

We recommend that you connect the tape library to the Tivoli Storage Manager server in parallel with IBM Virtualization Engine TS7520 (Figure 8-3). The Tivoli Storage Manager server then sees two tape libraries, one TS7250 Virtualization Engine and one physical library, such as a TS3500. Define the physical library as the next storage pool to the TS7530. Allow Tivoli Storage Manager to manage the migration from TS7530 to physical tape, depending on your requirements.

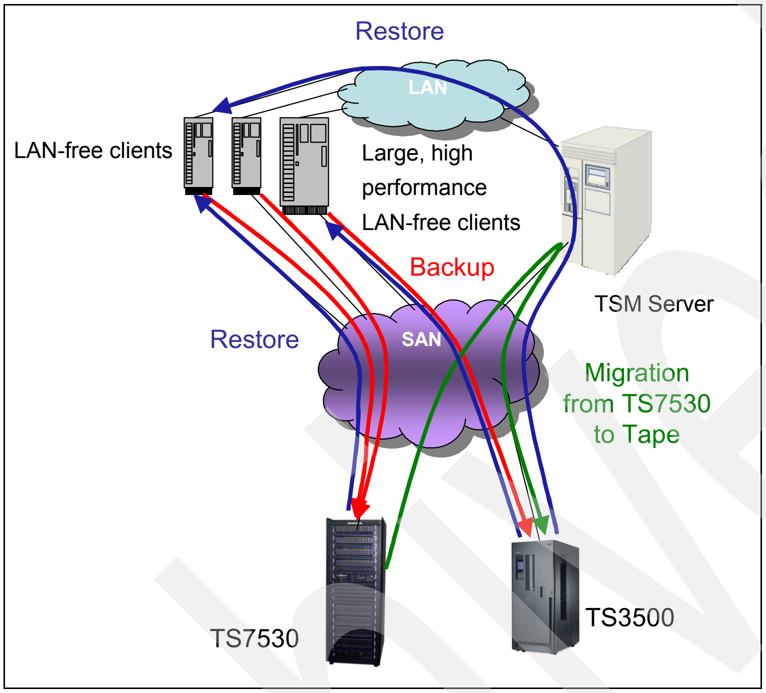



*Figure 8-3 TS7530 and physical tape library connected to a Tivoli Storage Manager server*

After migration, the restore path is different. In case of a restore, you need to restore the data over LAN or migrate the needed data back to TS7530 with the MOVE NODEDATA command.

As shown in Figure 8-3, the LAN-free clients back up to the IBM Virtualization Engine TS7520. The Tivoli Storage Manager server migrates the data from the TS7530 to the TS3500 Tape Library. LAN-free clients can restore data from the TS7530 as long as the data is still in the TS7530. After migration, the restore goes through the Tivoli Storage Manager server and over the LAN, because the LAN-free clients do not have access to the physical tape. LAN-free clients with large amounts of backup data (large DB) and with high throughput, which can fully utilize a physical tape drive, can directly backup and restore to and from physical tape. We discuss the Tivoli Storage Manager configuration in 8.4.1, “Only the Tivoli Storage Manager server has access to the tape library” on page 304.

You might size the capacity of the TS7530 Virtualization Engine based on the client that most restores come from. Alternatively you might consider that the LAN-free clients also have access to the physical tape library (Figure 8-4), which means that the LAN-free clients can also restore over the SAN from the physical tape drives.

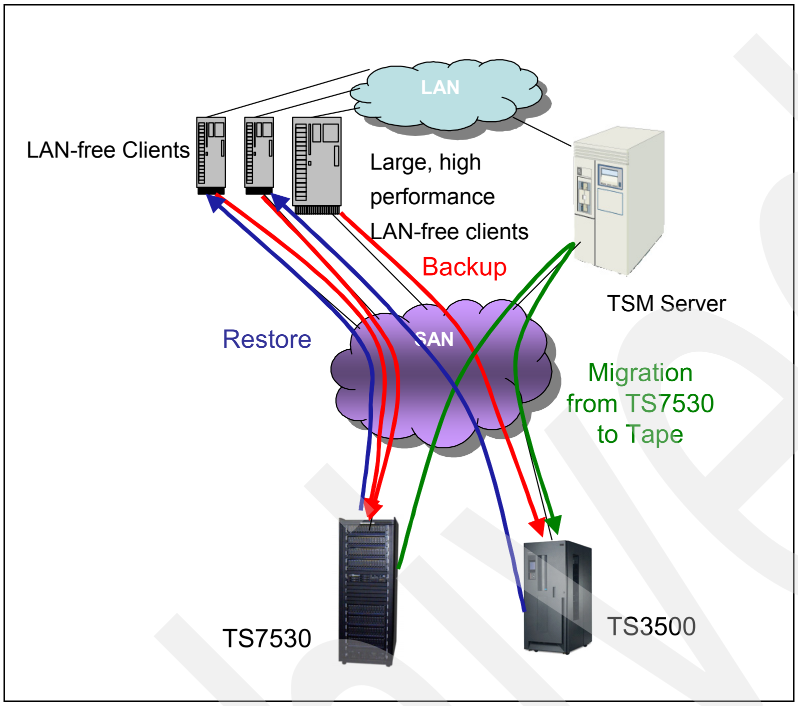



*Figure 8-4 LAN-free clients with access to a physical library*

We discuss the Tivoli Storage Manager configuration in 8.4.2, "The TSM server and LAN-free clients have access to the tape library" on page 308.

## 8.2 Sizing and usage considerations

Before we provide suggestions for sizing the disk capacity of the TS7530 Virtualization Engine, we must discuss which data should go to disk (Tivoli Storage Manager disk buffer or TS7530) and which should go directly to physical tape.

Backups with a large amount of data (a couple of hundred GB), which come from servers (LAN-free clients) that can fully use a physical tape drive, should go to physical tape. Physical tape can create backups at about 60 MB/s or more for a single stream. There is no advantage for backup or restore whether this data is stored on disk or on tape.

All other full backups (one data stream) should be directed first to disk, because you can have multiple backup streams to disk at the same time. After the backups are done, the data can be migrated with high throughput from disk to tape. Because this data is in one stream, there is no disadvantage during restore if the data comes from tape, since no locate must be done during restore. The whole backup is a single file.

Incremental backups should go first to disk and might be migrated to tape later, depending on the restore needs and the service-level agreements (SLAs).

Figure 8-5 illustrates the decision tree.

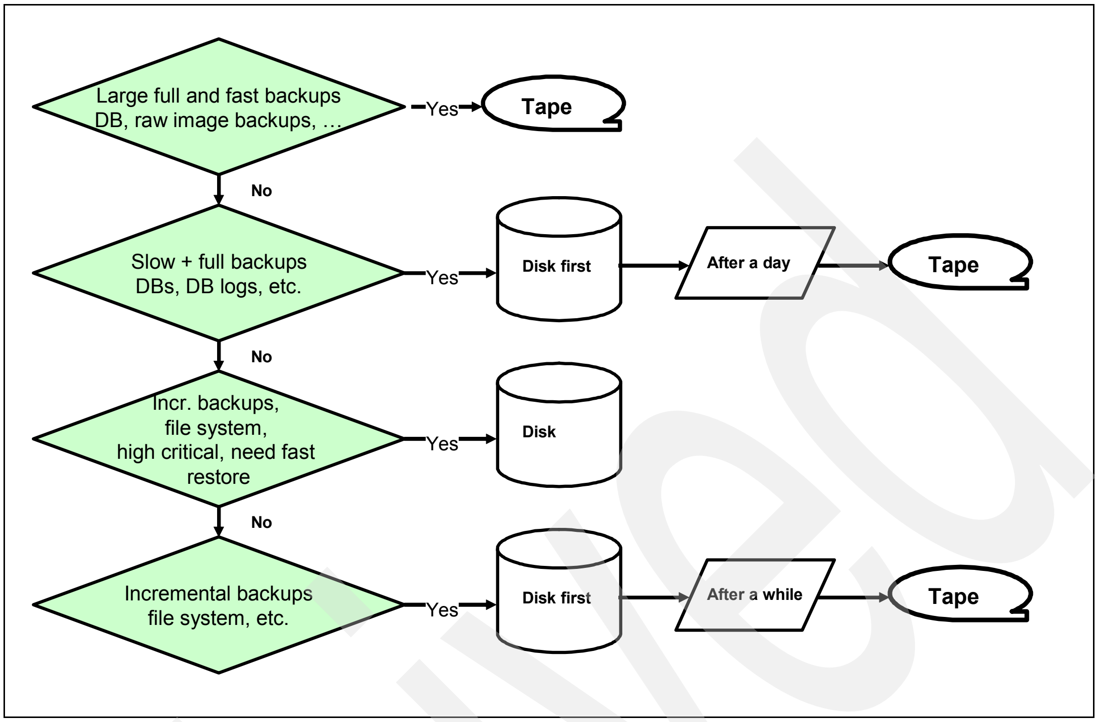



*Figure 8-5 Decision tree for data placement*

Now we can size the capacity. We assume a daily backup amount of 10 TB. Four TB are huge databases which go directly to tape. Another four TB are databases which go first to disk and then are migrated to tape on the same day. There are 1.5 TB from clients with incremental backups. This data has low priority for restore, and therefore, will also be migrated to tape on the same day. Finally there is 0.5 TB of incremental data which has high restore priority. You should keep this data on disk for one week. See Table 8-1. For this example, we need a disk capacity of at least 9 TB.

*Table 8-1 Capacity sizing example*

| Kind of data | Goes first to | Amount in TB | Kept on disk for *x* number of days | Capacity on disk in TB |
|---|---|---|---|---|
| DB, high throughput | Tape | 4 | | 0 |
| DBs | Disk | 4 | 1 | 4 |
| Incremental, low restore priority | Disk | 1.5 | 1 | 1.5 |
| Incremental, high restore priority | Disk | 0.5 | 7 | 3.5 |
| **Total** | | | | **9 TB** |

## 8.2.1 Tivoli Storage Manager features suited for a TS7530 environment

In the following sections, we describe the subset of Tivoli Storage Manager features that could benefit from being implemented using TS7530 virtual drives and libraries.

### Progressive backup methodology

Progressive backup methodology (often referred to as incremental backup) saves time and storage space by backing up only new files and modified files. The progressive backup feature uses Tivoli Storage Manager's own relational database to track data wherever it is stored, delivering direct one-step file restore. Progressive backup eliminates the need for traditional full-plus-incremental or full-plus-differential backup and restore procedures, commonly used by other storage management products.

TS7530 benefits for Tivoli Storage Manager implementations include these:

- In environments where large numbers of tape mounts occur during the backup window (for example, large numbers of Tivoli Storage Manager clients using collocated storage) the time taken within a physical library to MOUNT-LOCATE-DISMOUNT the tapes can negatively impact backup throughput.

  When using TS7530 virtual volumes, there are no mechanical delays resulting in reduced MOUNT-LOCATE-DISMOUNT times, resulting in an increase in the effective utilization of the Fibre Channel interfaces. Increased utilization means you can be potentially run more backup jobs to virtual tape over a single interface than to physical tape.

  Similar benefits will be seen during a restore if MOUNT-LOCATE-DISMOUNT time is affecting restore throughput.

- The duration of a progressive backup is dependent on the amount of changed data and can very difficult to accurately predict. Backups that exceed their expected duration can create major issues for the backups that follow. With the TS7530, you have the ability to define a maximum of 4,096 virtual tape drives and 512 virtual tape libraries. This provides the Tivoli Storage Manager administrator with the option of providing sufficient virtual resources to allow both backup streams to run in parallel when one of the backup streams exceeds its expected backup window.

- With policies that focus your management effort on data instead of media, Tivoli Storage Manager can help you fill a gap in any tape rotation scheme. Instead of setting up a traditional tape rotation, you can set up policy rules. Once Tivoli Storage Manager selects an available tape, the tape is used and eventually reclaimed according to its associated policy. Also, automating backup and recovery functions helps administrators to manage backup and restore activities, and the result reduces the likelihood of human errors. Refer to the chapter on managing media in the *Administrator's Guide* on the Web for more information:

  http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp?topic=/com.ibm.itsmcw.doc/anrwgd5502.htm

  TS7530 with Tivoli Storage Manger is able to extend the life of Tivoli Storage Manger's policies because the tape life is based on virtual tapes. The increased tape life span reduces the number of tapes needed for any rotation scheme.

- As already mentioned, Tivoli Storage Manager uses progressive backups. Progressive backups require less network bandwidth and result in faster backup times and less storage required. However, Tivoli Storage Manger increases recovery times and decreases the efficiency of tape cartridge utilization. To solve these issues, Tivoli Storage Manger uses two methodologies, called collocation and reclamation:
  - Collocation

    Tivoli Storage Manager uses collocation to dedicate as few tapes as required to hold all of one client's files. Collocation reduces elapsed time for multiple file restores and full client restores at the expense of using more tapes, potentially increasing backup times and increasing management time for migration and for storage pool copies (Figure 8-6). TS7530 enables Tivoli Storage Manger administrators to take advantage of the benefits of collocation while also dramatically improving performance, eliminating the need for numerous tape mounts.

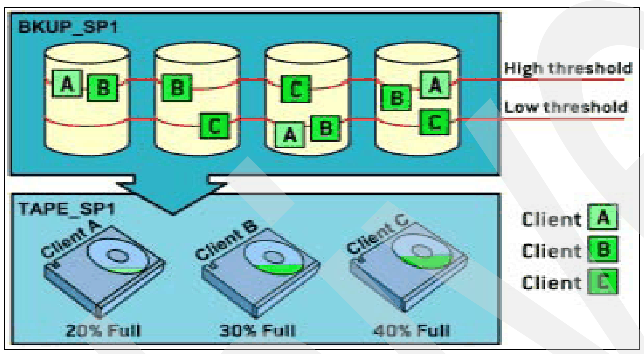



*Figure 8-6 Collocation*

  - Reclamation

    Data on tapes in sequential access storage pools will eventually expire, leaving portions of the tapes with empty areas. Over time, fragmentation can cause many tapes to have very little valid data on times. Reclamation is the process where the valid data on a number of tapes is consolidated onto a smaller number of tapes. The tapes that are emptied by the reclamation process are returned to scratch status for reuse. See *Data Storage in IBM Tivoli Storage Management Concepts,* SG24-4877, and Figure 8-7.

    In large environments, this function may become challenging depending on the number of tape drives. Because of that, some tape reclamation activity may not be completed before the next backup window begins. TS7530 enables Tivoli Storage Manger administrator to take advantage of the benefits of reclamation while also minimizing the time required to locate and reclaim the data.

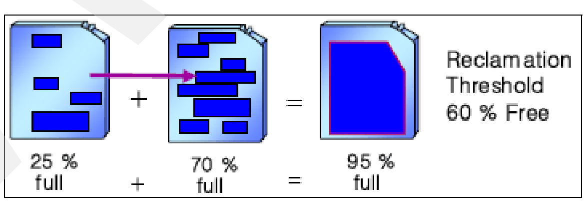



*Figure 8-7 Reclamation*

## Tape resource sharing

Tape resource sharing enables multiple Tivoli Storage Manager servers to use the same tape library and drives, optimizing tape hardware asset utilization.

TS7530 benefits for Tivoli Storage Manager implementations include these:

- You may be able to simplify and improve the sharing of physical tape resources using a TS7530 Virtualization Engine. During peak periods, there may not be enough physical resources to support all the business requirements for backup or restore. In this situation either the business requirements get changed, or additional hardware get purchased to satisfy peak demands.
- With a TS7530 Virtualization Engine, you can create virtual tapes and libraries to satisfy peak business requirements, rather than modify business requirements to suit the installed hardware. Data from the virtual volumes can then be transferred to a physical library or libraries in a controlled manner. The physical library and drives can then be sized to match the steady state business requirements.

### Dynamic multi threaded transfer

Dynamic multi-threaded transfer permits multiple clients to simultaneously transfer data to and from the same Tivoli Storage Manager server. Performance is boosted to more than three times the rate of a single-threaded session. The higher speed is achieved by transparently optimizing the number of data transfer sessions, based on available system resources.

TS7530 benefits for Tivoli Storage Manager implementations include these:

- On a highly configured application or database server, it is possible for a Tivoli Storage Manager restore to use up to eight parallel restore streams. For data stored on tape, Tivoli Storage Manager would require up to eight tape drives. Using TS7530 virtual tape drives, sufficient drives could be made available for the restore even if optimal number of drives needed for the restore exceeded the number of physical drives available.
- The data does need to reside on virtual tape or be managed within collocated storage pools to benefit from TS7530 virtual volumes. The Tivoli Storage Manager command MOVE NODEDATA can be used to copy data from physical volumes to virtual volumes in preparation for the restore.

### Adaptive differencing technology

Adaptive differencing technology changes the way data is backed up from the client. Using adaptive differencing, data is transferred to the server either by byte, block, or file level, based on the size of the file being backed up, and the portion of the file that has changed since the last backup. Adaptive differencing technology supports all connectivity strategies, including LANs, WANs, SANs, Internet, and dial-up connections. Adaptive differencing was initially designed with mobile computer users in mind, however, other users with a need to minimize data transmitted over the network can also benefit from the technology.

TS7530 benefits for Tivoli Storage Manager implementations include these: When restoring data backed up using the Tivoli Storage Manager adaptive differencing technology, the small subsets of data will often be spread across multiple tape volumes. When using TS7530 virtual volumes, there are no mechanical delays resulting in reduced MOUNT-LOCATE-DISMOUNT times, resulting in reduced restore times.

## 8.2.2 Customer activities suited to a TS7530 environment

TS7530 virtual volumes are ideally suited to situations where:

- The data is likely to be restored in the short term.
- It does not make business sense to dedicate physical resources to activities that require periodic access to tape resources.

Here are some examples of such activities suited to a TS7530:

- Education of storage administrators. Libraries and drives can be created to facilitate training of administrators without affecting the production backup environment.
- Tivoli Storage Manager software upgrade testing.
- Target for the backup of Tivoli Storage manager database backups.
- Ad hoc applications backups taken before major operating system, database or application upgrades.
- The ability to isolate data in tactical production environments (for example test, development, user acceptance test) from the core production environments.
- The ability to define fixed (capped) virtual libraries to each business area.
- The ability to manage unscheduled activities that require drive capacity on demand. for example the archive of application database recovery logs.

# 8.3 Implementation considerations

When used with Tivoli Storage Manager, the IBM TS7530 Virtualization Engine is not expected to totally replace real, physical tape drives and tape libraries, but will be used as a complementary tape backup device that can be used to augment an existing tape environment.

We recommend a top down structured approach to ensure that a TS7530 is implemented as part of a planned, integrated solution and not simply tacked onto an existing solution. You can use the following sections to assist in your planning for the introduction of a TS7530 into a Tivoli Storage Manager environment or solution.

## 8.3.1 Usage

The steps needed to define a TS7530 virtual tape library and drives to Tivoli Storage Manager are identical to those required for the corresponding physical tape library and drives.

The IBM TotalStorage 7500 V2 R1 Virtualization Engine for Tape Console (TS7530 VE for Tape Console) does however simplify the step to gather information about the virtual library and drives (such as serial number; see Figure 8-8) needed to map the drives to the tape resources as presented by the operating system.

General Clients

| Name | Value |
|---|---|
| Name | DrvVirtual-3592E0500033 |
| Virtual ID | 33 |
| Vendor ID | IBM |
| Product ID | 03592E05 |
| Revision | F26E |
| Media Type | 3592E |
| Element No | 257 |
| Serial No | 001214941161 |
| Status | Empty |
| Compression | Disabled |

*Figure 8-8 TS7530 VE for Tape Console: Drive serial number*

The TS7530-specific steps to activate a virtual library within Tivoli Storage Manager are:

1. Zone the Tivoli Server Manager with the TS7530.
2. Define the virtual library and drives. These steps are described in 6.6.2, “Creating a virtual library and drives” on page 206 and in 6.10, “Physical libraries and Enhanced Tape Caching” on page 233.
3. Define the Tivoli Storage Manger server as TS7530 SAN client, as described in 6.7, “SAN clients” on page 216.
4. Install the IBM devices drivers on the Tivoli Storage Manger server as described in 5.4.8, “Device drivers” on page 171.
5. Perform the steps to have your operating system discover the newly created TS7530 devices. For example, run **cfgmgr** on AIX and reboot Windows 2003.
6. Use the TS7530 VE for Tape Console to locate the serial number and WWN of the library and drives that you plan to define for Tivoli Storage Manager.

The following Tivoli Storage Manager specific steps are necessary to define a physical or virtual library:

1. Assign the SAN client of TS7530 to the AIX host, as shown in Example 8-1.

*Example 8-1 Recognition of a library and a drive*

```
-bash-3.00# cfgmgr -v

-bash-3.00# lstape

  number of tape devices:       2

     devName   M-Type       SN                 FW
 --------------------------------------------------
 |-- rmt0      03592E05     001214941164       F26E
 |-- smc0      03584L22     0012149411600401   4.02
   |----rmtX   03592E05     001214941164

-bash-3.00# lsdev -Cc tape
rmt0  Available 03-08-01 IBM 3592 Tape Drive (FCP)
smc0  Available 03-08-01 IBM 3584 Library Medium Changer (FCP)
```

2. Define the library to Tivoli Storage Manager using these commands:

   ```
   DEFINE LIBRARY ...
   QUERY LIBRARY
   ```

   See Example 8-2.

*Example 8-2 Define the library*

```
tsm: BERN>def libr ts7530lib libtyepe=scsi
NR8400I Library TS7530LIB defined.

tsm: BERN>q libr
         Library Name: TS7530LIB
         Library Type: SCSI
               ACS Id:
     Private Category:
     Scratch Category:
WORM Scratch Category:
```

```
     External Manager:
              Shared: No
             LanFree:
   ObeyMountRetention:
```

3. Define the path to the Tivoli Storage Manager library using these commands:

```
DEFINE PATH ...
QUERY PATH
```

See Example 8-3.

*Example 8-3 Define path for the library*

```
tsm: BERN>def path bern ts7530lib srctype=server destt=library device=/dev/smc0
NR1720I A path from BERN to TS7530LIB has been defined.

tsm: BERN>q path
Source Name     Source Type     Destination     Destination     On-Line
                                Name            Type
-----------     -----------     -----------     -----------     -------
BERN            SERVER          TS7530LIB       LIBRARY         Yes
```

4. Define the drives to Tivoli Storage Manager using these commands:

```
DEFINE DRIVE ...
QUERY DRIVE
```

See  Example 8-4.

*Example 8-4 Define the drives*

```
tsm: BERN>def dr ts7530lib ts7530drv01
NR8404I Drive TS7530DRV01 defined in library TS7530LIB.

tsm: BERN>q dr
Library Name     Drive Name       Device Type     On-Line
------------     ------------     -----------     -------------------
TS7530LIB        TS7530DRV01      UNKNOWN         Yes
```

5. Define the paths to the Tivoli Storage Manager drives using these commands:

```
DEFINE PATH ...
QUERY PATH
```

See Example 8-5.

*Example 8-5 Define the paths*

```
tsm: BERN>def path bern ts7530drv01 srctype=server destt=drive libr=ts7530lib
device=/dev/rmt0
NR1720I A path from BERN to TS7530LIB TS7530DRV01 has been defined.

tsm: BERN>q path
Source Name     Source Type     Destination     Destination     On-Line
                                Name            Type
-----------     -----------     -----------     -----------     -------
BERN            SERVER          TS7530LIB       LIBRARY         Yes
BERN            SERVER          TS7530DRV01     DRIVE           Yes
```

6. Define a Tivoli Storage Manager device class using these commands:

```
DEFINE DEVCLASS ...
QUERY DEVCLASS
```

See Example 8-6.

*Example 8-6 Define device class*

```
tsm: BERN>def devc ts7530dev devtype=3592 format=drive libr=ts7530lib
NR2203I Device class TS7530DEV defined.

tsm: BERN>q devc
Device       Device        Storage    Device       Format     Est/Max     Mount
Class        Access           Pool    Type                   Capacity     Limit
Name         Strategy        Count                              (MB)
---------    ----------    -------    ---------    ------    --------    ------
TS7530DEV    Sequential          0    3592         DRIVE                 DRIVES
```

7. Define a Tivoli Storage Manager storage pool that uses the device class defined in step 6 using these commands:

```
DEFINE STGPOOL ...
QUERY STGPOOL
```

See Example 8-7.

*Example 8-7 Define storage pool*

```
tsm: BERN>def stg ts7530_3592 ts7530dev maxscr=3
NR2200I Storage pool TS7530_3592 defined (device class TS7530DEV).
tsm: BERN>q stg
Storage      Device       Estimated    Pct    Pct  High  Low  Next Stora-
Pool Name    Class Name    Capacity   Util   Migr   Mig  Mig  ge Pool
                                                    Pct  Pct
-----------  ----------  ----------  -----  -----  ----  ---  -----------
TS7530_3592  TS7530DEV        0.0 M    0.0    0.0    90   70
```

8. Test the library. You can use these commands:

```
CHECKIN ...
QUERY LIBRARY
```

See the result in Example 8-8.

*Example 8-8 Labeling the cartridges*

```
tsm: BERN>checkin libv ts7530lib search=yes stat=scratch checklabel=barcode
NS8003I Process number 4 started.

tsm: BERN>q libv
Library Name Volume Name Status           Owner      Last Use  Home    Device
                                                               Element Type
------------ ----------- ---------------- ---------- --------- ------- ------
TS7530LIB    002000      Scratch                               1,025   3592
TS7530LIB    002001      Scratch                               1,026   3592
more...
TS7530LIB    00200J      Scratch                               1,044   3592
```

## 8.3.2 Copy storage pools

A Tivoli Storage Manager copy storage pool provides an additional level of protection for client data and is created for the express purpose of backing up a primary storage pool. Copy storage pool volumes are intended for shipment offsite, to assist in the recovery of the Tivoli Storage Manager server environment. The copy storage pool contains all current versions of all files, active and exactly as they appear in the primary storage pool. A copy storage pool provides recovery from partial and complete failures of a primary storage pool.

While the chance of multiple simultaneous disk failures is very small, such failures do occur. If a multiple disk failure was to occur in a TS7530 Virtualization Engine, multiple virtual tape volumes used by Tivoli Storage Manager might be affected. To prevent or minimize the extent of an data loss, we recommend that all Tivoli Storage Manager Copy Storage Pools be used to protect data stored on TS7530 virtual volumes.

The Tivoli Storage Manager copy storage pools could use physical tape or virtual volumes on a second TS7530. We do not recommend creating Tivoli Storage Manager copy storage pools within a single TS7530. It is important that the environment used to protect the original data is physically and logically separated from the original data.

## 8.3.3 Enhanced Tape Caching

TS7530 enhanced caching can be used to supplement Tivoli Storage manager processing. A key operational feature of Tivoli Storage Manager is that it will always attempt to fill existing tape volumes. When using a TS7530 Virtualization Engine with Tivoli Storage Manager it is important to avoid the features of TS7530 Enhanced Tape Caching that have been introduced assist backup applications that do not achieve the Tivoli Storage Manager tape volume utilization.

When using Tivoli Storage Manager with TS7530 Enhanced Tape Caching, observe the following considerations:

- Size the TS7530 to allow the TS7530 reclamation trigger to reclaim virtual volumes only after you have filled them (when cache is full or a specific number of days for reclamation) so all Tivoli Storage Manager writes are performed on virtual volumes. If Tivoli Storage Manger appends data to (or reads) a virtual volume that has been migrated and reclaimed, the append write (or read) will be performed to a physical drive. You may also set the migration trigger to migrate at end of backup and only when volume is full but you will only have the virtual volume copy of the data until migration occurs.
- Without TS7530 backup compression (compression of data in cache), using default values, a TS7530 volume will hold the native, uncompressed capacity of a physical volume. Assuming a full volume and a 2:1 compression ratio, when that virtual volume is migrated to a physical volume, the physical drive will compress the data and the physical volume will be half full. This could increase your physical tape requirements. TS7530 backup compression impacts performance.
- If you implement TS7530 backup compression, the compressed virtual volume size needs to be defined with 10–15% less capacity than the physical volume, as TS7530 compression can be more efficient than hardware compression. The reduced capacity is required so that when the virtual volume is migrated to physical tape the data will fit on the physical volume. Ten to 15% less is a general guideline and may vary depending on the compression characteristics of your data.
- Consider delaying the migration of important data from the TS7530 to physical media for *x* days to improve restore time.

## 8.4 TS7530 and physical tape library connected to Tivoli Storage Manager server

In this section, you see how to use a physical library connected to the Tivoli Storage Manager server. We explain how to use it, how to migrate data from TS7530 to the physical library, and how to restore data from the physical library.

### 8.4.1 Only the Tivoli Storage Manager server has access to the tape library

Now we need to change our setup, which we used in this IBM Redbooks publication, and connect the TS3500 Tape Library to the Tivoli Storage Manager server *ost36* (see Figure 8-9). We define the storage pool of the TS3500 as a next storage pool to the cvt_rock storage pool. We let the Tivoli Storage Manager server manage the data and the migration from TS7530 to the physical tape library.

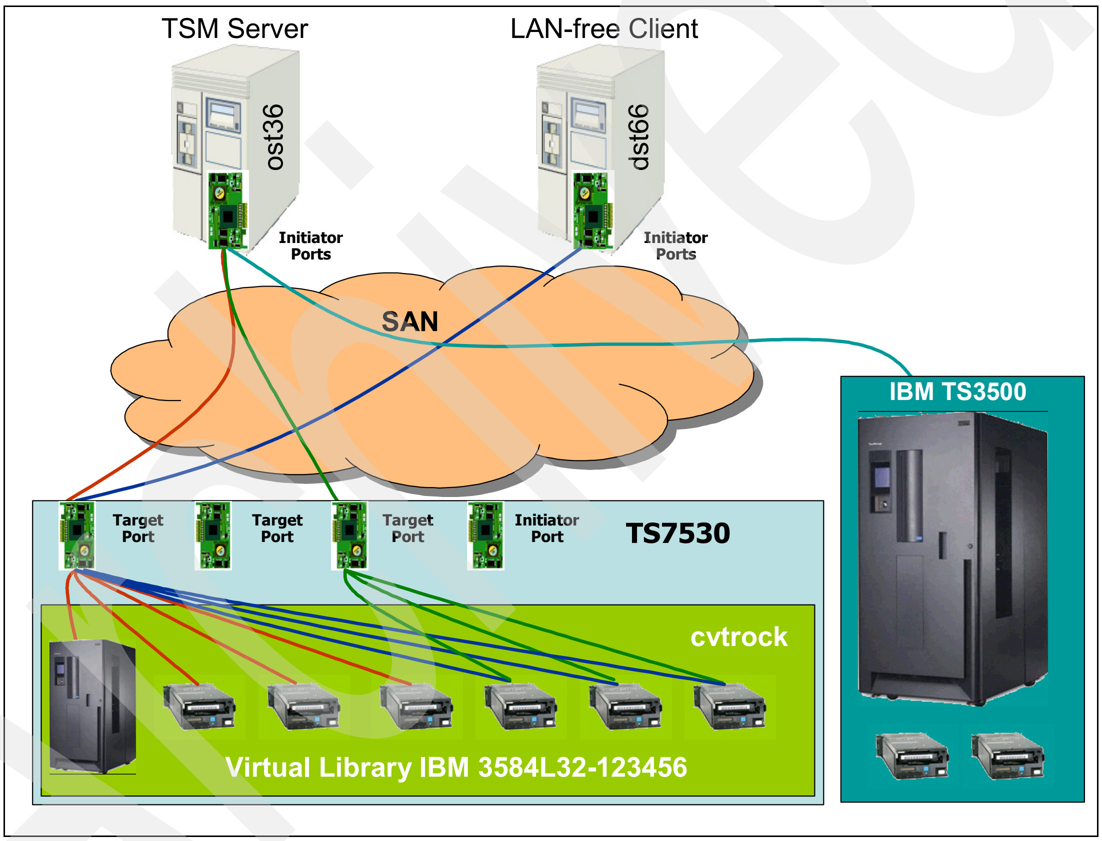



*Figure 8-9 TS7530 and Tivoli Storage Manager configuration*

#### Setup

After we change the SAN zoning to connect both physical 3592 Tape Drives to the Tivoli Storage Manager server ost36 and run the **cfgmgr** command, we see the tape drives on our server as shown in Example 8-9. rmt1 through rmt6 are the virtual tape drives in cvtrock. rmt6 and rmt7 are the physical 3592-J1A Tape Drives in the TS3500 Tape Library. smc1 is the medium changer for the physical TS3500 Tape Library.

*Example 8-9 lsdev -Cc tape output from ost36 after connecting the TS3500 library with 3592 drives*

```
ost36> lsdev -Cc tape
rmt0  Available 10-60-00-0,0 SCSI 4mm Tape Drive
rmt1  Available 10-78-02     IBM 3592 Tape Drive (FCP)
```

```
rmt2  Available 10-78-02     IBM 3592 Tape Drive (FCP)
rmt3  Available 10-78-02     IBM 3592 Tape Drive (FCP)
rmt4  Available 10-78-02     IBM 3592 Tape Drive (FCP)
rmt5  Available 10-78-02     IBM 3592 Tape Drive (FCP)
rmt6  Available 10-78-02     IBM 3592 Tape Drive (FCP)
rmt7  Available 10-78-02     IBM 3592 Tape Drive (FCP)
smc0  Available 10-78-02     IBM 3584 Library Medium Changer (FCP)
smc1  Available 10-78-02     IBM 3584 Library Medium Changer (FCP)
```

With this information, we configure the new tape library and drives on the Tivoli Storage Manager server. We named the library *3584*, the drives *dr3592*, the device class *3592* and the storage pool *3592stgpool.* Example 8-10 shows the output of the configuration.

*Example 8-10   3584 library configuration*

```
tsm: TSM>DEFINE LIBRARY cvtrock LIBTYPE=SCSI SHARED=YES
ANR8400I Library CVTROCK defined.

tsm: TSM>define path tsm   3584 srctype=server desttype=library device=/dev/smc1
ANR1720I A path from TSM to 3584 has been defined.

tsm: TSM>define drive 3584 dr3592_1
ANR8404I Drive DR3592_1 defined in library 3584.

tsm: TSM>define drive 3584 dr3592_2
ANR8404I Drive DR3592_2 defined in library 3584.

tsm: TSM>define path tsm dr3592_1 srctype=server desttype=drive library=3584
device=/dev/rmt7
ANR1720I A path from TSM to 3584 DR3592_1 has been defined.

tsm: TSM>define path tsm dr3592_2 srctype=server desttype=drive library=3584
device=/dev/rmt8
ANR1720I A path from TSM to 3584 DR3592_2 has been defined.

tsm: TSM>define devclass 3592 library=3584 devtype=3592 format=3592C mountlimit=drives
ANR2203I Device class 3592 defined.

tsm: TSM>define stgpool 3592stgpool 3592 maxscratch=10
ANR2200I Storage pool 3592STGPOOL defined (device class 3592).

tsm: TSM>label libvolume 3584 search=yes labelsource=barcode checkin=scratch
ANS8003I Process number 36 started.
```

We label the cartridges in the 3584 library, as shown in Example 8-11.

*Example 8-11   Label cartridges in 3584*

```
tsm: TSM>label libvolume 3584 search=yes labelsource=barcode checkin=scratch
ANS8003I Process number 36 started.
```

Next we check our LAN-free clients' settings that restore can also transfer over LAN. You might need to update the clients' settings and change at least the DATAREADPATH parameter to ANY. We updated our LAN-free client DST66 so that restores (DATAREADPATH) can be over any path (LAN or SAN) and backups (DATAWRITTEDPATH) can still go over SAN only:

```
UPDATE NODE DST66 DATAWRITEPATH=LANFREE DATAREADPATH=ANY
```

With this change, a restore now either goes over the SAN, if the needed data is still in the TS7530, or over the LAN, if the data had been migrated to the physical library.

## Configuration options

The new configured storage pool *3592stgpool* should be the next storage pool to the primary storage pool on the TS7530. We update the storage pool cvt_stgpool and add the NEXTSTGPOOL parameter:

```
UPDATE STGPOOL cvt_stgpool NEXTSTGPOOL=3592stgpool
```

To tune the migration behavior, you can choose from several parameters as explained in the following sections. You can change all of the parameters by using the UPDATE STGPOOL command.

### *HIghmig*

The HIghmig parameter specifies that the server starts migration for this storage pool when the number of volumes containing data reaches this percentage of the total number of volumes in the storage pool. The total number of volumes includes the maximum number of scratch volumes.

You can specify an integer from 1 to 100. The default value is 90. When the storage pool exceeds the high migration threshold, the server can start the migration of files by volume to the next storage pool defined for the pool. You can set the high migration threshold to 100 to prevent migration for the storage pool, for example during the peak workload, and decrease this value for times where a lower workload is expected.

### *LOwmig*

The LOwmig parameter specifies that the server stops migration for this storage pool when the number of volumes containing data reaches this percentage of the total number of volumes in the storage pool. The total number of volumes includes the maximum number of scratch volumes. This parameter is optional.

You can specify an integer from 0 to 99. The default value is 70. When the storage pool reaches the low migration threshold, the server does not start migration of files from another volume. You can set the low migration threshold to 0 to permit migration to empty the storage pool.

### *MIGDelay*

The MIGDelay parameter specifies the minimum number of days since a file was stored in the storage pool before the file becomes eligible for migration from the storage pool. This parameter is optional.

You can specify an integer from 0 to 9999. The default is 0, which means that you do not want to delay migration. If you sized the disk capacity of the TS7530 properly to keep the backup data long enough to get most of the restores done from the TS7530, you might use this parameter to keep your data in the TS7530.

### *MIGContinue*

The MIGContinue parameter specifies whether you allow the server to migrate files that do not satisfy the migration delay time. This parameter is optional.

The default is YES. Because you can require that files remain in the storage pool for a minimum number of days, the server may migrate all eligible files to the next storage pool, but not meet the low migration threshold. This parameter allows you to specify whether the server is allowed to continue the migration process by migrating files that do not satisfy the migration delay time. There are two possible values:

- Yes

  This value specifies that, when necessary to meet the low migration threshold, the server continues to migrate files that do not satisfy the migration delay time. If you allow more than one migration process for the storage pool, some files that do not satisfy the migration delay time might be migrated unnecessarily.

  As one process migrates files that satisfy the migration delay time, a second process could begin migrating files that do not satisfy the migration delay time to meet the low migration threshold. The first process that is still migrating files that satisfy the migration delay time might have, by itself, caused the low migration threshold to be met.

- No

  This value specifies that the server stops migration when no eligible files remain to be migrated, even before reaching the low migration threshold. The server does not migrate files unless the files satisfy the migration delay time.

#### *MIGPRocess*

The MIGPRocess parameter specifies the number of parallel processes to use for migrating the files from the volumes in the storage pool. This parameter is optional.

You enter a value from 1 to 999. The default value is 1. When calculating the value for this parameter, consider the number of sequential storage pools involved with the migration, and the number of logical and physical drives that can be dedicated to the operation.

To access a sequential-access volume, Tivoli Storage Manager uses a physical drive. The number of available mount points and drives depends on other Tivoli Storage Manager and system activity and on the mount limits of the device classes for the sequential access storage pools that are involved in the migration. For example, our TS3500 configuration has two drives installed. Therefore we cannot start more than two migration processes at the same time, and the MIGProcess value cannot be higher than 2.

### MOVE NODEDATA

If you want restore data that is already migrated to physical tape, you can use the MOVE NODEDATA command to migrate data back from the physical library to the TS7530 Virtualization Engine. After the migration is done, you can start the restore.

Use the MOVE NODEDATA command to move data located in a sequential-access storage pool. You can move data for one or more nodes or for a group of collocated nodes. You can also move selected file spaces for a single node. The data can be located in either a primary or copy storage pool.

The MOVE NODEDATA command takes two forms, depending on whether you are moving data only for selected file spaces or for all file spaces. Refer to the Tivoli Storage Manager manuals for further information.

We move data that is already migrated to 3592stgpool, from our LAN-free client dst66 back to TS7530. We want to move only one file space with file space ID 5 (Example 8-12).

*Example 8-12 MOVE NODEDATA*

```
tsm: TSM>move nodedata dst66 fromstgpool=3592STGPOOL tostgpool=CVT_STGPOOL fsid=5
ANR1649W MOVE NODEDATA:This command will move data for nodes stored in storage pool
3592STGPOOL to
storage pool CVT_STGPOOL; the data will be inaccessible to users until the operation
completes.

Do you wish to proceed? (Yes (Y)/No (N)) y
ANR2110I MOVE NODEDATA started as process 15.
ANS8003I Process number 15 started.
```

## 8.4.2 The TSM server and LAN-free clients have access to the tape library

If restore data should only be transferred over the SAN, even the data migrated to physical tape, and the MOVE NODEDATA approach is not sufficient, you need to give your LAN-free clients access to the physical library. We changed our sample setup and changed the SAN zoning so that our LAN-free client dst66 also gets access to the two physical tape drives in the TS3500 library (Figure 8-10).

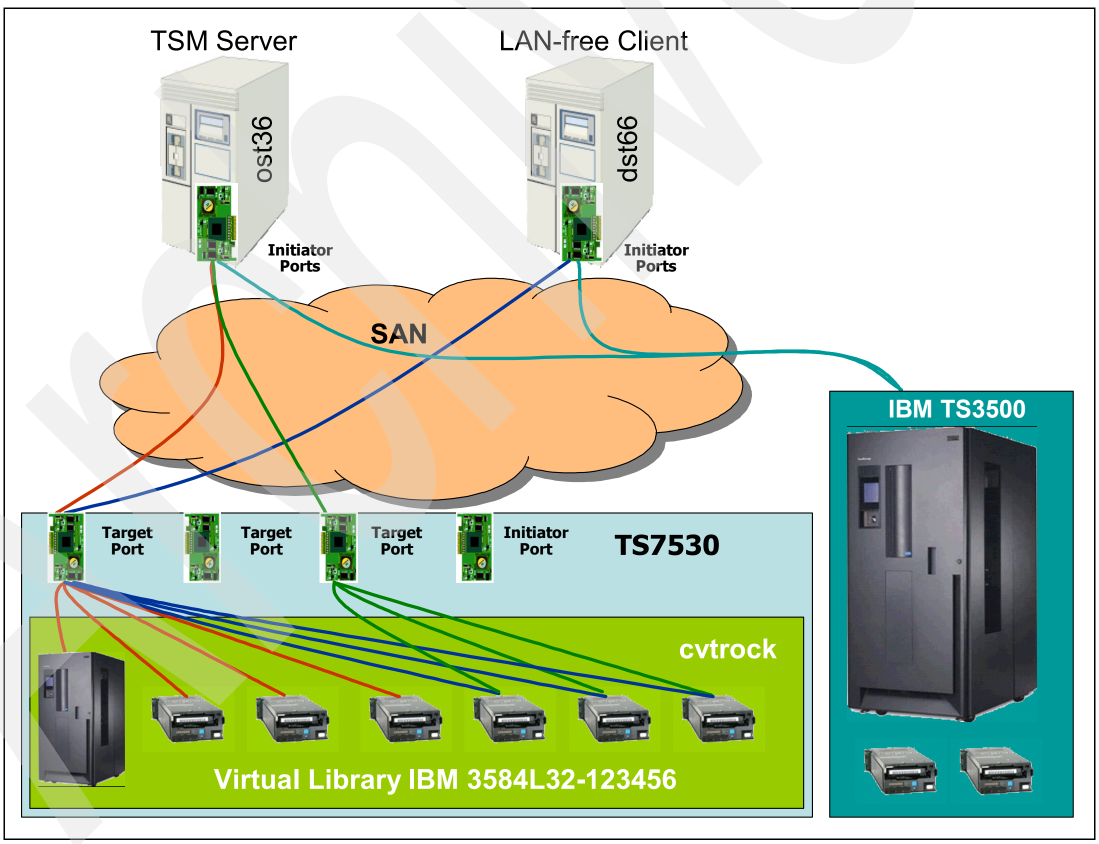



*Figure 8-10 LAN-free client with access to the physical library*

After we run the **cfgmgr** command on the server dst66, we see the list of tape drives on our server as shown in Example 8-13. rmt0 to rmt2 are the virtual tape drives in cvtrock. rmt3 and rmt4 are the physical 3592-J1A Tape Drives in the TS3500 Tape Library. smc0 is the medium changer for the physical TS3500 Tape Library.

*Example 8-13 lsdev -Cc tape output on dst66*

```
dst66> lsdev -Cc tape
rmt0 Available 14-08-02 IBM 3592 Tape Drive (FCP)
rmt1 Available 14-08-02 IBM 3592 Tape Drive (FCP)
rmt2 Available 14-08-02 IBM 3592 Tape Drive (FCP)
rmt3 Available 14-08-02 IBM 3592 Tape Drive (FCP)
rmt4 Available 14-08-02 IBM 3592 Tape Drive (FCP)
smc0 Available 14-08-02 IBM 3584 Library Medium Changer (FCP)
```

With this information, we configure the new tape paths on the Tivoli Storage Manager server ost36. Example 8-14 shows the output of the configuration.

*Example 8-14 Configuration output*

```
tsm: TSM>define path dst66agnt dr3592_1 srctype=server desttype=drive library=3584 device=/dev/rmt3
ANR1720I A path from DST66AGNT to 3584 DR3592_1 has been defined.

tsm: TSM>define path dst66agnt dr3592_2 srctype=server desttype=drive library=3584 device=/dev/rmt4
ANR1720I A path from DST66AGNT to 3584 DR3592_2 has been defined.
```

Now restores are fulfilled either from the TS7530 Virtualization Engine or from the physical TS3500 library, depending on where the data is currently stored.

## 8.5 Using Import/Export with Export Physical Copy for vaulting

Export Physical Copy is a function for vaulting. If you want to send cartridges offsite, you can use the Export Physical Copy function from TS7530 Virtualization Engine to create a physical tape. You should not use the manual Import/Export console functions for data movement from virtual tape to physical tape, because the data is not accessible from the Tivoli Storage Manager server without invoking a manual Import function.

## 8.5.1 Export Physical Copy

You can use the Move or Copy option with Export Physical Copy. You can change the settings for your virtual library by right-clicking the virtual library icon and selecting Properties. In the Change Virtual Library Properties window (Figure 8-11) that opens, we select the Move function and specify a grace period of 0 days. This means that the virtual volume is deleted after all data is copied to physical tape.

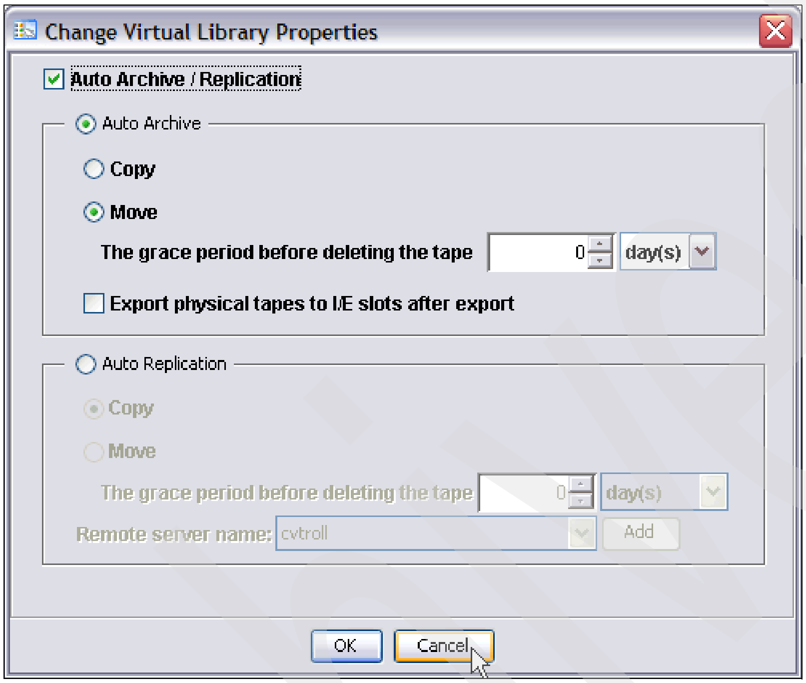



*Figure 8-11 Change Virtual Library Properties window*

To export a volume, use the Tivoli Storage Manager command:

```
CHECKOUT LIBVOL lib_name volume
```

We export the volume J1S387 from the library cvtrock:

```
CHECKOUT LIBVOL cvtrock J1S387
```

The TS7530 Virtualization Engine then moves the volume to the virtual vault. If a physical volume with the same barcode label exists in the physical library, the TS7530 Virtualization Engine starts to copy the data from the virtual volume to the physical volume. You can check the progress of the export job by clicking the job icon.

As you can see in Figure 8-12, the export job is not finished yet. The virtual volume is still in the virtual vault. After all data is copied from the virtual volume, the virtual volume is deleted, because we selected Move with a grace period of 0 days.

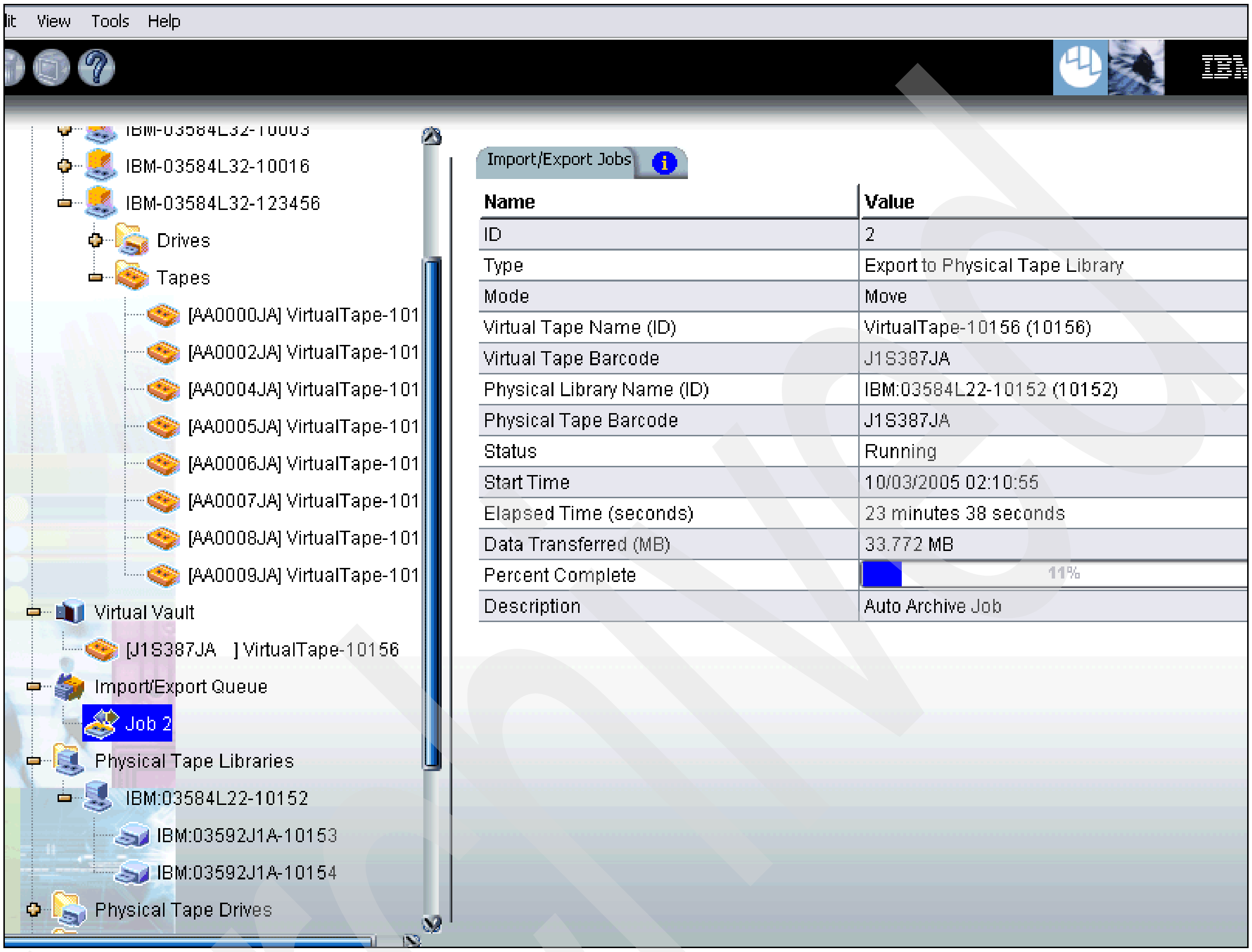



*Figure 8-12 Progress of the export job*

## 8.5.2 Import

You can import a physical volume to a virtual library by copying all the data from the physical tape to the TS7530 disk cache, or you can obtain direct physical access to this physical cartridge.

### Direct Access

You can use Direct Access mode for only for restoring data, because it only provides read access to the cartridge. Before Tivoli Storage Manager can access a direct access cartridge, you must update the volume access:

```
UPDATE VOLUME volume_name access=readonly
```

If a Tivoli Storage Manager process is already waiting for this cartridge, you cannot update the volume. You need either to cancel the Tivoli Storage Manager process or to import the volume in Copy mode.

After the import is done from the TS7530, you need to check in the volume:

```
CHECKIN LIBVOL library_name SEARCH=YES VOLLIST=volume_name STATUS=PRIVATE
```

### Copy mode

If you import a cartridge in Copy mode, all contents of the physical cartridge are copied to the disk cache of the TS7530 Virtualization Engine. The copy process may take some time (a couple of hours) until the whole cartridge (LTO2 = 200 GB, LTO3 = 400 GB or 3592 = 300 GB) is copied. If you want to import a volume after a Tivoli Storage Manager process requests the volume, set the *mountwait* parameter to a higher value to reflect the copy time. We update our device class with a mountwait of 300 minutes:

```
update dev cvt mountwait=300
```

We started a restore that needs data from volume J1S387, which we already exported in 8.5.1, “Export Physical Copy” on page 310. When querying the activity log (Example 8-15), we recognized that volume J1S387 is required.

*Example 8-15 Activity log*

```
09/22/05   20:13:26      ANR8308I 004: 3592 volume J1S387 is required for use in
                          library CVTROCK; CHECKIN LIBVOLUME required within 300
                          minutes. (SESSION: 86)
```

Now we import this cartridge using the TS7530 VE for Tape Console. Because Tivoli Storage Manager is already requesting this cartridge, an update volume cannot be done. Therefore, you need to import this cartridge in Copy mode (Figure 8-13).

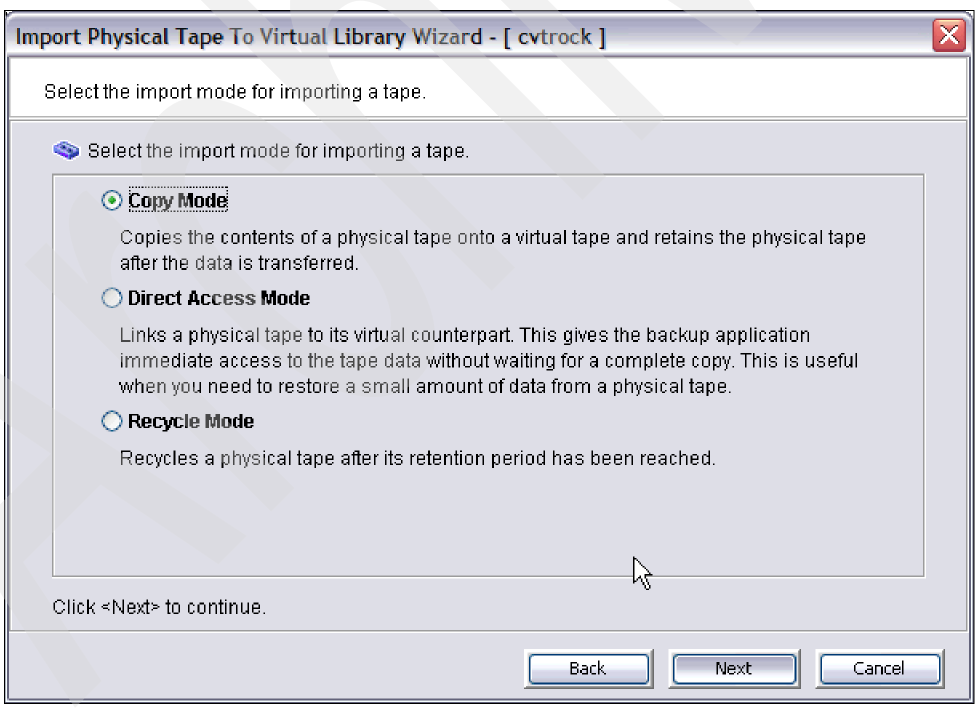



*Figure 8-13 Importing the cartridge using Copy Mode*

After the import job is finished, you must reply to the Tivoli Storage Manager message. In our Example 8-15, we respond by typing:

```
reply 004
```

# 9

# Using TS7500 with i5/OS

In this chapter we provide an overview of how System i can be used with the TS7500 Virtualization Engine. We show the basic steps and discuss an important restriction.

We also describe two customer cases of using the TS7500 Virtualization Engine with i5/OS partitions. We believe that these examples show typical customer scenarios where use of the TS7500 Virtualization Engine is a logical choice. Use these examples to help you plan for using this product as part of your specific backup and recovery processes.

# 9.1 Setup

Starting with the TS7500 Virtualization Engine Software Version 3 Release 1 with the default software and hardware configuration, it is possible to use a i5 System without a Request for Price Quotation (RPQ). All available models of emulated tape libraries and tape drives can assign to a i5 System server.

The System i will also recognize the virtual serial number of the emulated devices against issues with the TS7520 Virtualization Engine.

## 9.1.1 Requirement

IBM TS 7500 Virtualization Engine supports connection to IBM System i if the following criteria are complied:

- The System i operating system must be V5R3 or V5R4 with the latest PTFs.
- AS/400® must use either IBM 2765 or IBM 5704 FC tape controller.
- There must be a Fibre Channel connection between the System i server and the TS7500 Virtualization Engine.

## 9.1.2 Steps on TS7530 Virtualization Engine

As described in 6.6.2, “Creating a virtual library and drives” on page 206, and 6.7.3, “LUN masking: Assigning a host to a library and drives” on page 220, you must create a virtual library and drives for use with the i5 System.

## 9.1.3 Steps on i5 System

After successful creation from a virtual library and assigning to the host, verify the proper function of the connection between the System i server and TS7500 Virtualization Engine.

For more information about the export and import functions with i5 System in conjunction with the TS7500 Virtualization Engine, see I*BM Virtualization Engine TS7500 Users Guide Version 3 Release 1,* GC27-2179.

# 9.2 Restrictions with enhanced caching

With a connected physical tape library to IBM TS7500 Virtualization Engine there is the option to enable Enhanced Tape Caching. Normally, System i server controls the copy of data to a physical tape to ensure that the data that has been backed up can be restored accordingly and that data integrity is guaranteed. With usage of IBM TS7500 Virtualization Engine the copy control responsibility switches to the TS7500. In the case of enabled enhanced caching the limitations discussed in this section with Backup, Recovery, and Media Services (BRMS) apply.

## 9.2.1 Enhanced Caching

Remember that the Enhanced Caching feature improves the functionality of the TS7500 Virtualization Engine by acting as a cache to the physical tape library, providing transparent access to data regardless of its location.

## 9.2.2 Restriction

The System i host backs up or saves data to the TS7500 Virtualization Engine. The system holds the control of this job because tis point of view from the i5 the TS7500 is a physical library with physical drives. The host system self is responsible for data integrity. See Figure 9-1.

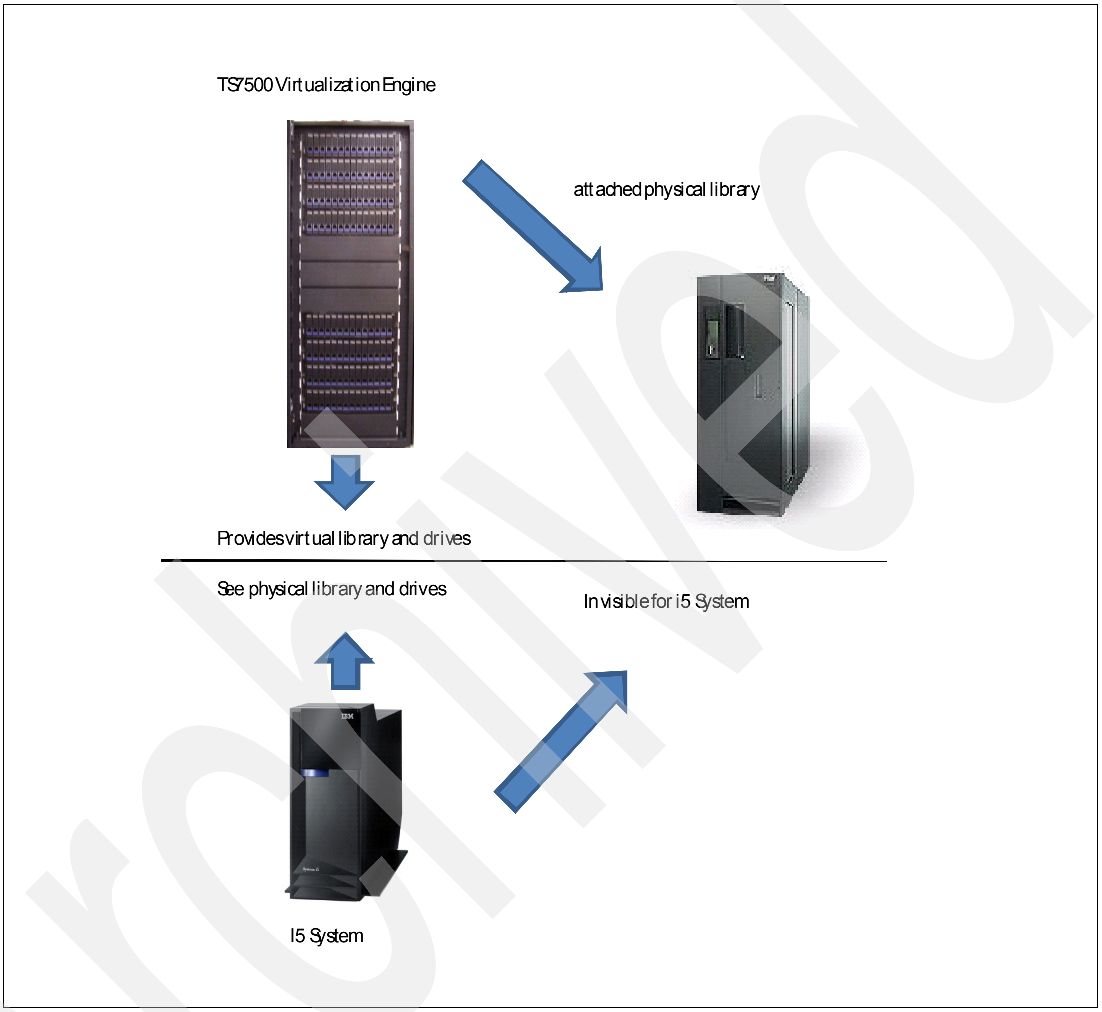



*Figure 9-1 Normal condition*

After enabling Enhanced Caching the TS7500 is responsible for ensuring that data on physical tape is identical to data on the corresponding virtual tape that the System i server has written and for providing access to the physical copy. Depending on how the Enhanced Caching settings are, only a pointer to the physical tape is left in the cache. See Figure 9-2.

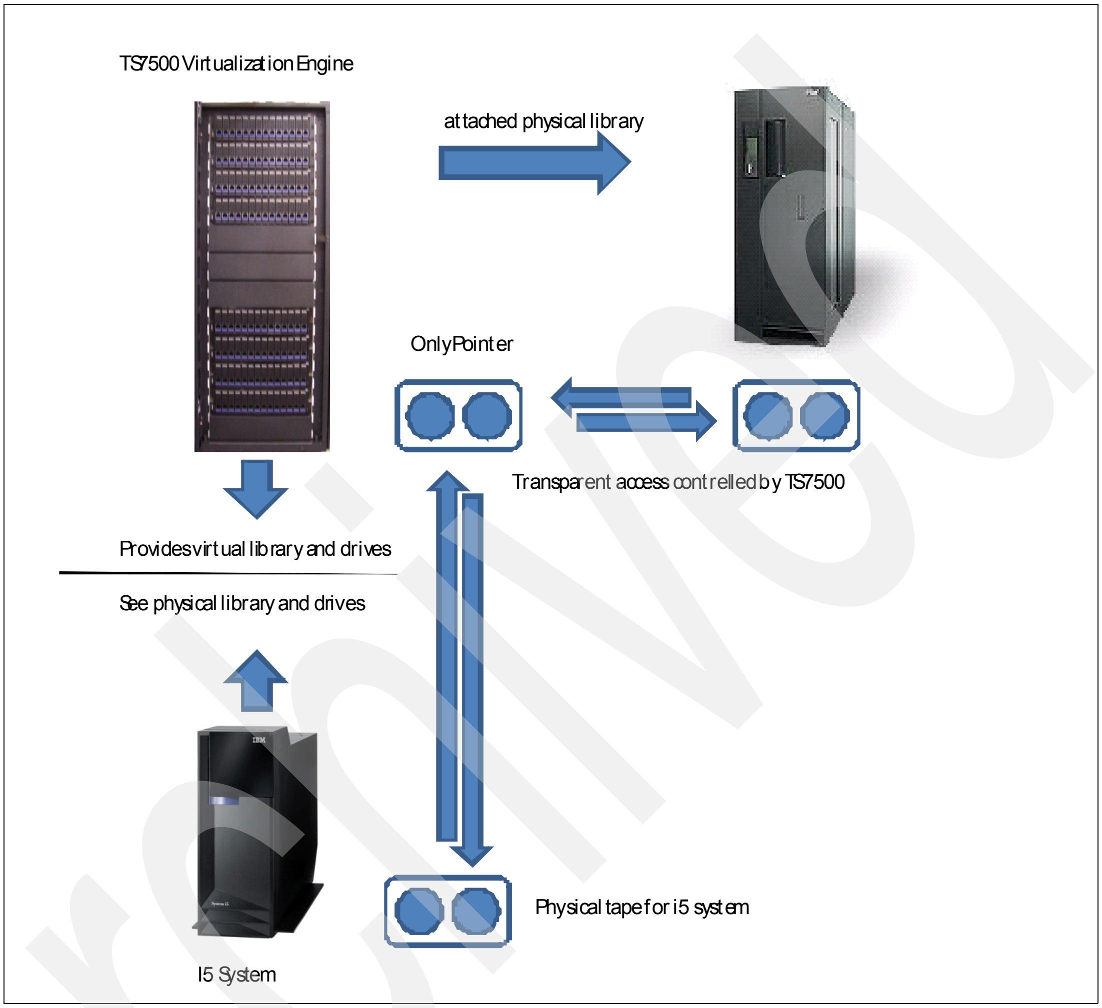



*Figure 9-2 Transparent access*

At this time the data location might not be readily apparent to the location information in Backup, Recovery, and Media Services. In normal conditions the access via the pointer to the data is transparent for the System i server. The TS7500 Virtualization Engine manages this.

In case of inoperable TS7500 Virtualization Engine, the System i server is not able to instantly access the data, which is stored on physical tape.

### 9.2.3 Solution

Access to data on the physical tape now is only possible with manual intervention via an alternate (direct) path to the physical tape library. If BRMS needs access to the physical tape, move the virtual tape location (assigned tapmlb resource) to the location of the physical tape library as defined by the BRMS setup.

At this point the System i server manages the virtual tape and the physical tape copy as distinct tapes.

**Note:** Users must take care in these circumstances because, while the physical and virtual volume serial numbers are identical, the tape library identifier is different.

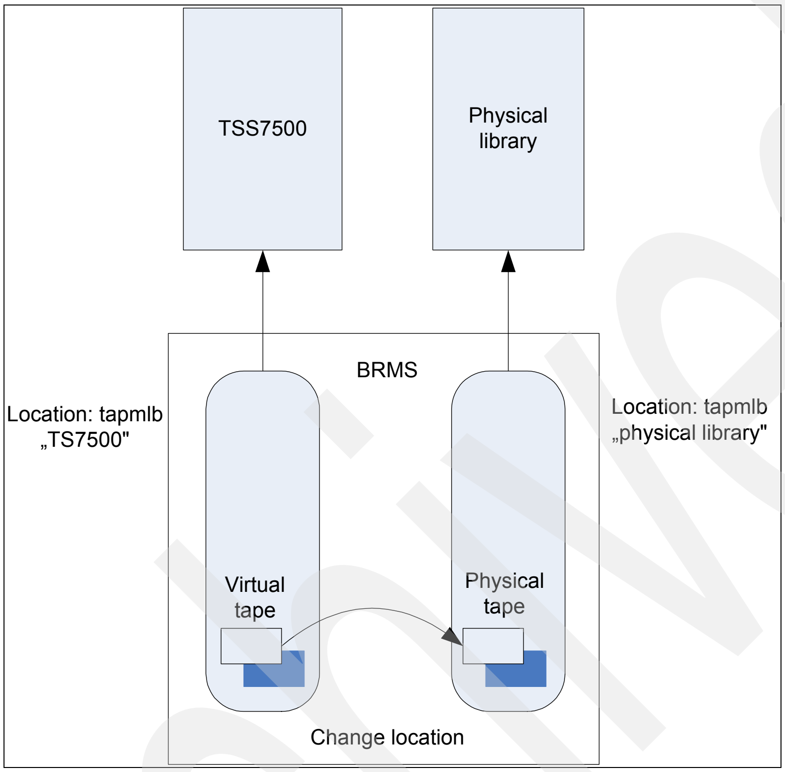



*Figure 9-3 Change location in BRMS*

Any changes to the data are now *no longer under control* of the TS7500 Virtualization Engine.

### 9.2.4 Customer responsibleness

It is the user's responsibility to monitor the TS7500 Virtualization Engine and its Enhanced Tape Caching function independently of the System i server to be aware of the limitations described above.

## 9.3 Scenarios

In this section we describe a few scenarios for using the TS7500 with i5/OS hosts.

### 9.3.1 Four i5/OS partitions saving the entire system in different time periods

The customer has four i5/OS partitions, each of them saving different amounts of data on different days in the week. The following is their backup schedule:

- System A backs up 0.7 TB of data daily from Monday to Thursday, and on Sunday. From Monday to Thursday, backups are incremental, the estimates are 0.2 TB on Monday and Tuesday, and 0.3 TB on Wednesday and Thursday. On Sunday, full backup is taken.
- System B performs full backup of 1.3 TB of data, on Saturday and Sunday.
- System C backs up 1.2 TB of data incrementally from Monday to Wednesday, 0.2 TB each day, and full backup is taken on Thursday.
- System D backs up1.5 TB of data, on Friday, Saturday, and Sunday. Full backup is taken on each of these three days.

All backups start at the same time in a day.

Table 9-1 shows these backup activities.

*Table 9-1 Backup activities for Example 1*

| | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** | **Sunday** |
|---|---|---|---|---|---|---|---|
| System A | 0.2 TB | 0.2 TB | 0.3 TB | 0.3 TB | | | 0.7 TB |
| System B | | | | | | 1.3 TB | 1.3 TB |
| System C | 0.2 TB | 0.2 TB | 0.2 TB | 1.2 TB | | | |
| System D | | | | | 1.5 TB | 1.5TB | 1.5 TB |
| Total size | 0.4 TB | 0.4 TB | 0.5TB | 1.5 TB | 1.5 TB | 2.8 TB | 3.5 TB |

As we can see in Table 9-1, a maximum of 3.5 TB of data is being saved at the same time.

After sizing is performed, you have information about how many tape drives will be used in each partition and how many will be used in total at the same time. You also have information for how many IOAs in a partition to plan and how many ports in the TS7500 Virtualization Engine server (3954-CV7) to plan. Then decide to use all available ports in the TS7500 Virtualization Engine server (3954-CV7) to connect to all IOA in four partitions or zone ports so that one or more partitions use the same port in TS7500 Virtualization Engine server (3954-CV7).

For information how to set up and use BRMS examples, refer to the IBM Redbooks publication, *Implementing IBM Tape in i5/OS*, SG24-7440.

### 9.3.2 Two partitions saving data with replication to remote site once a week

The customer has an i5/OS partition running Domino and another partition running WebSphere®. A disaster recovery solution for both partitions is provided by the TS7500 Virtualization Engine. The TS7500 Virtualization Engine replication function enables the recovery of partitions on a remote site.

On the production site, full backup of user data in libraries QUSRSYS and application libraries are performed every day. The customer transported the replicated tape to a safe place and restore to a remote site on Sunday before. They plan to replicate the tapes to recovery site over TCP/IP.

i5/OS partition A saves 300 GB of user data, partition B saves 200 GB of use data.

We plan two virtual tape libraries, each of them used by one i5/OS partition. We plan the disk space in the TS7520 Virtualization Engine based on the time period of how long to keep each backup, as described in 5.5, “Planning and sizing the TS7500 Virtualization Engine for i5/OS” on page 173.

We consider that replication to the remote TS7500 Virtualization Engine is the correct solution for the customer’s needs to copy backups taken on Sunday to the remote site.

We decided to set up replication so that the replication process is triggered when the virtual tapes for Sunday’s backups reach a certain size. After replication is set up, updates made to primary tape are copied to target tape on the remote site. In our case, the primary tape is rewritten with new full backup every Sunday, therefore the entire backup is replicated to remote each time.

On the production TS7500 Virtualization Engine, the customer needs 0.3 TB for Domino partition and 0.2 TB for WebSphere Application Server partition every day of a week. Also it required five generations of data on Sunday for one month. Table 9-2 shows the space requirements for the production TS7500 Virtualization Engine.

*Table 9-2 Production site: Disk space for the TS7520 Virtualization Engine*

| | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** | **Sunday** | **Total** |
|---|---|---|---|---|---|---|---|---|
| Domino partition | 0.3TB | 0.3TB | 0.3TB | 0.3TB | 0.3TB | 0.3TB | 1.5TB | 3.3TB |
| WebSphere Application Server partition | 0.2TB | 0.2TB | 0.2TB | 0.2TB | 0.2TB | 0.2TB | 1.0TB | 2.2TB |

On the remote TS7500 Virtualization Engine, we size the disk space to accommodate copies of tapes for full backups taken on Sundays. We keep 5 generations of saved Sunday data just as we did on the primary production site.

Table 9-3 shows the disk space estimation for saved Sunday data on the backup TS7500.

*Table 9-3 Backup site: Disk space for TS7520 Virtualization Engine*

| | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** | **Sunday** | **Total** |
|---|---|---|---|---|---|---|---|---|
| Domino Partition | | | | | | | 1.5 TB | 1.5 TB |
| WebSphere Application Server partition | | | | | | | 1.0 TB | 1.0 TB |

We must also consider the bandwidth of IP connection between the production and remote site. The connection should provide enough bandwidth for regular replication of Sunday’s backups. If the data for two partitions on Sunday replicates in 3 hours, then the following bandwidth is required.

```
(300,000 MB + 200,000 MB) X 8 bit / 3 hours / 3600 seconds = 370 Mb/s
```

370 Mb/s speed is required for replication. Of course, 1Gbps Ethernet infrastructure is essential.

# 10

# Using TS7530 with other backup systems

This chapter provides information about how the TS7530 can be used with other supported backup products, such as Symantec NetBackup and EMC NetWorker.

We show you how to install and implement TS7530 in these backup products. We also give you additional hints about what you should consider during the installation.

We discuss the following usage considerations:

- Use TS7530 as disk backup device.
- Use Enhanced Tape Caching.
- Use function from the backup application to migrate data from TS7530 to physical tape.

For detailed installation procedures and instructions, you should consult the relevant software Web sites and product documentation.

For Symantec NetBackup:

http://www.symantec.com/index.jsp
http://www.symantec.com/enterprise/products/overview.jsp?pcid=1018&pvid=2_1

For EMC NetWorker:

http://software.emc.com/
http://software.emc.com/products/product_family/networker_family.htm

## 10.1 Using TS7530 with Symantec NetBackup

Symantec NetBackup provides backup, restore, and recovery function for several different operating systems. Symantec NetBackup was formerly known as Veritas NetBackup.

Veritas NetBackup 6.0/6.5[1] delivers high-performance data protection that scales to protect the largest UNIX, Windows, Linux, and NetWare environments. With complete protection from the desktop to the data center, NetBackup offers a single console for management of all backup and recovery operations.

- End-to-End Data Protection: Data protection for all environments, from desktop to data center to vault.
- Single Solution for All Platforms: NetBackup helps you to consolidate and standardize your backup and recovery operations, protecting all major UNIX variants, Windows, Linux, and NetWare systems.
- Unlimited Scalability: Centralized management and control, high-performance technology, and a flexible multi-tier architecture enable NetBackup software to adapt to the growing requirements of the modern data center.

For detailed product information, visit the Symantec NetBackup Web sites:

http://www.symantec.com/enterprise/products/overview.jsp?pcid=1018&pvid=2_1
http://www.symantec.com/enterprise/support/index.jsp

In a NetBackup environment, there is one Master Server, which holds the NetBackup database where all metadata and configuration is stored.

At least one Media Server is required. The Media Server has access to a Storage Unit and manages the Storage Unit. Master and Media Server can be installed on the same hardware. Several Media Server can be installed. Each Media Server controls and manage its own Data. NetBackup Clients writes over LAN/IP the backup data to a Media Server, but Client and Media Server can be installed on the same hardware.

In general, a Media Server uses its owns Storage Unit. A Storage Unit can be either a Disk Staging Device or a Tape Storage Unit. If a Tape Storage Unit should be shared over several Media Servers, then an additional license, Shared Storage Option (SSO), is required. The TS7530 can eliminate or reduce the usage of SSO, because the TS7530 can emulate many virtual tape drives, and sharing might no longer be required.

This chapter includes new information about the NetBackup 6.5 and the TS7530.

### 10.1.1 General TS7530 implementation considerations

The following list summarizes important general implementation considerations:

- Before configuring NetBackup, you must have the storage devices attached to the server and perform all configuration steps specified by the device and operating system vendor (including installation of any required device drivers).
- In an AIX environment, if you are using IBM tape drives, VERITAS recommends that you install the IBM AIX tape driver. Refer to the IBM documentation when using this driver. If you are using other tape drives, VERITAS recommends that you use the IBM AIX OST (other SCSI tape) driver. Refer to the IBM documentation when using this driver.

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- Use the IBM *atdd* driver when configuring IBM tape drives on HP-UX. Configure atdd and BEST device paths according to IBM driver documentation. Do not configure atdd for robotic control of IBM robots. Check the VERITAS support Web site for the latest recommended atdd driver version from IBM.
- Some recent versions of the IBM device drivers (Atape for AIX, atdd for HP-UX, and IBMtape for Windows) are tested and can be used with the IBM tape drives. For the library, generally use the passthru drivers. The passthru device files must still be created.
- For NetBackup 6.0 and later use the failover capabilities from NetBackup. DPF on the IBM Device Driver must be disabled for NetBackup 6.0 and later.
- On Solaris, use the native st driver.

  Example 10-1 shows necessary entries for selected IBM tape drives for the st.conf. Copy the necessary entries for the tape drives that you want to emulate on the TS750 into the existing st.conf on your system. Use either entries without timeout values (1) or with timeout values. We recommend using them with timeout values.

*Example 10-1 st.conf for Solaris 9, 10, and some Solaris 8 operating systems*

```
Table 10-1 on page 326 tape-config-list=
   "IBM     ULT3580-TD2",  "IBM 3580 Ultrium-2",           "CLASS_LTO2",
   "IBM     ULT3580-TD3",  "IBM 3580 Ultrium-3",           "CLASS_LTO3",
   "IBM     ULT3580-TD4",  "IBM 3580 Ultrium-4",           "CLASS_LTO4";
   "IBM     03592J1A",     "IBM 3592J",                    "CLASS_3592J",
   "IBM     03592E05",     "IBM 3592E",                    "CLASS_3592E",

# use for Solaris 9, 10 and some Solaris 8 operating system (ST_BUFFERED_WRITES is
obsolete)
   # (1) without timeout values
   # CLASS_3592J      =       1,0x24,0,0x45963d,2,0x00,0x51,1;
   # CLASS_3592E      =       1,0x24,0,0x45963d,3,0x00,0x51,0x52,2;
   # CLASS_LTO2       =       1,0x3B,0,0x45963d,2,0x40,0x42,1;
   # CLASS_LTO3       =       1,0x3B,0,0x45963d,3,0x40,0x42,0x44,2;
   # CLASS_LTO4       =       1,0x3B,0,0x45963d,3,0x42,0x44,0x46,2;

   # (2) with the timeout values
# CLASS_3592J=2,0x24,0,0x45963d,2,0x00,0x51,1,30,0,480,840,720,660,9060;
# CLASS_3592E=2,0x24,0,0x45963d,3,0x00,0x51,0x52,2,30,0,480,840,720,660,9060;
# CLASS_LTO2=2,0x3B,0,0x45963d,2,0x40,0x42,1,60,0,540,9060,720,720,9060;
# CLASS_LTO3=2,0x3B,0,0x45963d,3,0x40,0x42,0x44,2,60,1080,540,9900,720,720,9600;
# CLASS_LTO4=2,0x3B,0,0x45963d,3,0x42,0x44,0x46,2,60,1080,540,10980,540,780,10800;
```

  Note that ST_BUFFERED_WRITES is obsolete.

- Because NetBackup uses per default only 64 KB Blocksize for writing and reading to tape drives and only 8 of those blocks are buffered in the shared memory (Number of Blocks), the performance might be not optimal. Therefore we recommend changing the blocksize and the number of blocks:
  - A Blocksize (SIZE_DATA_BUFFERS) of 256kB would be optimal.
  - Use a higher Number of Blocks (NUMBER_DATA_BUFFERS) to be buffered. For example, use 16 blocks.
  - These buffers can be configured by creating the files on the NetBackup media server:
    - /usr/openv/netbackup/db/config/SIZE_DATA_BUFFERS
    - /usr/openv/netbackup/db/config/NUMBER_DATA_BUFFERS

## 10.1.2 Implementing TS7530 with Symantec NetBackup

Here we show you an example of how to implement TS7530 in a Symantec NetBackup environment. The implementation is basically the same for all supported operating systems. We give you some detailed information with figures and outputs from a Symantec NetBackup environment running on Linux. We are using the following environment:

- xSeries 366
  - QLogic PCI to Fibre Channel Host Adapter for QLA2340

    Firmware version 3.03.15 IPX™, Driver version 8.01.00b5-rh2
  - Red Hat 2.6.9-22.ELsmp
  - IBM tape device driver 2.1.4
- Symantec NetBackup 6.0/6.5

  NetBackup Master and Media Server is installed on the same server.

However, we will also tell you if and where the installations differ on the various operating systems. Here is an overview of the different implementation steps:

1. Check the interoperability.
2. Do the basic setup of the TS7530 as described in Chapter 6, “Initial setup” on page 181.
3. Install the device driver as described in *IBM Tape Device Drivers - Installation and User's Guide,* GC27-2130.
4. Check the device configuration and create a device table.
5. Implement the devices in Symantec NetBackup.
6. Inventory the library.

For a detailed explanation of the general installation process, refer to the following manuals for Veritas NetBackup 6.0/6.5:

- *Installation Guide for Unix and Linux*
- *Media Manager Device Configuration Guide for Unix, Windows and Linux*
- *Media Manager System Administrator Guide for Unix and Linux*

See your installation documentation or look up the Symantec Veritas support Web site:

- For NetBackup 6.0: *Veritas NetBackup 6.0 Installation Guide for UNIX*

  http://seer.entsupport.symantec.com/docs/279261.htm
- For NetBackup 6.5: *Veritas NetBackup 6.5 Installation Guide for UNIX*

  http://seer.entsupport.symantec.com/docs/290199.htm

### NetBackup and IBM LTO interoperability

Be sure that NetBackup is supported in your specific environment. You should cross check on both the IBM and NetBackup Web sites to verify this. Look for interoperability on the following Web site:

http://www-304.ibm.com/jct03004c/systems/storage/tape/library.html (public IBM site)

ftp://service.boulder.ibm.com/storage/tape/lto_isv_matrix.pdf (download site)

http://seer.entsupport.symantec.com/docs/278692.htm (for NetBackup 6.0)

http://seer.entsupport.symantec.com/docs/284599.htm (for NetBackup 6.5)

http://ftp.support.veritas.com/pub/support/products/NetBackup_Enterprise_Server/278064.pdf (public Symantec site)

**Note:** You can only use non-rewinding devices with the NetBackup server. If you use a rewinding device, the read/write head is repositioned at the beginning of the volume, and the previously backed-up data is overwritten.

NetBackup supports, as a virtual library, only library types with the "string" TS7510 or TS7530. Both library types TS7510 and TS7530 act like a 3584 library. The function and configuration options of TS7510/TS7530 and 3584 library types are the same. Symantec just wants to distinguish between virtual and physical libraries, therefore they do not support for virtual libraries, the same "string" as for physical libraries. This is the reason why TS7510 or TS7530 as library type must be used in conjunction with NetBackup.

Always use the latest available Device Mappings Package. Download the Device Mappings Package from the Symantec Web site:

http://seer.entsupport.symantec.com/docs/302599.htm (for Windows v1.7)

http://seer.entsupport.symantec.com/docs/302599.htm (for UNIX, Linux v1.7)

Then follow the instructions to apply the new Device Mappings file.

### Check some conditions before a NetBackup installation

NetBackup 6.x fails on AIX running downrev versions of the C++ runtime libraries. NetBackup requires the libraries of above 8.0.0.8 or above 9.0.0.3.

The NetBackup 6.5 release notes mention the requirement for 8.0.0.8 (page 35, footnote 30 and page 73, mentioning required patch APAR IY92889) but do not mention Version 9.0.0.x as the IBM release came after Symantec's. The November 2007 IBM C++ Runtime Environment Components for AIX is also available to download:

http://www.ibm.com/support/docview.wss?rs=2239&uid=swg24017673

See Symantec's knowledge DB 292450 at:

http://seer.entsupport.symantec.com/docs/292450.htm

### Check the device configuration and create a device table

You should already have configured the virtual libraries and tape drives on the TS7530 as described in Chapter 6, "Initial setup" on page 181, and you should have installed and configured the tape drives as described in the *IBM Tape Device Drivers - Installation and User's Guide,* GC27-2130. However, the IBM Device Driver is only necessary for installation on AIX, HP-UX, and Windows. This means that, in our example, actually we would not have had to install the IBM tape device driver. However, on our server, some other testing was ongoing, and therefore the IBM Device Driver was installed in addition.

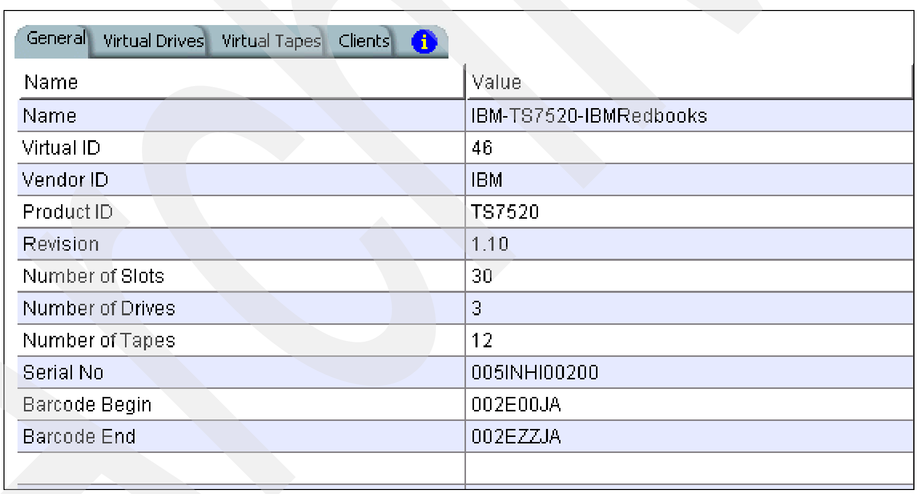
In our first example, we implemented just one virtual library. We created the library as a TS7530 library type with two 3592-J1A tape drives. The library has 30 slots and we created ten 3592 cartridges. In addition, on the Linux server, there are also one physical TS3500 (3584-L22) with two 3592-J1A and one virtual 3584-L22 with two 3592-E05 Tape Drives connected (for other testing purposes).

During the creation of the virtual library we notice the serial number of the library (Figure 10-1) and the drives (Figure 10-3 on page 327 and Figure 10-5 on page 328) Table 10-1. By assigning a SAN Host to the library and drives, we notice the lun number. The serial number and lun number are necessary to distinguish the multiple libraries and drives that are connected to the server.

*Table 10-1 Virtual devices with serial number and lun id*

| | **Serial number** | **lun** |
|---|---|---|
| Library TS7530 | 005INHI002000401 | 0 |
| Drive 1 | 005INHI00201 | 1 |
| Drive 2 | 005INHI00202 | 2 |

Figure 10-1 shows the virtual tape library which we will use for the NetBackup implementation.




| Name | Value |
|---|---|
| Name | IBM-TS7520-IBMRedbooks |
| Virtual ID | 46 |
| Vendor ID | IBM |
| Product ID | TS7520 |
| Revision | 1.10 |
| Number of Slots | 30 |
| Number of Drives | 3 |
| Number of Tapes | 12 |
| Serial No | 005INHI00200 |
| Barcode Begin | 002E00JA |
| Barcode End | 002EZZJA |

*Figure 10-1 Virtual TS7530 Tape Library*

Figure 10-2 shows the Lun ID and some more details about this virtual tape library

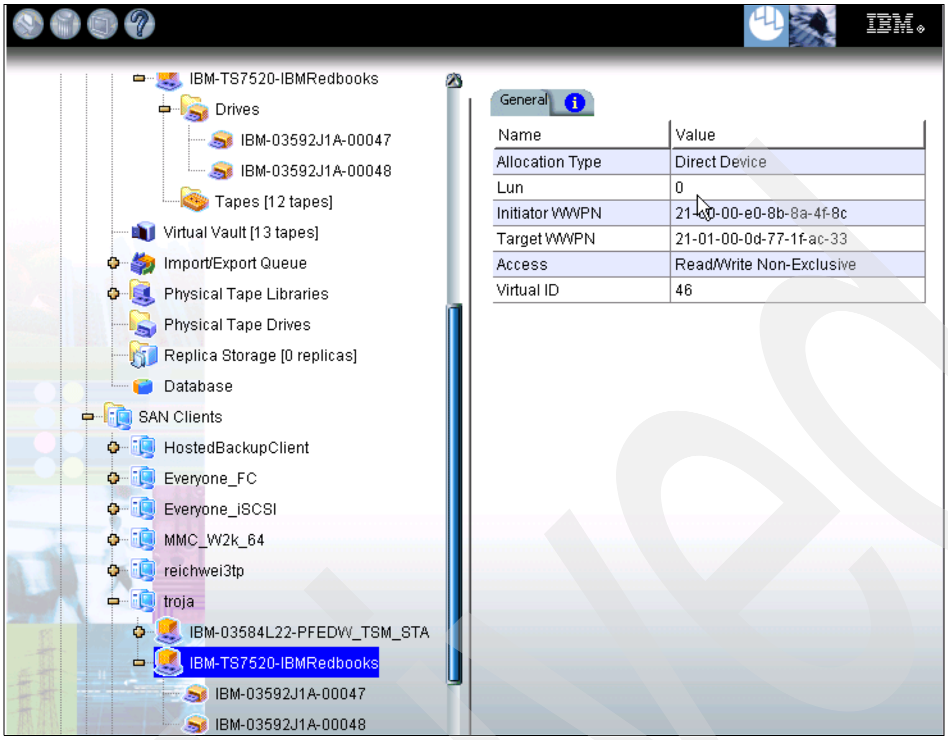



*Figure 10-2 Virtual TS7530 tape library: Lun ID*

Figure 10-3 shows details about the first virtual tape drive.

General | Clients

| Name | Value |
|---|---|
| Name | IBM-ULT3580-TD3-00080 |
| Virtual ID | 80 |
| Vendor ID | IBM |
| Product ID | ULT3580-TD3 |
| Revision | 69U2 |
| Media Type | ULTRIUM3 |
| Element No | 257 |
| Serial No | 1210092710 |
| Status | Empty |
| Compression | Disabled |

*Figure 10-3 First virtual 3592-J1A drive*

Figure 10-4 shows details of the 3592-J1A Lun ID.

| Name | Value |
|---|---|
| Allocation Type | Direct Device |
| Lun | 1 |
| Initiator WWPN | 21-00-00-e0-8b-8a-4f-8c |
| Target WWPN | 21-01-00-0d-77-1f-ac-33 |
| Access | Read/Write Non-Exclusive |
| Virtual ID | 47 |

*Figure 10-4 First virtual 3592-J1A drive: Lun ID*

Figure 10-5 shows details about the second virtual tape drive we will be using in our example.

| Name | Value |
|---|---|
| Name | IBM-ULT3580-TD3-00080 |
| Virtual ID | 80 |
| Vendor ID | IBM |
| Product ID | ULT3580-TD3 |
| Revision | 69U2 |
| Media Type | ULTRIUM3 |
| Element No | 257 |
| Serial No | 1210092710 |
| Status | Empty |
| Compression | Disabled |

*Figure 10-5 Second virtual 3592-J1A drive*

Figure 10-6 shows details of the 3592-J1A Lun ID of the second virtual drive.

| Name | Value |
|---|---|
| Allocation Type | Direct Device |
| Lun | 2 |
| Initiator WWPN | 21-00-00-e0-8b-8a-4f-8c |
| Target WWPN | 21-01-00-0d-77-1f-ac-33 |
| Access | Read/Write Non-Exclusive |
| Virtual ID | 48 |

*Figure 10-6 Second virtual 3592-J1A drive: Lun ID*

**Note:** In a normal customer environment, we would expect to set up more virtual tape drives, more virtual tape cartridges, and possibly also more virtual libraries, because the great advantage of a TS7530 Virtualization Engine is that you can set up virtual drives and libraries to better match your business requirements.

Because Symantec NetBackup on Linux uses the native Linux tape device driver, the IBM Tape tools (tapeutil), which comes with the IBM tape device driver, might be not helpful. Hence we installed *sg_utils*. *sg_utils*, which might be already installed on your system, and you can already use **`sgscan`**. If not, then you can download the package from:

`http://www.torque.net/sg/`

To implement the TS7530:

1. We download the **sg_utils-1.02-1.i386.rpm** packages and install it as shown in Example 10-2.

*Example 10-2 Install sg_utils*

```
root@troja: /home/sepp/sg rpm -ivh sg_utils-1.02-1.i386.rpm
Preparing...                ########################################### [100%]
   1:sg_utils               ########################################### [100%
```

2. After creating the virtual library TS7530 and the two virtual 3592-J1A tape drives, assigning it to the LAN-Host, and zoning the TS7530 to the Linux server, we have to reboot the Linux server to get the device files generated.

3. With **cat /proc/scsi/sg/device_strs**, we list the attached and by the native Linux driver created devices. You see the output in Example 10-3.

*Example 10-3 Devices on our Linux Server*

```
root@troja: ~ cat /proc/scsi/sg/device_strs
IBM-ESXS        MAV2036RC              S113
IBM-ESXS        MAV2036RC              S113
IBM-ESXS        MAV2036RC              S113
IBM             03592J1A               085A
IBM             03584L22               7050
IBM             TS7530                 1.10
IBM             03592J1A               044C
IBM             03592J1A               044C
IBM             03584L22               4.02
IBM             03592E05               F26E
IBM             03592E05               F26E
IBM             03592J1A               0830
```

4. With the output of Example 10-3, currently we cannot distinguish which tape library device file and which tape drive device file belongs to our tape library used with NetBackup. With **sg_scan -i** we get a more detailed view, including device file and lun number, about the device configuration (Example 10-4).

*Example 10-4 sg_scan: i output*

```
root@troja: ~ sg_scan -i
/dev/sg0: scsi0 channel=0 id=128 lun=0  type=0
    IBM-ESXS  MAV2036RC         S113  [wide=0 sync=0 cmdq=1 sftre=0 pq=0x0]
/dev/sg1: scsi0 channel=1 id=128 lun=0  type=0
    IBM-ESXS  MAV2036RC         S113  [wide=0 sync=0 cmdq=1 sftre=0 pq=0x0]
/dev/sg2: scsi0 channel=2 id=128 lun=0  type=0
    IBM-ESXS  MAV2036RC         S113  [wide=0 sync=0 cmdq=1 sftre=0 pq=0x0]
/dev/sg3: scsi2 channel=0 id=2 lun=0  type=1
    IBM       03592E05          1A38  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg4: scsi2 channel=0 id=4 lun=0  type=1
    IBM       03592E05          1A38  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg5: scsi2 channel=0 id=4 lun=1  type=8
    IBM       03584L22          6830  [wide=0 sync=0 cmdq=1 sftre=0 pq=0x0]
/dev/sg6: scsi2 channel=0 id=11 lun=0  type=1
    IBM       03592J1A          085A  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg7: scsi2 channel=0 id=11 lun=1  type=8
    IBM       03584L22          6830  [wide=0 sync=0 cmdq=1 sftre=0 pq=0x0]
/dev/sg8: scsi2 channel=0 id=13 lun=0  type=1
```

```
    IBM      03592J1A         0830  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg9: scsi2 channel=0 id=14 lun=0  type=8
    IBM      TS7530           1.10  [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg10: scsi2 channel=0 id=14 lun=1  type=1
    IBM      03592J1A         044C  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg11: scsi2 channel=0 id=14 lun=2  type=1
    IBM      03592J1A         044C  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg12: scsi2 channel=0 id=14 lun=3  type=8
    IBM      03584L22         4.02  [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg13: scsi2 channel=0 id=14 lun=4  type=1
    IBM      03592E05         F26E  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg14: scsi2 channel=0 id=14 lun=5  type=1
    IBM      03592E05         F26E  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg15: scsi2 channel=0 id=14 lun=6  type=1
    IBM      03592J1A         044C  [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
```

5. With the information from Table 10-1 on page 326 and the output of **sg_scan -i** (see Example 10-4 on page 329) we can figure out that /dev/sg9 is our virtual tape library TS7530. The library is connected to SCSI id 14, therefore our tape drives must be also on SCSI id 14, because the library and drives are assigned over one FC HBA to the server. The */dev/sg10* is our first virtual tape drive (lun = 1) and */dev/sg11* is our second tape drive (lun = 2).
6. Because NetBackup uses on Linux */dev/nst* device files for tape drives, we have to check the corresponding device files. With the **scsi_id** command, we can identify the serial number of the tape drives and the corresponding device number. For /dev/nst4, we can issue the command shown Example 10-5.

*Example 10-5 scsi_id command*

```
>scsi_id -p 0x80 -gs /class/scsi_tape/nst4
SIBM     03592J1A       005INHI00201
```

The *005INHI00201* in the output is the serial number of /dev/nst4.

7. Now we can complete our device table with the device files, as shown in Table 10-2.

*Table 10-2 Device table*

| | Serial number | LUN | Device file |
|---|---|---|---|
| Library TS7530 | 005INHI002000401 | 0 | /dev/sg9 |
| Drive 1 | 005INHI00201 | 1 | /dev/nst4 |
| Drive 2 | 005INHI00202 | 2 | /dev/nst5 |

## Installing ovpass Device Driver on AIX for Library Control Path

NetBackup on AIX uses its owns Device Driver (ovpass) for the library control. Therefore we have to install this driver on the Master/Media Server, which controls the library. We show the installation on an AIX with an IBM System p5® 570 Model 9117-570 with following configuration:

- IBM FC1095 4 Gbit FC HBA
- AIX 5.3

These are the implementation steps:

1. We create one virtual library with the library string TS7530 and two LTO2 tape drives and connect it to the AIX server. We have already installed and configured the tape drives as described in the *IBM Tape Device Drivers - Installation and User's Guide,* GC27-2130.

2. After we run config manager with the command **`cfgmgr`**, the device files for the virtual LTO2 tape drives are available. But there is no device file for the TS7530 library because the IBM device driver creates library device files only for the real tape library string, for example, TS3500/3584, TS3310/3576, and so on. However, the library device file, created from the IBM device driver, is not required with NetBackup. NetBackup on AIX uses the ovpass device driver for the library communication.

3. To install the ovpass driver, enter the command:

   ```
   /usr/openv/volmgr/bin/driver/install_ovpass
   ```

4. To ensure that the driver device files are accessible after a system boot, add the following command to the system startup script; enter:

   ```
   /usr/openv/volmgr/bin/driver/mkdev_ovpass
   ```

5. We have to create the ovpass device file with this command:

   **`mkdev -c media_changer -s fcp -t ovpass -p controller`** `-w scsi_id`**`,`** `lun`

   Where:

   **`controller`** This is the logical identifier (device file name) of the drive's SCSI adaptor, such as scsi0, or fscsi1.

   **`scsi_id`** This is the Fibre Channel identifier for the N_Port address (D_ID) of the robotic connection.

   **`lun`** This is the logical unit number of the robotic connection which is assigned during the assignment of the virtual library to a SAN Host. As you can see in Figure 10-7, our library has the lun 0.

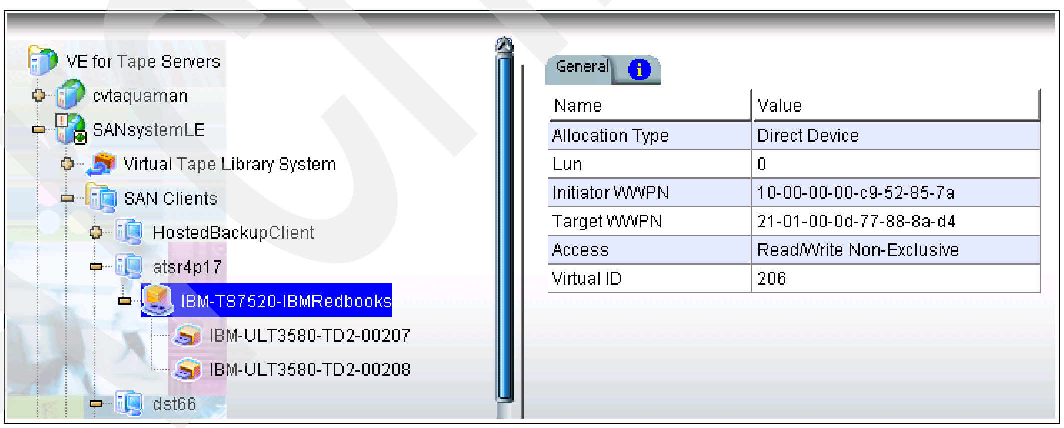



*Figure 10-7 Library assignment*

6. Now, we know the **`lun`**, but we still have to figure out the **`controller`** and the **`scsi_id`**. We start with the **`controller`**. First we display which SCSI controllers are physically available on our machine by using the following command:

   ```
   /usr/sbin/lsdev -C | grep I/O
   ```

Example 10-6 shows the available I/O controller in our system. In our system we just have one FC HBA, therefore we could already stop here and use the device name *fscsi0*. But in a system with more FC HBAs, we do not know to which adapter the library is connected. Therefore we have to do some more displays.

*Example 10-6 I/O adapter in our system*

```
root@atsr4p17:/ > lsdev -C |grep I/O
aio0       Defined            Asynchronous I/O (Legacy)
ent1       Available          Virtual I/O Ethernet Adapter (l-lan)
fscsi0     Available 06-08-02 FC SCSI I/O Controller Protocol Device
posix_aio0 Defined            Posix Asynchronous I/O
vio0       Available          Virtual I/O Bus
```

7. Next we display the tape device files on our system by using the following command:

   **/usr/sbin/lsdev -Cc tape**

   In Example 10-7 we now see all tape drives on our system. In the next step we figure out which tape device files belong to our library.

*Example 10-7 Tape device listing*

```
root@atsr4p17:/ > lsdev -Cc tape
rmt0  Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt1  Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt2  Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt3  Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt4  Available 06-08-02 IBM 3592 Tape Drive (FCP)
rmt5  Available 06-08-02 IBM 3592 Tape Drive (FCP)
rmt6  Available 06-08-02 IBM 3592 Tape Drive (FCP)
rmt7  Available 06-08-02 IBM 3592 Tape Drive (FCP)
rmt8  Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt9  Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt10 Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt11 Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt12 Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt13 Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt14 Available 06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt15 Defined   06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt16 Defined   06-08-02 IBM 3580 Ultrium Tape Drive (FCP)
smc0  Available 06-08-02 IBM 3584 Library Medium Changer (FCP)
smc1  Available 06-08-02 IBM 3584 Library Medium Changer (FCP)
smc2  Defined   06-08-02 IBM 3584 Library Medium Changer (FCP)
smc3  Available 06-08-02 IBM 3584 Library Medium Changer (FCP)
smc4  Available 06-08-02 IBM 3584 Library Medium Changer (FCP)
smc5  Available 06-08-02 IBM 3584 Library Medium Changer (FCP)
smc6  Available 06-08-02 IBM 3573 Tape Medium Changer (FCP)
smc7  Available 06-08-02 IBM 3584 Library Medium Changer (FCP)
smc8  Defined   06-08-02 IBM 3584 Library Medium Changer (FCP)
```

Our two tape drives have the serial numbers 1179414102 and 1179414103, as you can see in Figure 10-8 and Figure 10-9.

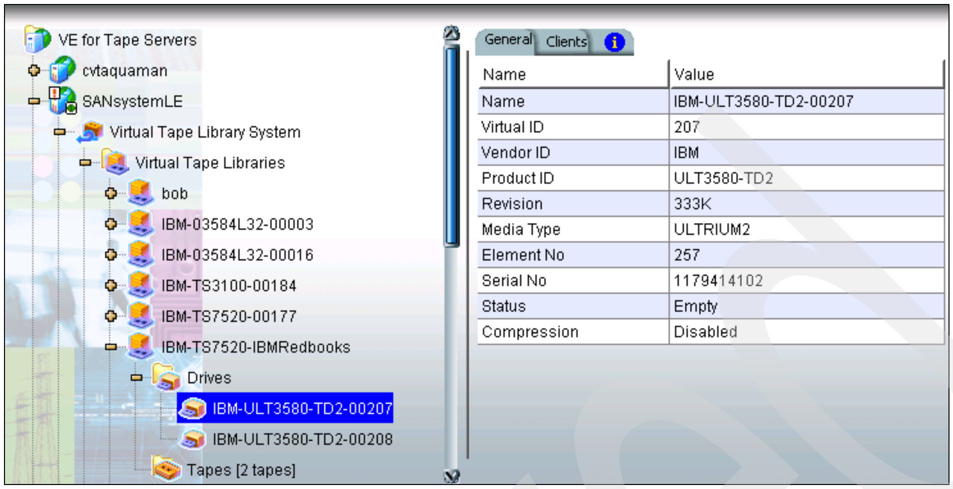



*Figure 10-8 First Tape Drive*

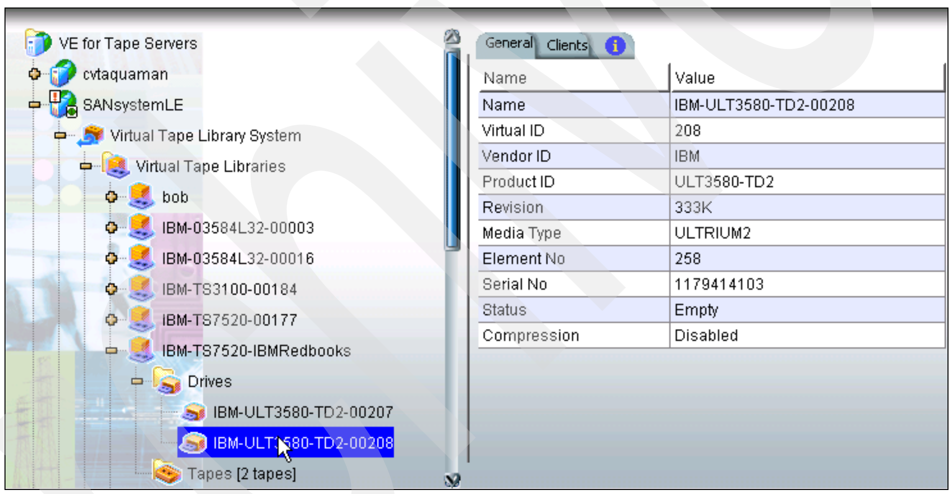



*Figure 10-9 Second Tape Drive*

8. With **`lscfg -vl device_file`** we can display the serial number of the tape drives. As you see in Example 10-8, our tape drives are rmt13 and rmt14.

*Example 10-8 Tape drive serial number*

```
root@atsr4p17:/ > lscfg -vl rmt13
  rmt13            U7311.D11.10A017A-P1-C5-T1-W2101000D77888AD4-L1000000000000
IBM 3580 Ultrium Tape Drive (FCP)

Manufacturer................IBM
        Machine Type and Model......ULT3580-TD2
        Serial Number..............1179414102
        Device Specific.(FW)........333K

root@atsr4p17:/ > lscfg -vl rmt14
  rmt14            U7311.D11.10A017A-P1-C5-T1-W2101000D77888AD4-L2000000000000
IBM 3580 Ultrium Tape Drive (FCP)
```

```
Manufacturer................IBM
Machine Type and Model......ULT3580-TD2
Serial Number...............1179414103
Device Specific.(FW)........333K
```

Because the tape drives and the library are assigned over the same FC HBA we can assume that the tape drive and the library are using the same FC HBA. As you can see in Example 10-7 on page 332 the tape drives rmt13 and rmt14 are connected over the adapter with the location code *06-08-02*. With this location code we can now distinguish on Example 10-6 on page 332 that the library is connected to *fscsi0*.

9. Now we have the *controller* and the *lun*, but we still have to figure out the *scsi_id*. Because the library and the tape drive are connected over the same FC HBA and the several tape drives and library device files are differentiate only on the lun, therefore we can display the *scsi_id* from a tape drive. We use **lsattr -El** as shown in Example 10-9 and found the SCSI ID *0xeb00e8*.

*Example 10-9 SCSI ID*

```
root@atsr4p17:/ > lsattr -El rmt13
alt_pathing    no                 Enable Alternate Pathing Support         True
autoload       no                 Use Autoloading Feature at End-of-Tape   True
block_size     0                  Block Size (0=Variable Length)           True
compress       yes                Use Hardware Compression on Tape         True
debug_trace    no                 Debug Trace Logging Enabled              True
dev_status                        N/A                                      False
devtype        ULT3580-           Device Type                              False
drv_encryption no                 Drive Encryption Support                 False
location                          Location                                 True
logging        no                 Activate volume information logging      True
lun_id         0x1000000000000    Logical Unit Number                      True
max_log_size   500                Maximum size of log file (in # of entries)  True
new_name                          New Logical Name                         True
node_name      0x2001000d77888ad4 World Wide Node Name                     False
primary_device rmt13              Primary Logical Device                   False
retain_reserve no                 Retain Reservation                       False
rew_immediate  no                 Use Immediate Bit in Rewind Commands     True
scsi_id        0xeb00e8           SCSI Target ID                           True
space_mode     SCSI               Backward Space/Forward Space Record Mode True
sys_encryption no                 Use System Encryption FCP Proxy Manager  True
trace_logging  no                 Trace Logging Enabled                    True
trailer_labels no                 Trailer Label Processing                 True
wrt_encryption custom             System Encryption for Write Commands at BOP True
ww_name        0x2101000d77888ad4 World Wide Port Name                     False
```

10. Now we can create the ovpass device file with

**mkdev -c media_changer -s fcp -t ovpass -p controller** -w scsi_id, lun

Where:

| | |
|---|---|
| **controller** | fscsi0 |
| **scsi_id** | 0xeb00e8 |
| **lun** | 0 |

See Example 10-10 for the whole command.

*Example 10-10 Create ovpass device file*

```
root@atsr4p17:/ > mkdev -c media_changer -s fcp -t ovpass -p fscsi0 -w
0xeb00e8,0
ovpass0 Available
```

11. You can display the new device file for the library wit:

    `lsdev | grep ovpass`

    Example 10-11 shows our new created device file ovpass0.

    *Example 10-11 New created ovpass device file*

```
root@atsr4p17:/ > lsdev | grep ovpass
ovpass0    Available 06-08-02 VERITAS Media Changer
```

Use this newly created device file ovpass0 to configure your library in NetBackup as we described in “Implementing TS7530 with NetBackup” on page 335.

### Implementing TS7530 with NetBackup

These are the steps we took to implement the TS7530 with NetBackup:

1. On the NetBackup Administrator Console, we start the Device Configuration Wizard.
2. Next, we select the media server where the library and drives are connected. In our example we just have one Media Server. Our Server is called *troja.mainz.de.ibm.com* and therefore we select this server, as shown in Figure 10-10.

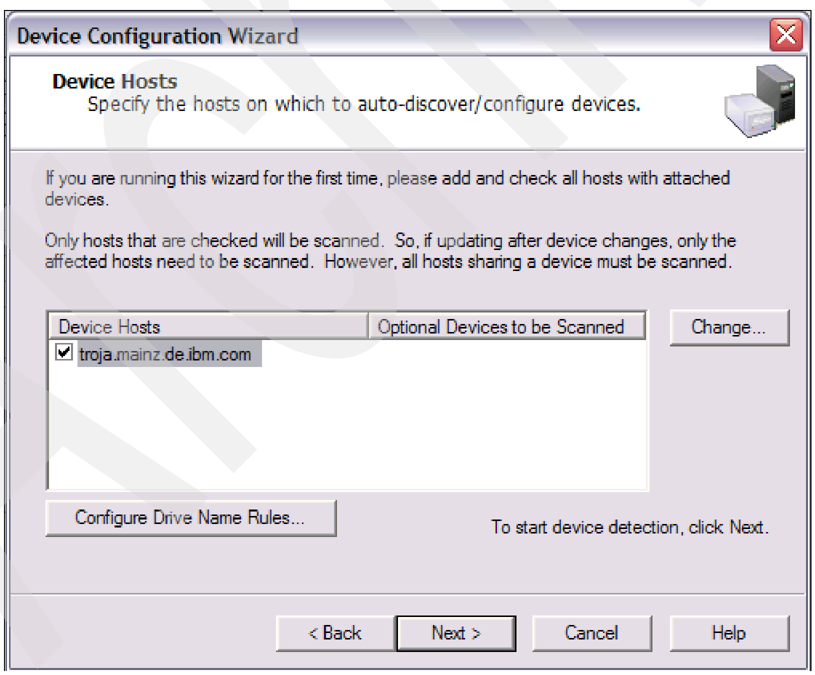



*Figure 10-10 Device configuration: Media Manager selection*

3. After clicking **Next**, the device configuration scans the Media Manager for all tape devices and tries to automatically configure the library with the associated tape drives.

In a simple configuration with just one tape library, this works quite well. However, in our example, where we have several tape libraries connected, we have to check the recommended configuration.

As shown in Figure 10-11, the Device Configuration Wizard would use /dev/sg12 as the device file for the TS7530, but as we know from Example 10-4 on page 329, the device file for the TS7530 library is /dev/sg9. We must change the device files later.

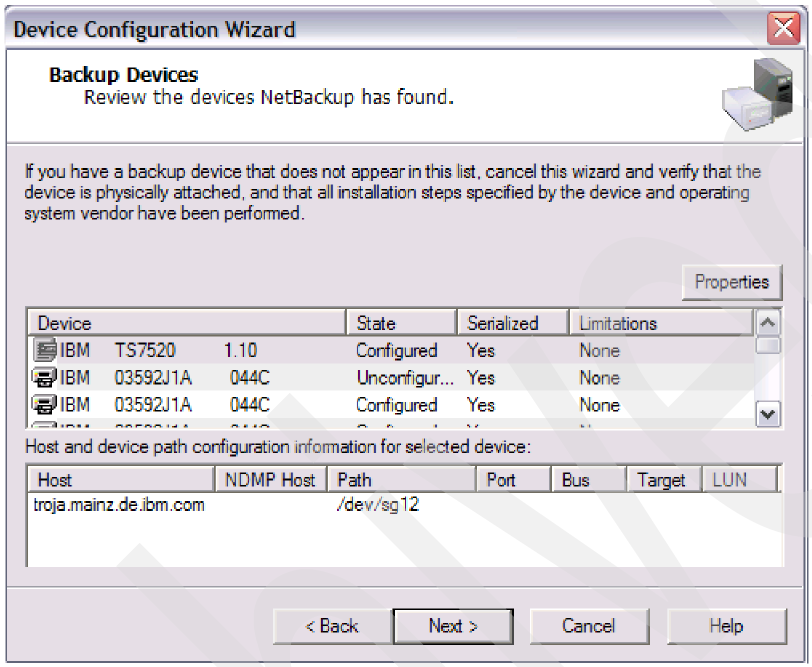



*Figure 10-11 Device configuration*

4. On the next panel we select the TS7530 library only (as shown in Figure 10-12) and submit these changes to the NetBackup database by clicking **Next**.

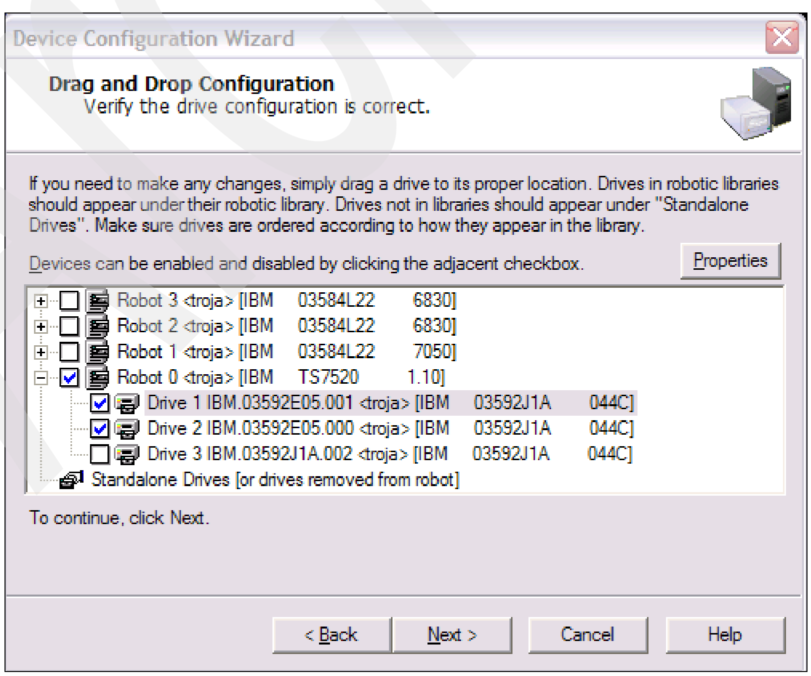



*Figure 10-12 NetBackup device configuration*

5. The next panel (Figure 10-13) gives us the possibility to change the library name. Click the **Properties** button.

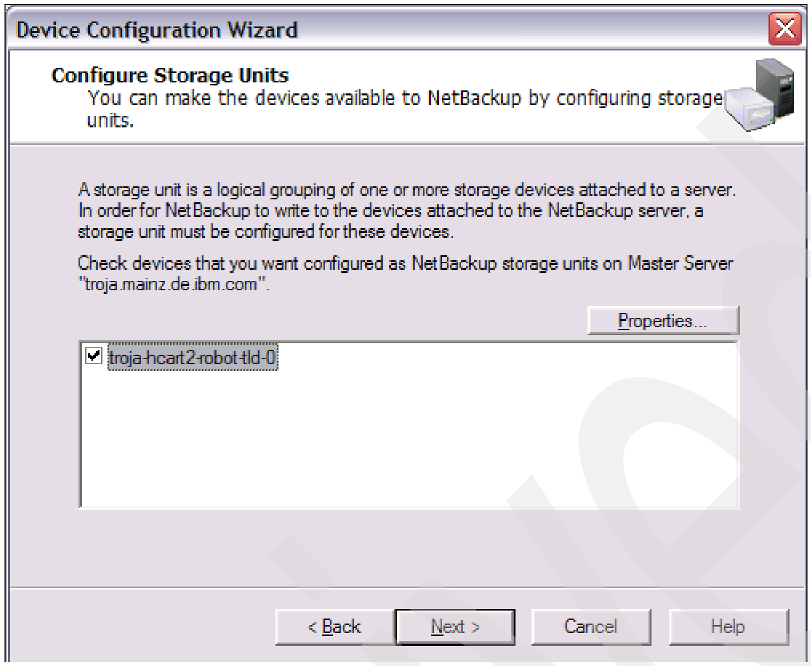



*Figure 10-13 NetBackup device configuration*

6. On the Properties panel (see Figure 10-14) we change the name of library to LibVirtual and keep all other settings unchanged.

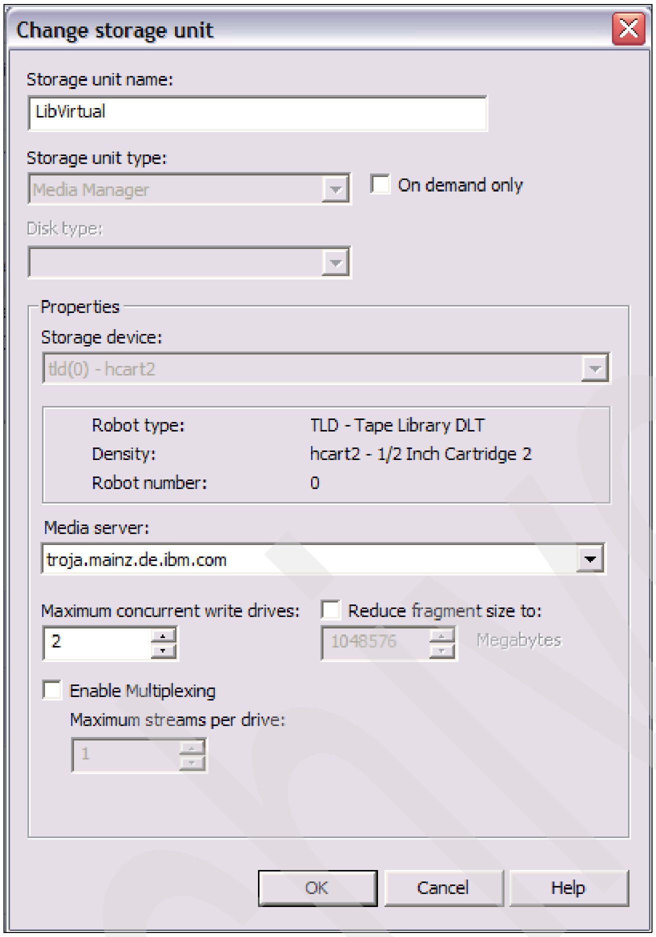



*Figure 10-14 Properties of storage unit*

Now the library and the tape drives are configured in NetBackup, but we still have to change the device paths to the proper ones:

1. First we change the device file of the library. On the NetBackup Administration Console select **Media and Device Management** → **Devices** → **Robots**. Select the library which we have just created and select with right mouse button **Change**.

2. On the *Change Robot* panel (Figure 10-15) we still see the wrong device path. Click **Browse** to change the device file.

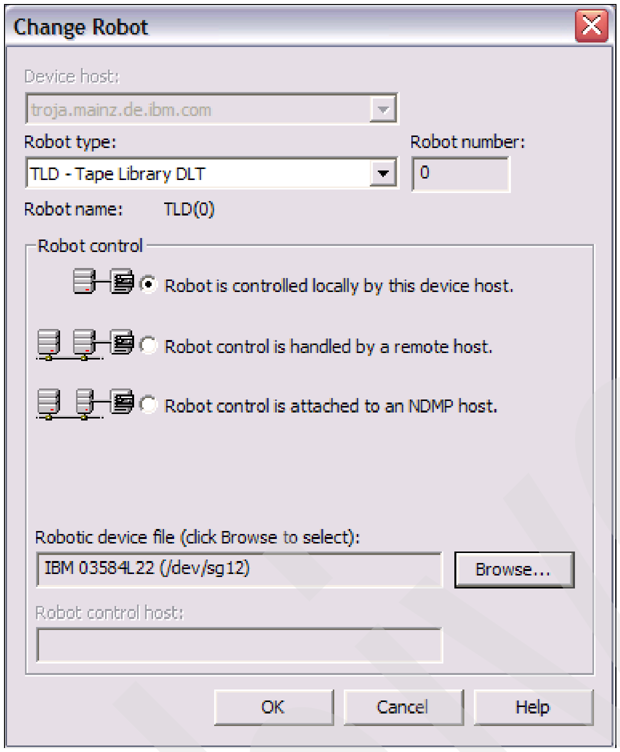



*Figure 10-15 Change Robot device file*

3. On the next panel we select now the proper device file /dev/sg9, as shown in Figure 10-15.

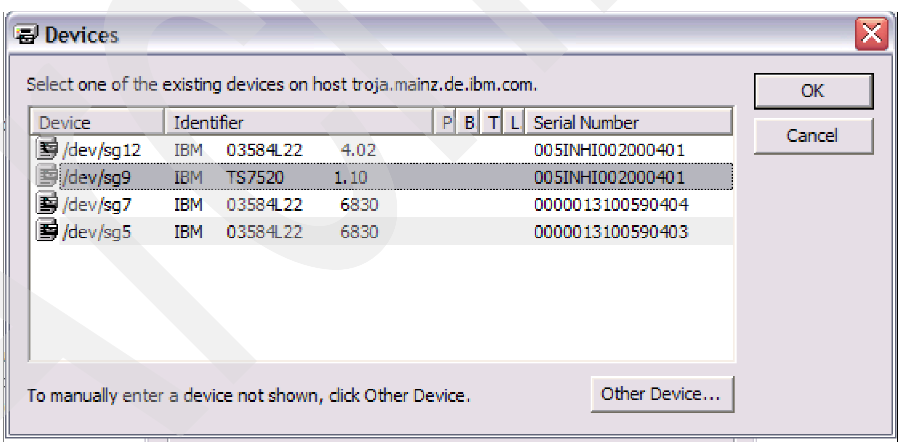



*Figure 10-16 Change device file for the library*

Now we also have to change the device files for our tape drives:

1. On the NetBackup Administration Console select **Media and Device Management** → **Devices** → **Drives**. We select a tape drive where we have to change the device file and select with right mouse button **Change**.
2. On the *Change Tape Drive* panel (seeFigure 10-16 on page 339)we enable only the device path for */dev/nst4*. In addition we change the default *Drive name* to a drive name which fits to our naming convention. We choose for the drive name DrvVirtual_1.

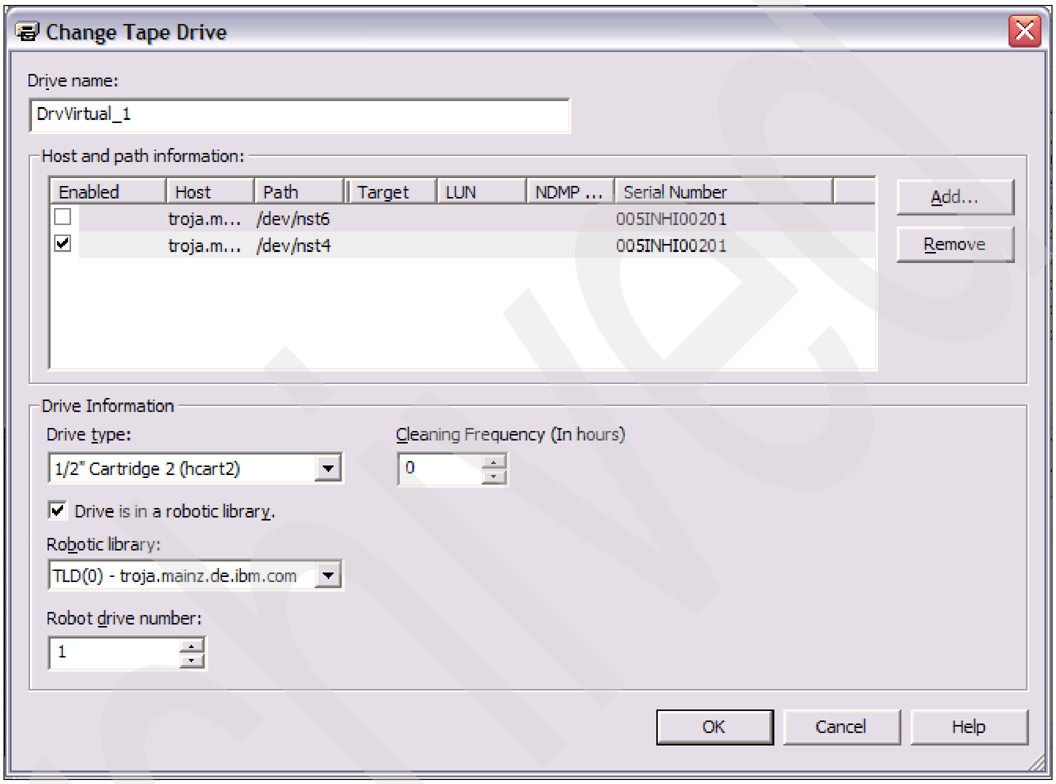



*Figure 10-17 Change device file for drive 1*

3. We change also the device path and the name for our second tape drive, as shown in Figure 10-17 on page 340.

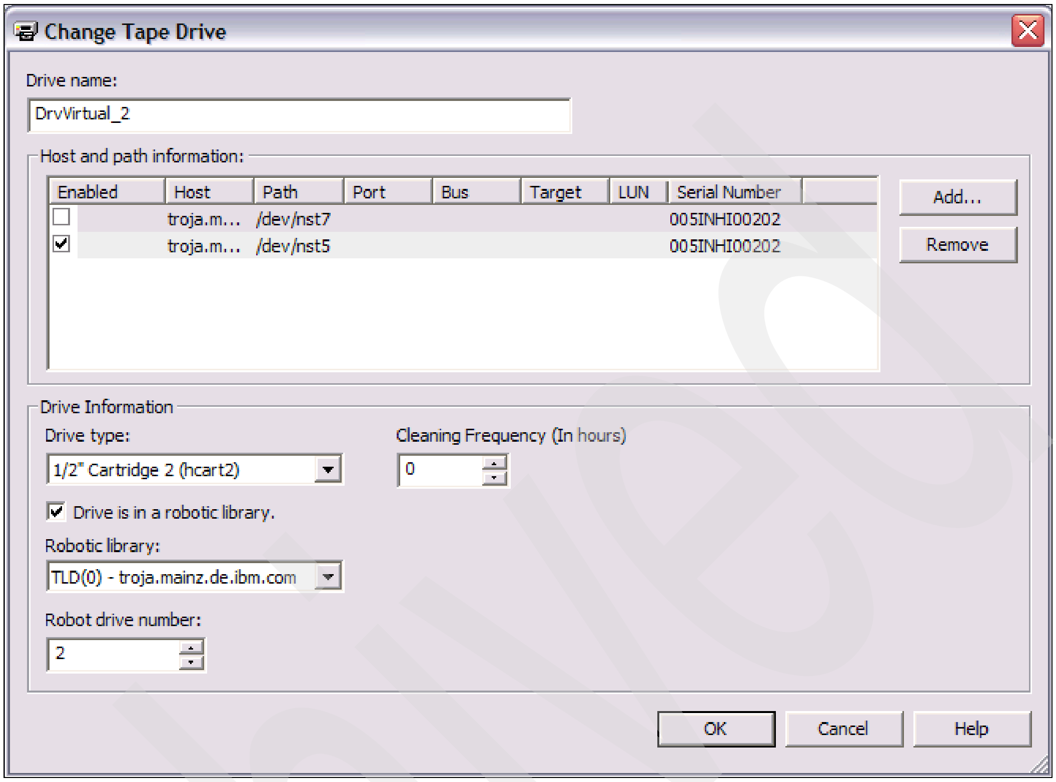



*Figure 10-18 Change device file for drive 2*

4. To activate these changes, we have to restart the device manager service (daemon). NetBackup asks us automatically (Figure 10-17 on page 340) after we submit the changes on the *Change Tape Drive* panel by clicking **OK**.

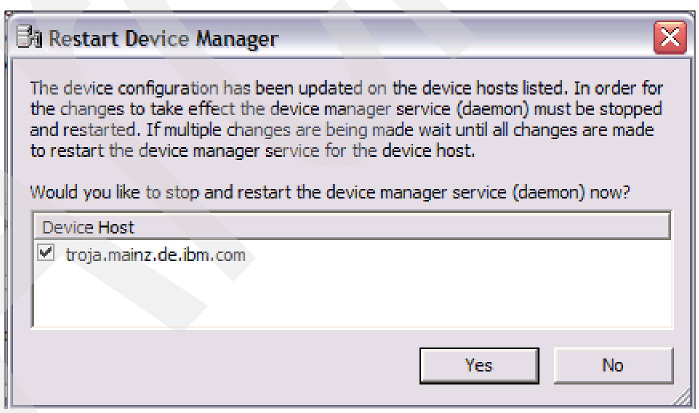



*Figure 10-19 Restart the Device Manager*

Now we have completed setup of the library and the drives and we are ready to work with them. But before we can make any backups to the library, we have to inventory and make the cartridges available for NetBackup.

## Inventory Library

To inventory the library, take the following steps:

1. On the NetBackup Administration Console, select **Media and Device Management** → **Devices** → **Robots**. Select the library and right-click it and select **Inventory Robot**.
2. Depending on the barcode label of the virtual library, you have to set up a media ID rule. NetBackup works only with 6 characters of the barcode. If you use only virtual tapes on the TS7530 without using Enhanced Tape Caching, you can set up barcode labels for the virtual volumes with only six characters. Then you do not have to set up a media ID rule.

   In our example, we choose to generate virtual volumes with 8 characters. In addition, we have enabled Enhanced Tape Caching, and therefore the cartridges with Enhanced Tape Caching enabled have always a barcode length of 8.

   To set up a media ID rule, click **Advanced Options** and on the Advance Options windows, select the **Media ID Generation** tab and create a new Media ID rule. We create a new media ID rule for our library Robot number 0, where we have cartridges with a barcode length of 8, and we want to use the first 6 characters. Therefore our new Media ID rule is:

   ```
   1:2:3:4:5:6
   ```

   This is shown in Figure 10-20.

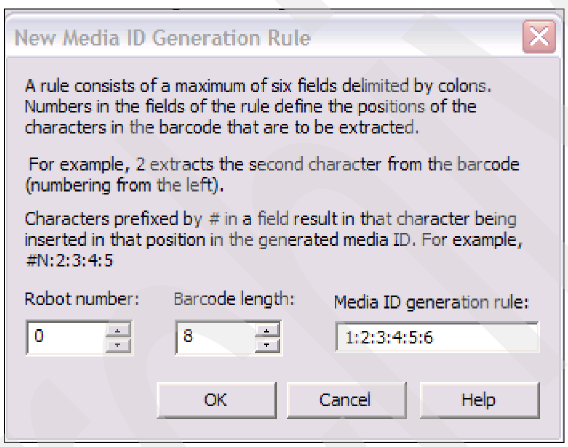



*Figure 10-20 Generate a new media ID rule*

3. Now we can start the inventory of the library by clicking the **Start** button. To accept this inventory, we select **Update volume configuration** under the Inventory operation pane and click the **Yes** button, as shown in Figure 10-21.

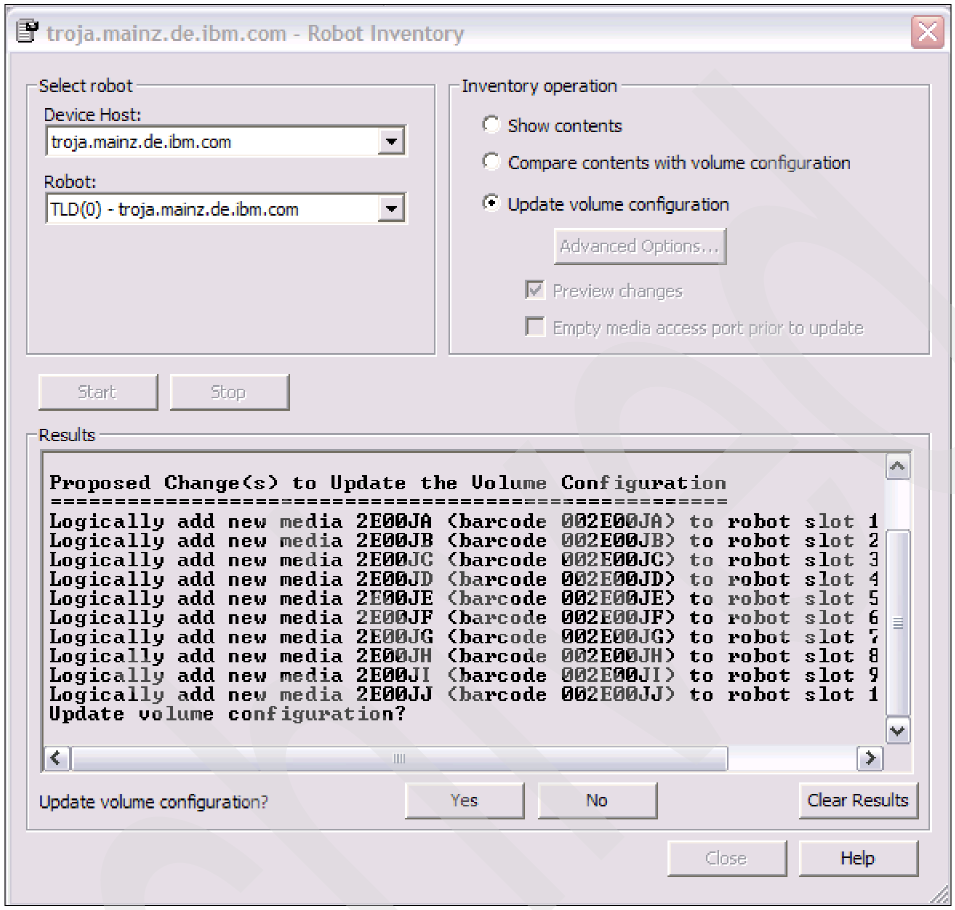



*Figure 10-21 Inventory robot*

Now we are ready to work with our library and configure Media Pools and Backup rules. But these are normal NetBackup operations and are common for all tape libraries no matter whether the library is physical or virtual. Therefore, we do not cover this topic in this IBM Redbooks pubication.

## 10.2 Using TS7530 with EMC NetWorker

EMC NetWorker, formerly EMC NetWorker, is a centralized, automated backup and recovery product for heterogeneous enterprise data. The NetWorker Server runs on all major operating systems, such as on AIX, Linux, Windows, SUN Solaris and HP-UX.

Also the NetWorker Storage Node, which is a kind of LAN-free Client with proxy node capability, runs on all major operating systems. The proxy node capability of the Storage Node can receive data from other NetWorker clients over the LAN and store the data directly to the storage device. Only the meta-data will be handled by the NetWorker Server.

The NetWorker Client sends the backup data either to the NetWorker Server or to a NetWorker Storage Node. There are different Clients available for the integration in special application, like NetWorker for IBM DB2®.

A NetWorker Domain consists of one NetWorker Server, several NetWorker Clients, and also, several NetWorker Storage Nodes can exist in one NetWorker Domain. There is no data exchange or storage resource sharing outside one NetWorker Domain. In addition, if tape drives must be shared between one or more Storage Nodes and the NetWorker Server, then additional licenses might be required. Therefore, the TS7530 might be a great solution for sharing physical tape resources.

## 10.2.1 General TS7530 implementation considerations

The following list summarizes some important implementation considerations:

- On Solaris, use either the IBMtape driver or the native st driver.
- For Solaris 10, the NetWorker internal device driver is not supported, and the NetWorker software will use the native Solaris device drivers of sgen, st, and fp.

  Example 10-12 shows necessary entries for selected IBM tape drives for the st.conf. Copy the necessary entries for the tape drives which you want to emulate on the TS750 into the existing st.conf on your system. Use either entries without timeout values (1) or with timeout values. We recommend using them with timeout values.

  *Example 10-12 st.conf for Solaris 9, 10, and some Solaris 8 operating system*

```
tape-config-list=
   "IBM     ULT3580-TD2",  "IBM 3580 Ultrium-2",           "CLASS_LTO2",
   "IBM     ULT3580-TD3",  "IBM 3580 Ultrium-3",           "CLASS_LTO3",
   "IBM     ULT3580-TD4",  "IBM 3580 Ultrium-4",           "CLASS_LTO4";
   "IBM     03592J1A",     "IBM 3592J",                    "CLASS_3592J",
   "IBM     03592E05",     "IBM 3592E",                    "CLASS_3592E",

# use for Solaris 9, 10 and some Solaris 8 operating system (ST_BUFFERED_WRITES is
obsolete)
   # (1) without timeout values
   # CLASS_3592J      =       1,0x24,0,0x45963d,2,0x00,0x51,1;
   # CLASS_3592E      =       1,0x24,0,0x45963d,3,0x00,0x51,0x52,2;
   # CLASS_LTO2       =       1,0x3B,0,0x45963d,2,0x40,0x42,1;
   # CLASS_LTO3       =       1,0x3B,0,0x45963d,3,0x40,0x42,0x44,2;
   # CLASS_LTO4       =       1,0x3B,0,0x45963d,3,0x42,0x44,0x46,2;

   # (2) with the timeout values
# CLASS_3592J=2,0x24,0,0x45963d,2,0x00,0x51,1,30,0,480,840,720,660,9060;
# CLASS_3592E=2,0x24,0,0x45963d,3,0x00,0x51,0x52,2,30,0,480,840,720,660,9060;
# CLASS_LTO2=2,0x3B,0,0x45963d,2,0x40,0x42,1,60,0,540,9060,720,720,9060;
# CLASS_LTO3=2,0x3B,0,0x45963d,3,0x40,0x42,0x44,2,60,1080,540,9900,720,720,9600;
# CLASS_LTO4=2,0x3B,0,0x45963d,3,0x42,0x44,0x46,2,60,1080,540,10980,540,780,10800;
```

- On the HP-UX platform, use the native tape device driver.
- On Linux, use the native “st” driver only.
- On Windows and AIX, use the IBMtape device driver only.
- Tapes must be non-rewinding, and the pathnames must follow the BSD semantics. For AIX this means that the path name must be */dev/rmtx.1* or */dev/rmtx.5*.
- In NetWorker 7.3 you should use the Administration Interface to set device parameters.
- IBM tape libraries using the IBM tape device driver must be configured using the **jbconfig** command. The NetWorker device autodetection will use the NetWorker internal driver, thus jbconfig must be used.

### 10.2.2 Implementing TS7530 with EMC NetWorker

We give you an example on AIX showing how to implement TS7530 in an EMC NetWorker v7.3/v7.4 environment. The implementation is pretty much the same of all supported operating systems. We are using the following environment:

- IBM 7025 RS/6000 Model F80
  - IBM FC6228 2 Gbit FC HBA
  - AIX 5.3
  - IBM tape device driver 10.5.2.0
- EMC NetWorker 7.3.2.Build.364 Eval

However, we will also give you information regarding cases where the installations differ on different operating systems.

#### Implementation steps

Here is an overview of the different implementations steps:

1. Check the interoperability.
2. Do the basic setup of the TS7530 as described in Chapter 6, "Initial setup" on page 181.
3. Install the device driver as described in the *IBM Tape Device Drivers - Installation and User's Guide,* GC27-2130.
4. Check the device configuration and create a device table.
5. Implement the devices in EMC NetWorker.
6. Perform additional setup and labeling.

For a detailed explanation of the NetWorker installation process for the IBM AIX platform, refer to the *EMC NetWorker v7.4 Installation Guide - Multi Platform Version*. For up-to-date documentation, we recommend that you log in with your EMC user ID at this Web site:

https://powerlink.emc.com/nsepn/webapps/btg548664833igtcuup4826/kmlogin/login.jsp?CTAuthMode=BASIC

#### NetWorker and IBM TS7530 interoperability

Be sure that NetWorker and TS7530 are supported in your specific environment. You should cross-check on both the IBM and NetWorker Web sites to verify this. Look for interoperability:

http://www-03.ibm.com/systems/storage/tape/ts7530/index.html
http://software.emc.com/products/product_family/networker_family.htm

For a detailed tape hardware compatibility guide, logon to the EMC Powerlink Support at:

http://powerlink.emc.com/

Then select **Products** → **Software** → **NetWorker** and search for Compatibility Guides.

> **Note:** You can only use non-rewinding devices with the NetWorker server. If you use a rewinding device, the read/write head is repositioned at the beginning of the volume, and the previously backed-up data is overwritten.

### Prepare to install the NetWorker software

Because the NetWorker installation process modifies several of the configuration files, be sure to make and retain a copy of the current configuration as follows:

```
/etc/inittab
/etc/rc.nsr
/etc/rpc
/etc/syslog.conf
```

If you want to change the default location for NetWorker configuration files, create another directory as follows:

```
For example, in the case of /nsr
mkdir /disk2/nsr
ln -s /disk2/nsr /nsr
```

Ensure that you have enough space in the /usr/bin for the NetWorker binaries.

If more space is required and you have enough unallocated disk space, use the AIX installp utility to allocate more space to the /usr/bin.

> **Important:** The AIX installp utility does not enable you to change the default installation location of packages. NetWorker binaries are installed to the /usr/bin.

### Check the device configuration and create a device table

You should already have configured the virtual libraries and tape drives on the TS7530 as described in Chapter 6, “Initial setup” on page 181, and you should have installed and configured the tape drives as described in the *IBM Tape Device Drivers - Installation and User’s Guide,* GC27-2130.

In our first example we want to implement just one virtual library:

1. We created the library as a 3584-L32 library with two LTO3 tape drives. The library has 32 slots and we created 10 LTO3 cartridges. In addition, on the AIX server there is already a TS3400 (3577) with one TS1120 (3592) and a TS3100 (3573) with one LTO4 drive connected. We have already installed the IBM tape device driver, and we just issued **cfgmgr**. An output of **lsdev -Cc tape** shows the tape configuration, as you can see in Example 10-13.

*Example 10-13 lsdev output*

```
dst66> lsdev -Cc tape
rmt0 Available 14-08-02 IBM 3592 Tape Drive (FCP)
rmt1 Available 34-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt2 Available 34-08-02 IBM 3580 Ultrium Tape Drive (FCP)
rmt3 Available 34-08-02 IBM 3580 Ultrium Tape Drive (FCP)
smc0 Available 14-08-02 IBM 3577 Library Medium Changer (FCP)
smc1 Available 34-08-02 IBM 3573 Tape Medium Changer (FCP)
smc2 Available 34-08-02 IBM 3584 Library Medium Changer (FCP)
```

2. We check now with **inquire** if NetWorker can see the library and the tape drives. The inquire output (see Example 10-14) lists all available devices that NetWorker discovered. This includes tape and disk devices.

*Example 10-14 inquire*

```
dst66> inquire
scsidev@3.8.0:IBM     DPSS-309170M    5339|Disk, /dev/rhdisk0
scsidev@3.9.0:IBM     DPSS-309170M    5339|Disk, /dev/rhdisk1
scsidev@3.15.0:IBM     HSBP06E RSU2SCSIB019|(Unknown Device Type d)
scsidev@4.1.0:IBM     CDRM00203           |CD-ROM, /dev/rcd0
scsidev@6.1.0:IBM     03592E05        1B16|Tape, /dev/rmt0.1
                                           S/N: 000001365258
                                           ATNN=IBM     03592E05
000001365258
                                           WWNN=5003013D38357010
                                           WWPN=5003013D38357012
                                           PORT=00000002
scsidev@6.1.1:IBM     3577-TL         0009|Autochanger (Jukebox), /dev/smc0
                                           S/N: 0000013F00721003
                                           ATNN=IBM     3577-TL
0000013F00721003
scsidev@7.1.0:IBM     ULT3580-TD4     73FA|Tape, /dev/rmt1.1
                                           S/N: 1300000978
                                           ATNN=IBM     ULT3580-TD4
1300000978
                                           WWNN=2001000E11105B14
                                           WWPN=2002000E11105B14
                                           PORT=00000001
scsidev@7.1.1:IBM     3573-TL         3.03|Autochanger (Jukebox), /dev/smc1
                                           S/N: 00X2U78B0215_LL0
                                           ATNN=IBM     3573-TL
00X2U78B0215_LL0
scsidev@7.2.0:IBM     ULT3580-TD3     69U2|Tape, /dev/rmt2.1
                                           S/N: 1210092710
                                           ATNN=IBM     ULT3580-TD3
1210092710
                                           WWNN=2000000D77885ED4
                                           WWPN=2000000D77C85ED4
                                           PORT=00000001
scsidev@7.2.1:IBM     03584L32        4.02|Autochanger (Jukebox), /dev/smc2
                                           S/N: 0000013999000401
                                           ATNN=IBM     03584L32
0000013999000401
scsidev@7.2.2:IBM     ULT3580-TD3     69U2|Tape, /dev/rmt3.1
                                           S/N: 1178273749
                                           ATNN=IBM     ULT3580-TD3
1178273749
                                           WWNN=2000000D77885ED4
                                           WWPN=2000000D77C85ED4
                                           PORT=00000001
```

3. With a device table, as described in the *IBM Tape Device Drivers - Installation and User's Guide,* GC27-2130, we can easily sort out our tape devices and the correct order of the devices. Our library has serial number 13999000 (Figure 10-22); the first drive with element address 257 has serial number 1210092710 (Figure 10-23) and the second drive with element address 258 has serial number 1178273749 (Figure 10-24 on page 349).

General | Virtual Drives | Virtual Tapes | Clients

| Name | Value |
|---|---|
| Name | IBM-03584L32-IBM Redbooks_NW |
| Virtual ID | 79 |
| Vendor ID | IBM |
| Product ID | 03584L32 |
| Revision | 4.02.03 |
| Number of Slots | 32 |
| Number of Drives | 2 |
| Number of Tapes | 10 |
| Serial No | 000001399900 |
| Barcode Prefix Begin | 004F00 |
| Barcode Prefix End | 004FZZ |
| | |
| Tape Capacity On Demand | Yes |
| Initial Allocation Size (MB) | 5.120 |
| Increment Size (MB) | 7.168 |
| Maximum Capacity (MB) | 12.288 |
| Export Physical Copy | Disabled |
| Export Network Copy | Disabled |
| Automated Tape Caching | Disabled |
| Media Type | ULTRIUM3 |

*Figure 10-22 VE Console panel which shows the serial number of the library*

General | Clients

| Name | Value |
|---|---|
| Name | IBM-ULT3580-TD3-00080 |
| Virtual ID | 80 |
| Vendor ID | IBM |
| Product ID | ULT3580-TD3 |
| Revision | 69U2 |
| Media Type | ULTRIUM3 |
| Element No | 257 |
| Serial No | 1210092710 |
| Status | Empty |
| Compression | Disabled |

*Figure 10-23 VE Console panel which shows the serial number of drive 1*

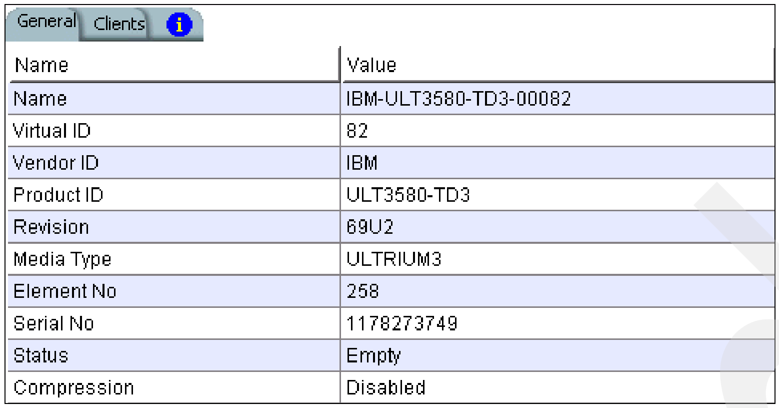

| Name | Value |
|---|---|
| Name | IBM-ULT3580-TD3-00082 |
| Virtual ID | 82 |
| Vendor ID | IBM |
| Product ID | ULT3580-TD3 |
| Revision | 69U2 |
| Media Type | ULTRIUM3 |
| Element No | 258 |
| Serial No | 1178273749 |
| Status | Empty |
| Compression | Disabled |

*Figure 10-24 VE Console panel which shows the serial number of drive 2*

4. With this information, we have created a device table as shown in Table 10-3.

*Table 10-3 Device Table*

| device file | serial number | element number | drive name |
|---|---|---|---|
| /dev/rmt2.1 | 1210092710 | 257 | DrvVirtual_1 |
| /dev/rmt3.1 | 1178273749 | 258 | DrvVirtual_2 |

Tapes must be non-rewinding, and the pathnames must follow the BSD semantics. For AIX, this means that the path name must be */dev/rmtx.1*.

## Implementing TS7530 with NetWorker

We have to use **jbconfig** to configure the library and the tape drives. You can see the jbconfig output in Example 10-15:

1. As library type we choose **2.) Autodetect SCSI Jukebox**.
2. Then NetWorker searches for available autochangers. In our case it detects three libraries.
3. We choose number **3)** as this is our virtual 3584-L32 library, which we can also see in the inquire output (see Example 10-14 on page 347).
4. Because the 3584-L32 library was detected during inquire as *scsidev@7.2.1.,* we name this library *LibVirtual_1.*
5. We turn off autoclean. Notice that **jbconfig** has detected the drives automatically, therefore no further action during **jbconfig** is required.

*Example 10-15 Configure library and drives with jbconfig*

```
dst66> jbconfig

Jbconfig is running on host dst66.storage.tucson.ibm.com (AIX 5.3),
  and is using dst66.storage.tucson.ibm.com as the NetWorker server.

         1) Configure an AlphaStor Library.
         2) Configure an Autodetected SCSI Jukebox.
         3) Configure an Autodetected NDMP SCSI Jukebox.
         4) Configure an SJI Jukebox.
         5) Configure an STL Silo.

What kind of Jukebox are you configuring? [1] 2
```

```
Scanning SCSI buses; this may take a while ...
These are the SCSI Jukeboxes currently attached to your system:
  1) scsidev@6.1.1: Standard SCSI Jukebox, IBM / 3577-TL
  2) scsidev@7.1.1: Standard SCSI Jukebox, IBM / 3573-TL
  3) scsidev@7.2.1: Standard SCSI Jukebox, IBM / 03584L32
Which one do you want to install? 3
Installing 'Standard SCSI Jukebox' jukebox - scsidev@7.2.1.

What name do you want to assign to this jukebox device? LibVirtual_1
Attempting to detect serial numbers on the jukebox and drives ...

Will try to use SCSI information returned by jukebox to configure drives.

Turn NetWorker auto-cleaning on (yes / no) [yes]? no

The following drive(s) can be auto-configured in this jukebox:
 1> LTO Ultrium-3 @ 7.2.0 ==> /dev/rmt2.1
 2> LTO Ultrium-3 @ 7.2.2 ==> /dev/rmt3.1
These are all the drives that this jukebox has reported.

To change the drive model(s) or configure them as shared or NDMP drives,
 you need to bypass auto-configure. Bypass auto-configure? (yes / no) [no] no


Jukebox has been added successfully

The following configuration options have been set:

> Jukebox description to the control port and model.
> Autochanger control port to the port at which we found it.
> Autocleaning off.
> Barcode reading to on.
> Volume labels that match the barcodes.

You can review and change the characteristics of the autochanger and its
        associated devices using the NetWorker Management Console.

Would you like to configure another jukebox? (yes/no) [no]no
```

## Additional setup steps and tape labeling

On the NetWorker Management Console (Figure 10-25) we can now see the library, the drives, and the tape cartridges, and we can define some more settings and configurations.

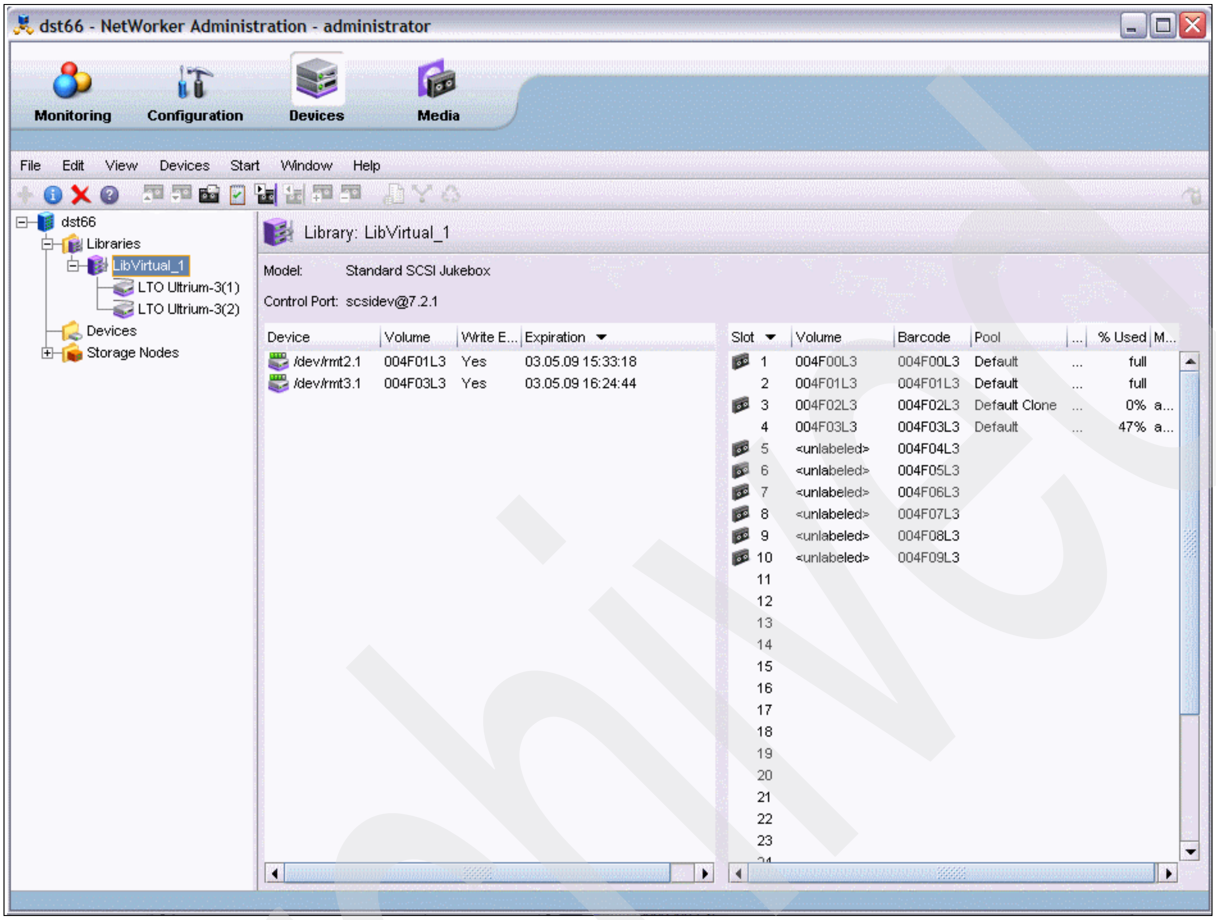


*Figure 10-25 EMC NetWorker Management Console shows the configured tape library*

Either we have to label the cartridges manually or we must enable auto media management. Auto media management will automatically label cartridges if the cartridges are mounted the first time and NetWorker cannot read any NetWorker label. To enable auto media management, right-click the library and select **Properties**. Go to the **Configuration** tab and enable **Auto media management**, as shown in Figure 10-26.

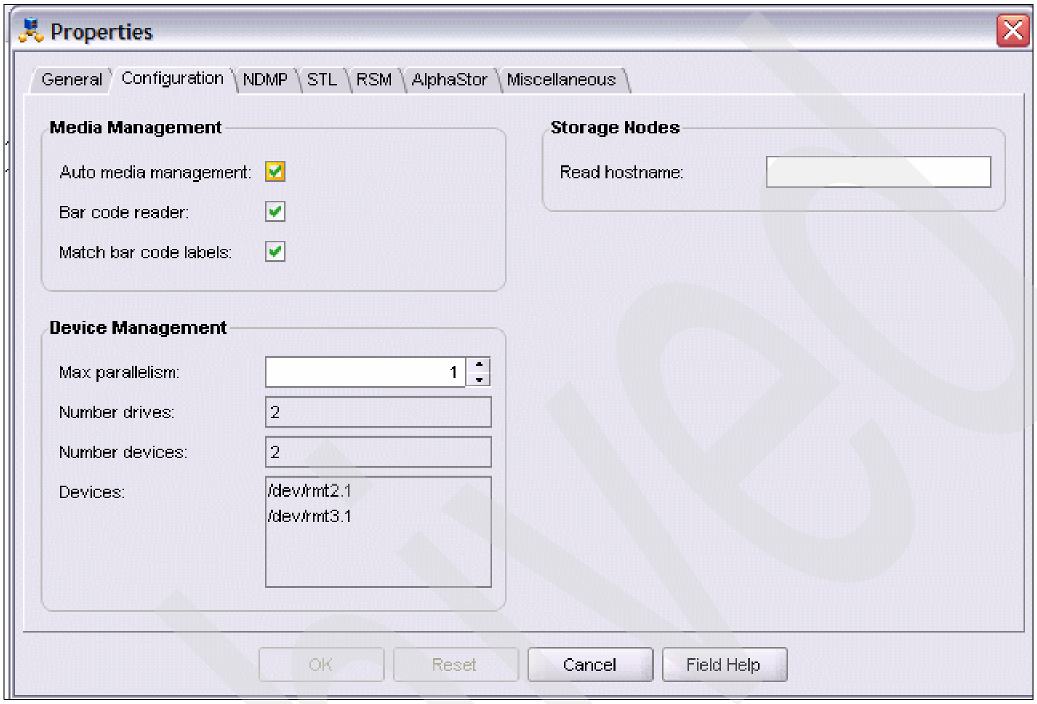



*Figure 10-26 Library configuration: set auto media management*

You can increase or decrease the **Max parallelism** value for the library, if you want. The default value is always one number less than the amount of available drives in the library. The default value reserve has at least one drive for restore purpose.

Next we verify the library timeout values. For this, we have to enable the diagnostic mode. Click **View** → **Diagnostic Mode** → on the NetWorker Management Console. After that, open the library properties again by right-clicking the library and selecting **Properties**. On the **Timer** tab, you can change the timer values, as shown in Figure 10-27 on page 353.

Here is an explanation of the different timers:

**Load sleep**
Define the number of seconds for a jukebox to sleep after a load operation.

**Unload sleep**
Define the number of seconds for a jukebox to sleep before attempting to unload a given cartridge.

**Eject sleep**
Define the number of seconds for a jukebox to sleep after an eject operation.

**Deposit timeout**
Define the number of seconds for a jukebox to wait for a slot to be deposited in the mail slot before it times out.

**Withdraw timeout**
Define the number of seconds for a jukebox to wait for a slot to be withdrawn to a mail slot before it times out.

**Cleaning delay**
Define the number of seconds for a jukebox to sleep before attempting to unload a cleaning cartridge.

**Idle device timeout** The number of minutes before an idle device is unmounted. This attribute only applies to SmartMedia, Silo, and shared native jukeboxes with device sharing enabled. A value of zero disables this feature, volumes will not be unmounted from idle devices.

**Port polling period** Define the number of seconds for a jukebox to wait before polling a mail slot to check for updated status.

**Operation lifespan** Minimum length of time (in seconds) that Operation Status resources are kept after the operations are complete.

**Operation timeout** Length of time (in seconds) after which a jukebox operation is automatically cancelled.

In our example (Figure 10-27) we have not enabled the tape automated caching function, therefore we can leave the default values for:

- Load sleep = 5 sec
- Unload sleep = 5 sec
- Eject sleep = 5 sec

For Enhanced Tape Caching enabled, we would increase these values to at least:

- Load sleep = 30sec
- Unload sleep = 60sec
- Eject sleep = 30sec

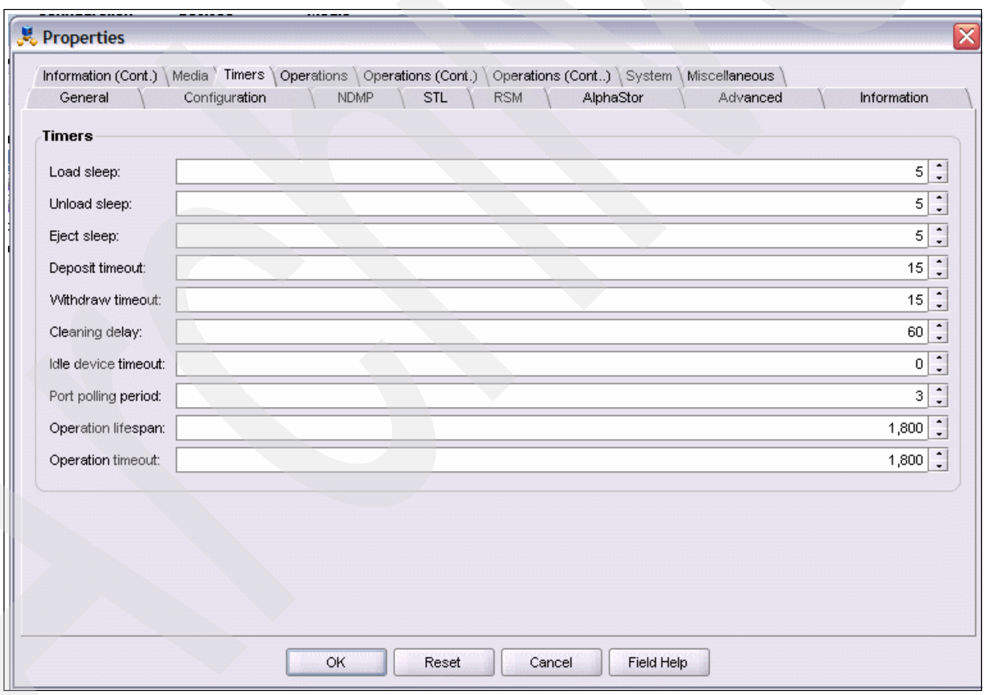



*Figure 10-27 Library timer*

You are now ready to use this virtual library in your NetWorker environment.

# 11

# Reporting and monitoring

In this chapter we describe the different options for reporting and monitoring of the TS7530 Virtualization Engine. If needed we refer to differences compared with the TS7520 Virtualization Engine. We discuss these topics:

- Reporting
  - Type of reports
  - Creation of reports
  - Showing of reports
- Monitoring
  - SMTP
  - SNMP
  - Event log
- Service tasks
  - Diagnostic data summary collection
  - Test storage throughput
  - E-mail notification
  - Assist On-site

For more information also see the *IBM Virtualization Engine TS7500 Users Guide Version 3, Release 1,* GC27-2179.

## 11.1 Reporting

The IBM Virtualization Engine for Tape Console has the ability to generate a series of reports that all depend on the options that are installed on the unit.

### 11.1.1 Types of reports

The following list covers the wide variety of reports that are available for the TS730. The same reports were also available with earlier versions of the TS7500 Virtualization Engine.

**Server throughput** The server throughput report displays the overall throughput of the IBM Virtualization Engine TS75320 Model CV7 server or servers.

**SCSI/FC throughput** The SCSI/Fibre Channel throughput report shows the data that goes through fibre adapter on the IBM Virtualization Engine TS7530 Model CV7 servers.

**SCSI device throughput** The SCSI device throughput report shows the utilization of the physically attached fibre storage.

**Physical resources configuration**
The physical resources configuration report lists all of the physical resources on IBM Virtualization Engine TS7530 Model CV7 servers, including each physical adapter and physical device.

**Disk space usage** The VE for Tape Disk Space usage report shows the amount of disk space that is used by each fiber adapter including LUNs that are not virtualized.

**Physical resources allocation**
The physical resources allocation report shows the disk space usage and layout for all the physical resources. Physical resources are all of your SCSI adapters, Fibre Channel (FC) host bus adapters (HBAs), and storage devices. Storage devices include hard disks, tape drives, and tape libraries. Hard disks are used for creating virtual tape libraries or drives and virtual tapes.

**Physical resource allocation**
The physical resource allocation report shows the disk space usage and layout for a specific physical device.

**FC adapters configuration** The Fibre Channel adapters configuration report shows worldwide port names (WWPNs) and port information for each Fibre Channel adapter. It is also useful for matching WWPNs with server clients.

**Replication status** The replication status report displays information about all successful replication activity. It also provides a centralized view for displaying real-time replication status for all drives enabled for replication. The report can be generated for the source server or target server, for all specific resources, and for date ranges.

**Virtual library information** The virtual library information report shows information about each tape being emulated, including the number of drives, tapes, and slots.

**Virtual tape information** The virtual tape information report shows information about each virtual tape, including the barcodes, size, and virtual tape location.

**Shared virtual tape** This report lists all the virtual tapes that have been shared out to other servers in the same group. It is only available for multi-node groups.

**Borrowed virtual tape** This report lists all the virtual tapes that are being used by this server but are owned by another server in the same group. It is only available for multi-node groups.

**Job report** The job report lists each import and export job that has been run during the specified time frame, including the job type, status, and start and end time.

## 11.1.2 Creating reports

It is important to monitor the status of the TS7530 system. The steps to create reports are straightforward and can be easily duplicated for each report type:

1. Use the VE for Tape Console by right-clicking **Reports** and then selecting **New** as shown in Figure 11-1.

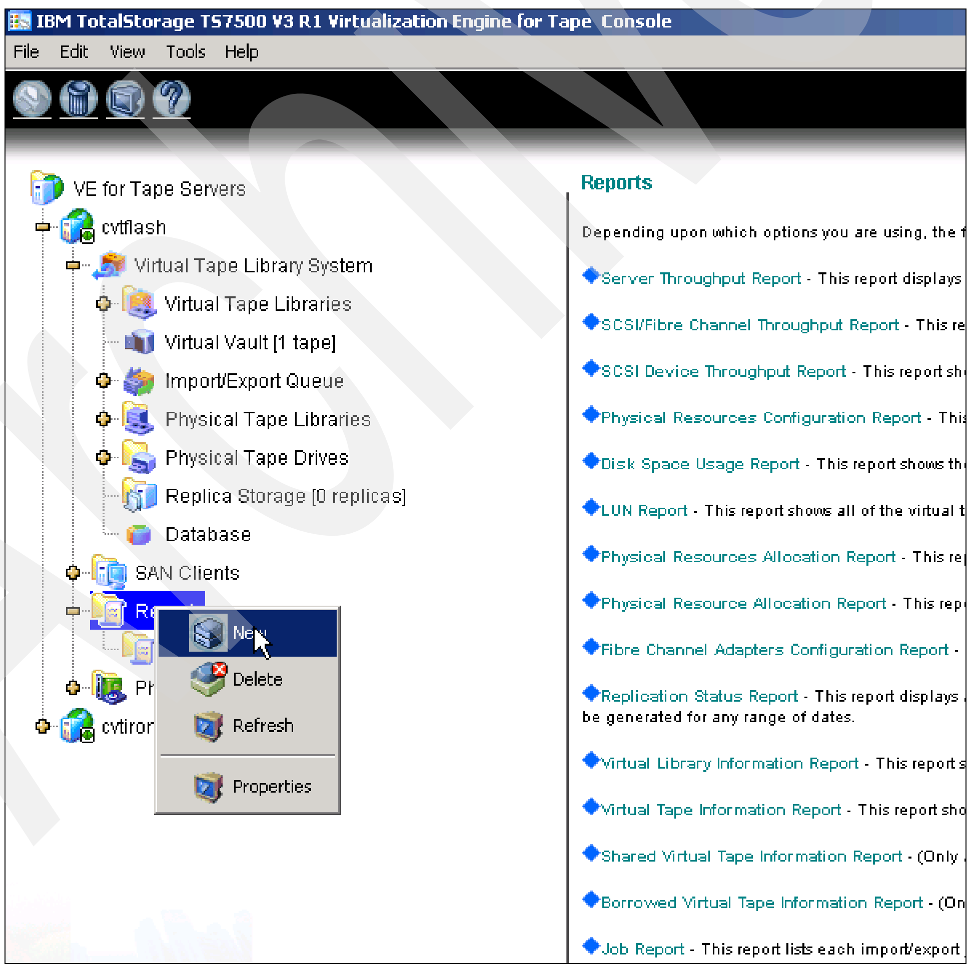



*Figure 11-1 Create report*

2. You will now see a list of all the reports you are able to generate (Figure 11-2). Select the report type you wish to view and click **Next**.

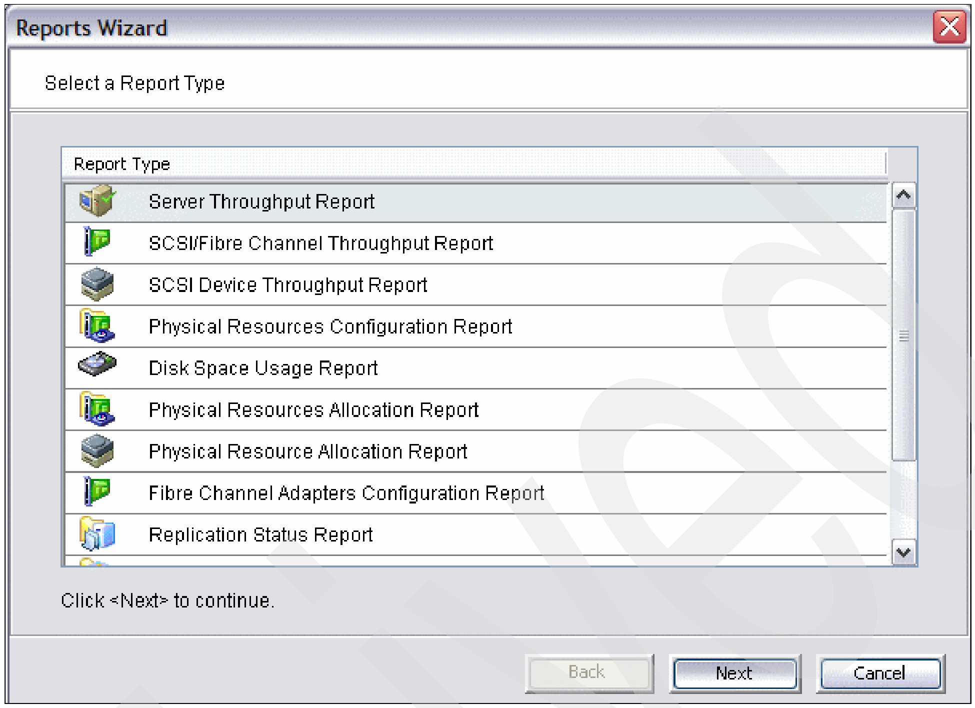



*Figure 11-2 Report selection list*

3. Next you have to select the time period you wish to gather. There are several options to choose from to fit your requirements. Select the appropriate options in the window shown in Figure 11-3 on page 359 and click **Next**.

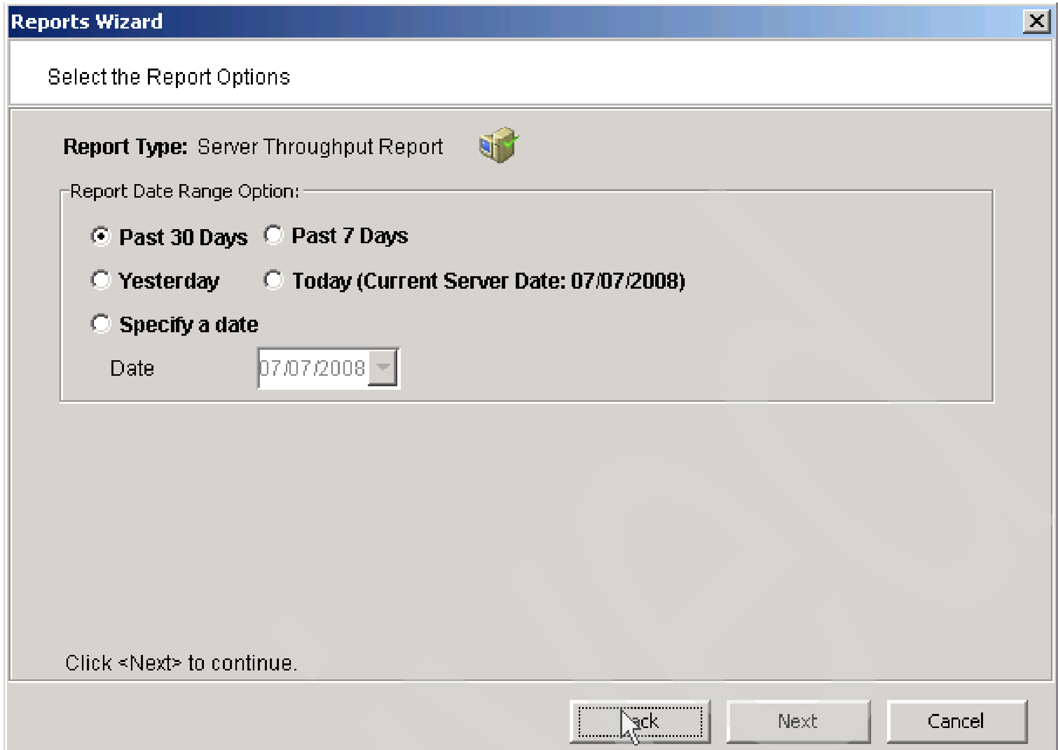



*Figure 11-3 Report data range options*

4. Now you are provided with a panel (Figure 11-4) that shows the report you have chosen and gives you the opportunity to name the report.

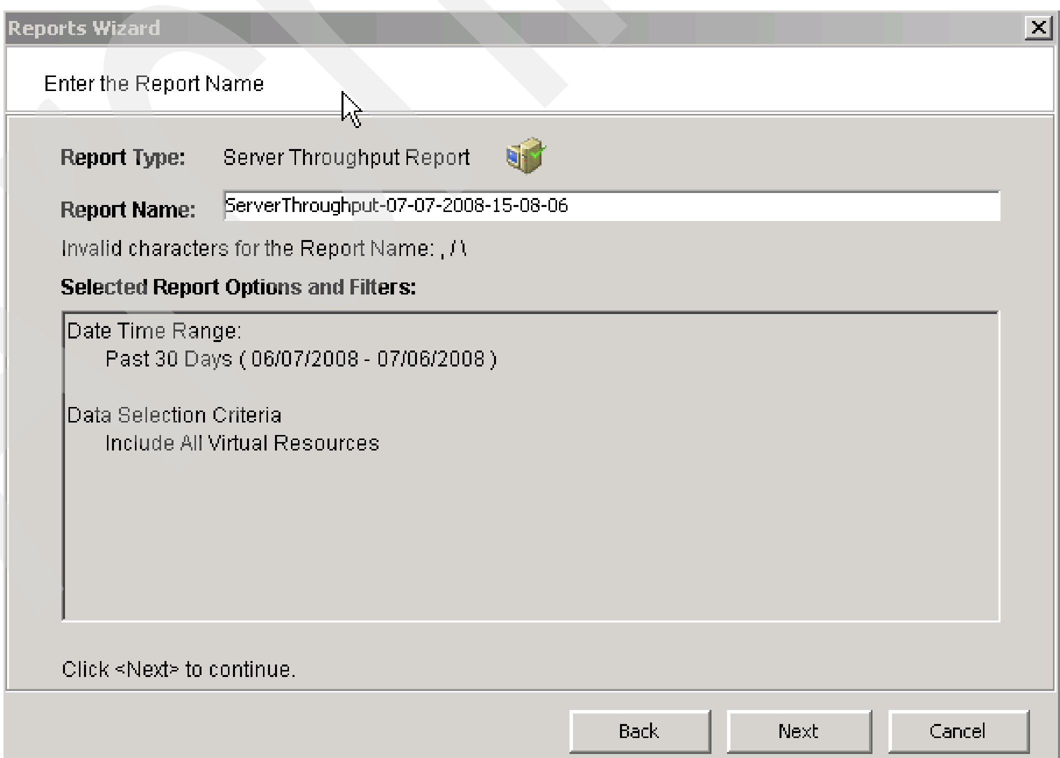



*Figure 11-4 Naming the report*

The report has now been created and will be located under the Reports section in the TS7530 VE for Tape Console.

## 11.1.3 Viewing a report

To view a report, select **Reports** from the VE for Tape Console. This will show a list of all reports that have been generated on the system (Figure 11-5). Double-clicking the report will open it in the VE for Tape Console.

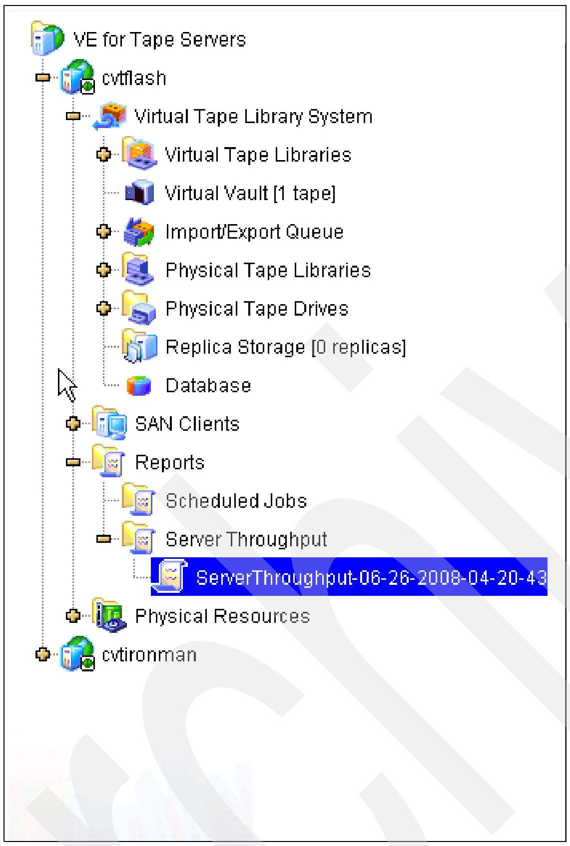



*Figure 11-5 Select reports*

Figure 11-6 shows an example of a server throughput report. With page forward and backward it is possible to get more text-based information.

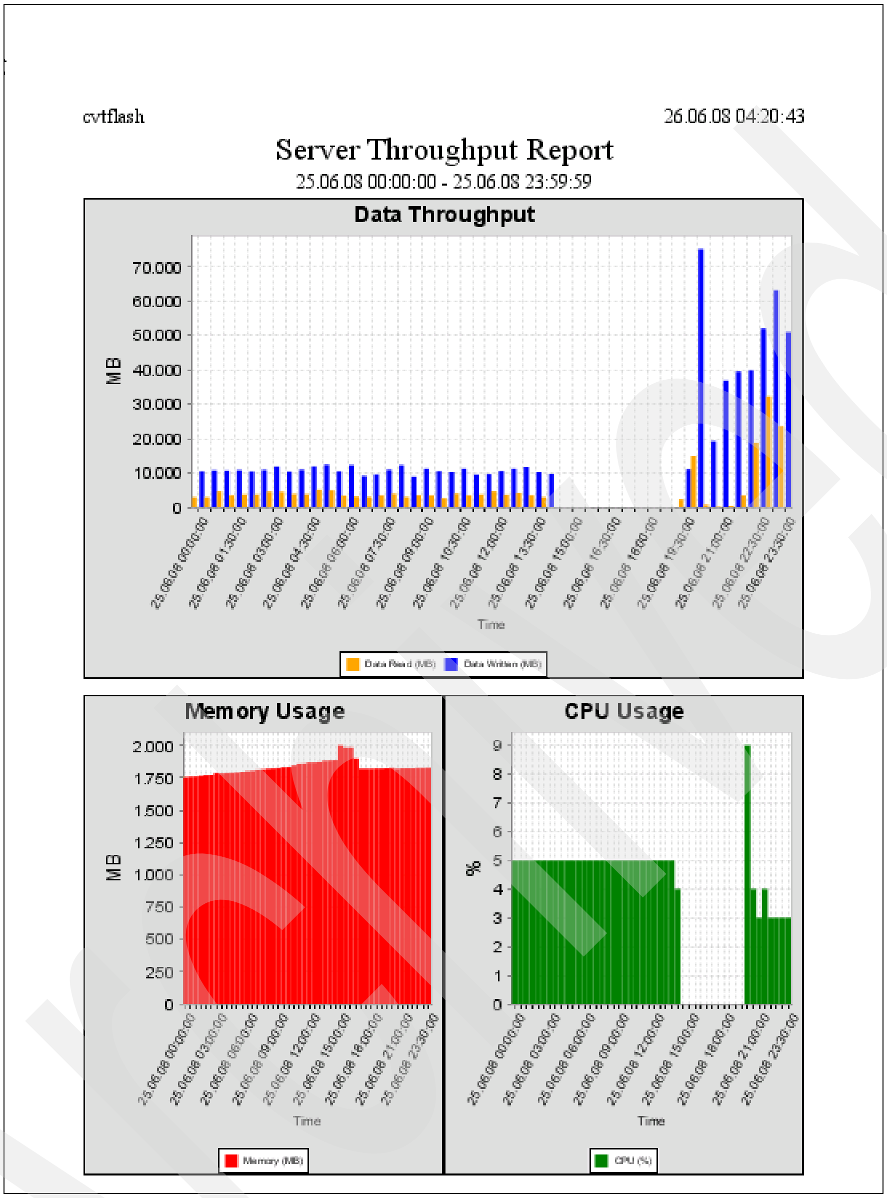



Figure 11-6 Throughput report example

As shown in Figure 11-7, by right-clicking you also have the ability to print, export, or mail the report file for use in the application of your choice.

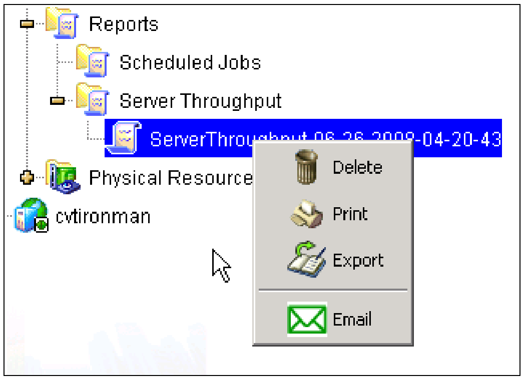



*Figure 11-7 Options for created report*

# 11.2 Monitoring

IBM Virtualization Engine TS7530 uses Simple Mail Transfer Protocol (SMTP) to perform its proactive monitoring of tasks and functions. You can monitor the logs manually by using the *event log*. In this section we describe the different monitoring processes and explain how to configure proactive monitoring.

## 11.2.1 Simple Mail Transfer Protocol

SMTP is a protocol for sending e-mail messages between servers. Most e-mail systems that send mail over the Internet use SMTP to send messages from one server to another. The messages can then be retrieved with an e-mail client using either Post Office Protocol (POP) or Internet Message Access Protocol (IMAP).

In addition, SMTP is generally used to send messages from a mail client to a mail server. This is why you need to specify both the POP, or IMAP, server and the SMTP server when you configure your e-mail client applications.

## 11.2.2 SNMP configuration

The TS7530 Virtualization Engine provides the ability to send Simple Network Management Protocol traps to existing enterprise-level SNMP management appliances like IBM Tivoli NetView® in the case of certain events or errors.

To set up SNMP traps:

1. Right-click **<your TS7530 server>** and select **Properties**.
2. Select the **SNMP Maintenance** and you will see the window shown in Figure 11-8.

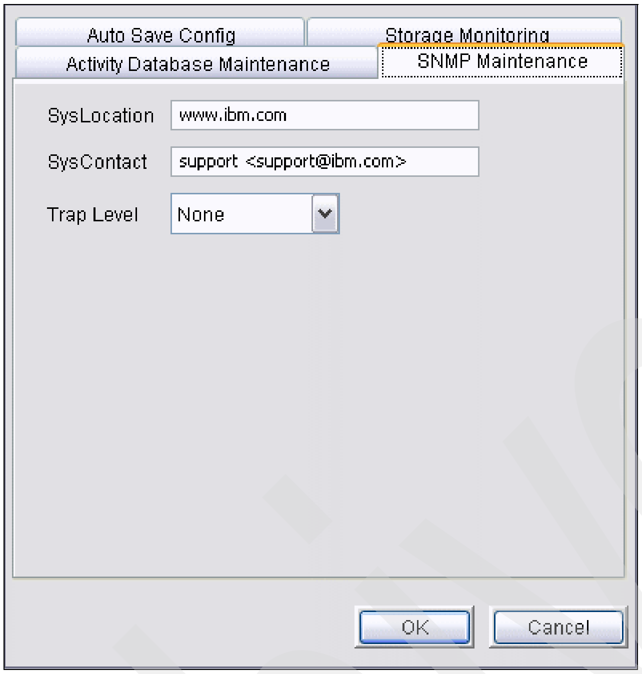



*Figure 11-8 SNMP Maintenance*

The fields on this panel are:

**SysLocation** This directive is used to define the location of the host on which the SNMP agent is running.

**SysContact** This directive is used to define the system contact address.

**Trap Level** This directive sets at what level of internal error you want to be notified via the SNMP traps. Set this to an appropriate level.

3. Fill in the fields SysLocation and SysContact and select the trap level. As shown in Figure 11-9, you can select between the different levels.

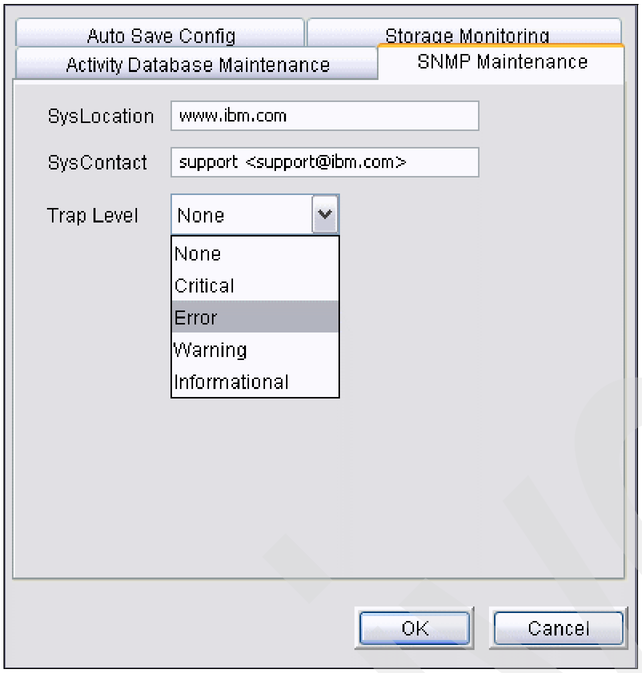



*Figure 11-9 SNMP traps*

The different trap levels are:

**None** No traps will be sent.

**Critical** This level includes errors that are so serious that the systems may be prevented from performing normal operations.

**Error** This level is used when an operation has failed. Error and critical events will be trapped.

**Warning** This level indicates an event where corrective action needs to be taken or maintenance is required. Warning, error, and critical events will be trapped.

**Informational** This is a basic operational notification.

> **Note:** Selecting **Informational** will automatically include all warning, error, and critical events.

SNMP MIB files are available on the Base Firmware Update disk. The system administrator who manages the SNMP server must compile these MIB files based on the SNMP server software being used.

## 11.2.3 Event log monitoring

As an administrator for the system it is import for you to monitor the statistics of the system. The event log is the tool used to monitor this status. You can easily access it by using the TS7530 VE for Tape Console and selecting **<your TS7530 server>**. On in the right panel (Figure 11-10) you see a set of tabs. Select the event log tab to see the live event log.


*Figure 11-10 Event log tab*

Sometimes you will find it necessary to manipulate the event log. Use the **Filter button** above the Event Log table.

> **Note:** With VE for Tape Console *V2,* you can find the filter option by right-clicking the created server and then selecting **Event Log**.

### Filters

It is sometimes necessary, when the event log gets large, to filter for certain errors only. This can be done by applying a filter for the event types that you want to see in the panel shown in Figure 11-11.

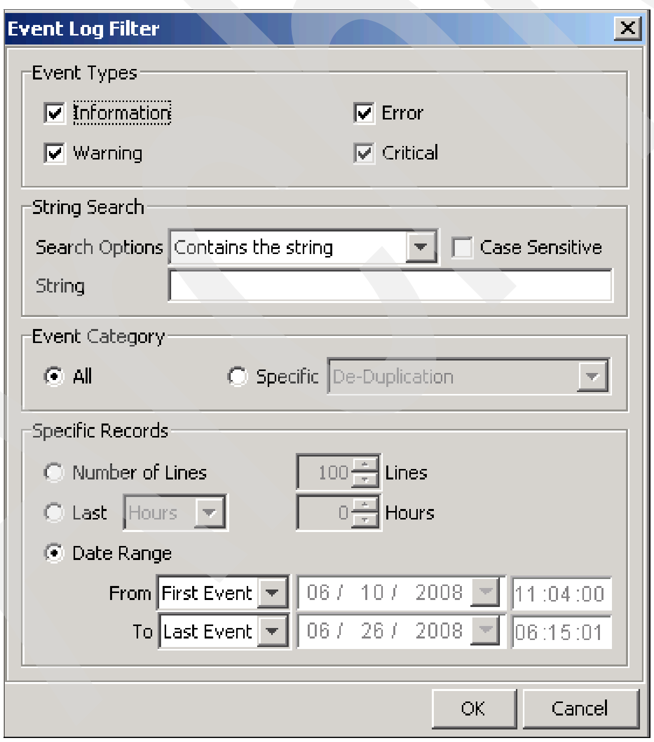



*Figure 11-11 Event log options*

You can choose the type of events that you wish to see:

**Informational** This event type is reserved for events that do not require intervention.

**Warning** This event type is reserved for events that may require user intervention or at least user observation.

**Error** This event type is reserved for errors that need user intervention immediately.

**Critical** This event type is reserved for errors that are found to have the TS7530 in a degraded state and need user intervention immediately.

When filtering is selected the default date range is the entire log. As a user you have the ability to restrict what appears in the panel. This filter will survive over time and will need to be set back to default or you will only see errors in the range that you have specified. This survives a system reboot and disconnection and reconnection to the VE for Tape Console. This will only be for your connection to the VE for Tape Console. It is important that you reset your filter, as you may miss events that do not meet your filter criteria.

### Export

Under the Event log panel you have also an option to export your event log. If you have applied a filter, this will be applied to the exported data as well. Your only choice when exporting data is to export as a comma-delimited or tab-delimited file.

### Print

Under the Event log panel you can select to print the event log. Print is the same as export in the respect that the filter is applied and sent immediately to your default printer.

### Purge

There is also a button for the Purge option. This will delete the contents of the event log. It gives you the opportunity to export prior to purging the event log. This is desirable after a serious problem has been resolved, allowing you to view a substantially smaller event log. We always recommend that an export is taken prior to purging the event log.

# 11.3 Additional information

In this section we summarize other information that can be obtained from the VE Console.

## 11.3.1 Diagnostic summary data collection

Diagnostic summary data should be gathered prior to opening a technical call. The support engineer is able to take this data and will have a comprehensive snapshot of your environment, making problem resolution and root cause analysis much more rapid.

This information is nothing more than what can be observed through the VE Console:

**System information** This option provides information about the firmware code levels that the TS7530 Virtualization Engine is running.

**VE for tape configuration** This section provides information regarding the configuration of the VE for Tape Server code and basic configuration.

**SCSI devices** This option provides detail on what storage and host WWPNs are attached to each host bus adapter on the TS7530 Virtualization Engine.

**VE for virtual tape devices** This option provides detailed information about the virtual tapes in VE for Tape Server

**Fibre channel** This section provides information about the VE for Tape Server host bus adapters and their configuration. This is not to be confused with the SCSI devices which identifies what is attached to the host bus adapters.

**Storage subsystem** This gathers information from each TS7520 Cache Module (3955 SX6). Note this can take some time together on a fully configured system. Therefore the option should only be chosen when requested by support engineer or event logs indicates problems with the TS7520 Cache Module (3955 SX6). By default the check box is unchecked.

**Loaded kernel** This option gathers detail from the live system kernel.

**Network configuration** This option provides network configuration detail for all attached Ethernet adapters and their configuration.

**Kernel symbols** This option provides detail regarding the loaded kernel modules.

**Core file** This option will capture any core files that have been generated by abnormally terminating programs.

**Scan physical devices** This option will make the VE for Tape Server rescan for newly attached devices. This is only used when there is difficulty discovering new physical devices. Note that this option can take some time to complete depending on the number of devices attached. By default the check box is unchecked.

## 11.3.2 Diagnostic summary data collection procedure

To gather the diagnostic summary, you can use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **Diagnostic Summary Data**. From this window you can select the options that are required. You should ask your IBM support representative if you are unsure which options to choose. To save the file in a preferred location, select the button to the right of the **Save As** box. See Figure 11-12 on page 368.

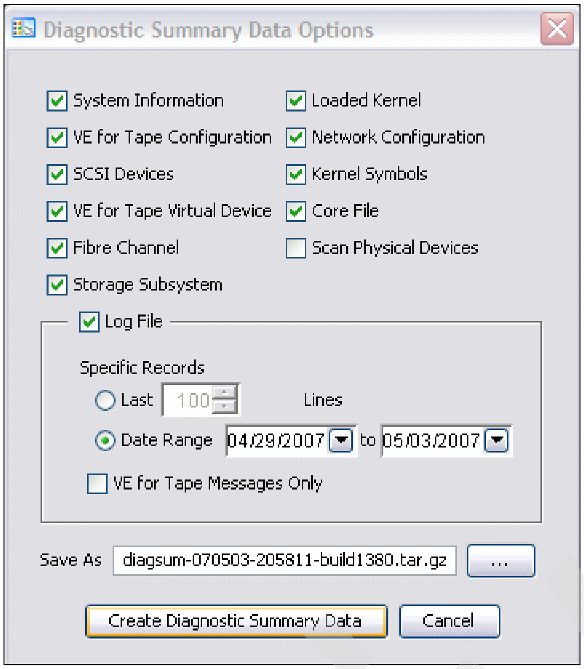



*Figure 11-12 Diagnostic Summary Data Options*

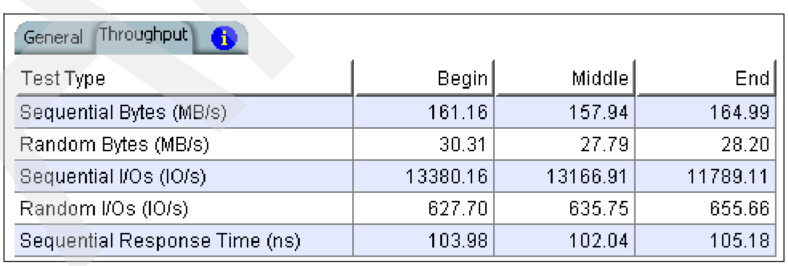
**Note:** Dependent on the selected date range and workload of the TS7530, the compressed diagnostic summary data file may be large.

## 11.3.3 Test storage throughput

You have the ability to test the throughput to a specific LUN. This is test that checks Sequential Bytes, Random Bytes, Sequential I/Os, and Random I/Os. This can be useful in determining backed disk drive performance if performance degradation is suspected of a specific disk drive.

Select <**your TS7520**> **node** → **Physical Resources** → **Storage Devices** → **Fibre Channel Devices**. Right-click the necessary LUN to test and select **Select Test**.

The sample result is shown in Figure 11-13.



General | Throughput

| Test Type | Begin | Middle | End |
|---|---|---|---|
| Sequential Bytes (MB/s) | 161.16 | 157.94 | 164.99 |
| Random Bytes (MB/s) | 30.31 | 27.79 | 28.20 |
| Sequential I/Os (IO/s) | 13380.16 | 13166.91 | 11789.11 |
| Random I/Os (IO/s) | 627.70 | 635.75 | 655.66 |
| Sequential Response Time (ns) | 103.98 | 102.04 | 105.18 |

*Figure 11-13 Storage LUN throughput*

## 11.3.4 E-mail notification

E-mail notification should be configured on each node. This includes failover and high-availability configurations.

### Configuring e-mail notification

To configure e-mail notifications:

1. Contact the e-mail administrator of your environment to gather the following information:

   **SMTP server** The SMTP server is the machine that is configured in your environment to accept incoming SMTP messages. Contact your e-mail administrator for assistance with this.

   **SMTP port** The SMTP port is the communications channel used by your SMTP server. A port in Transmission Control Protocol/Internet Protocol (TCP/IP) and User Datagram Protocol (UDP) networks is an endpoint to a logical connection. The port number identifies the type of port that it is. For example, port 80 is used for HTTP traffic and port 21 is used for File Transfer Protocol (FTP) traffic.

   **SMTP username** The SMTP username is the account that has access to send SMTP messages. Contact your e-mail administrator for assistance with this.

   **SMTP password** The SMTP password is for the account that has access to send SMTP messages. Contact your e-mail administrator for assistance with this.

   **User account** The user account is the account that is listed in the from section of the received e-mail.

   **Target e-mail address** This address is where you want e-mail alerts to go.

   **CC e-mail** The CC e-mail field is the second e-mail address to which you want the alerts to be sent.

   **Subject** Subject refers to the subject of the e-mail sent by IBM Virtualization Engine TS7530. Choose a subject that will not be marked as junk e-mail (spam). Contact your e-mail administrator for assistance with this.

   **Interval** The Interval defines how often you want IBM Virtualization Engine TS7530 to check for errors. For this option, you must specify the interval in the day, hour, and minute field that are provided. We recommend that you set the interval clock for every 0 days, 0 hours, and 10 minutes. This way the SMTP monitor checks for errors every 10 minutes. You may reduce or increase this time to any interval that you want.

2. As shown in Figure 11-14 on page 370, use the TS7530 VE for Tape Console and right-click **<your TS7530 server>** and then select **Options → Enable E-mail Notification**.

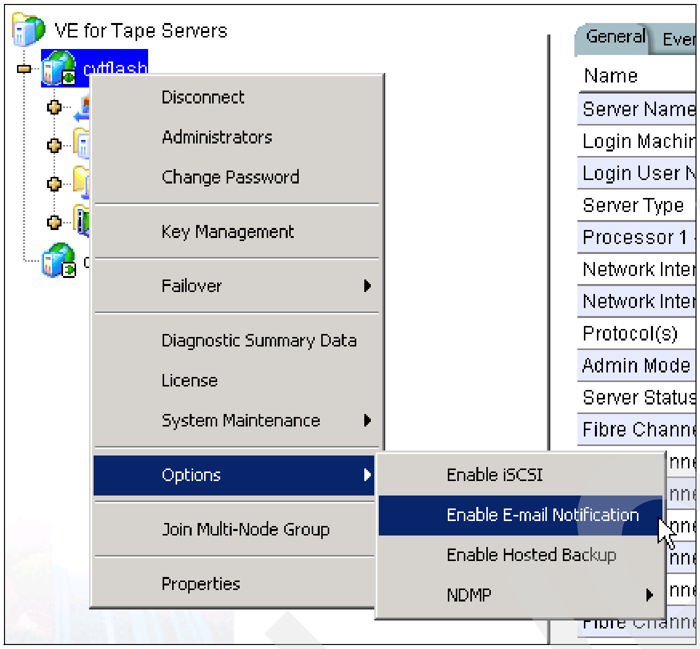



*Figure 11-14 Enable E-mail Notification*

3. In the window shown in Figure 11-15, fill in the information obtained in step 1, then click **Next**.

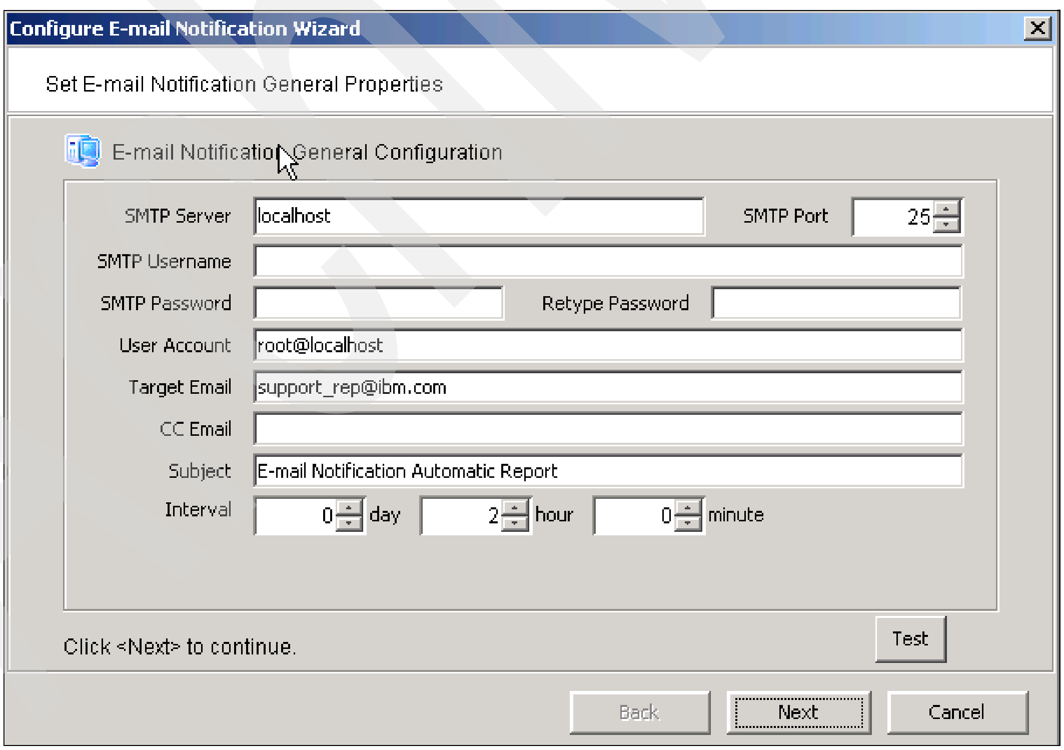



*Figure 11-15 E-mail notification general properties*

4. The next panel (Figure 11-16 on page 371) allows you add critical contact information. This information is included in the e-mail that is sent with the alerts. Click **Next**.

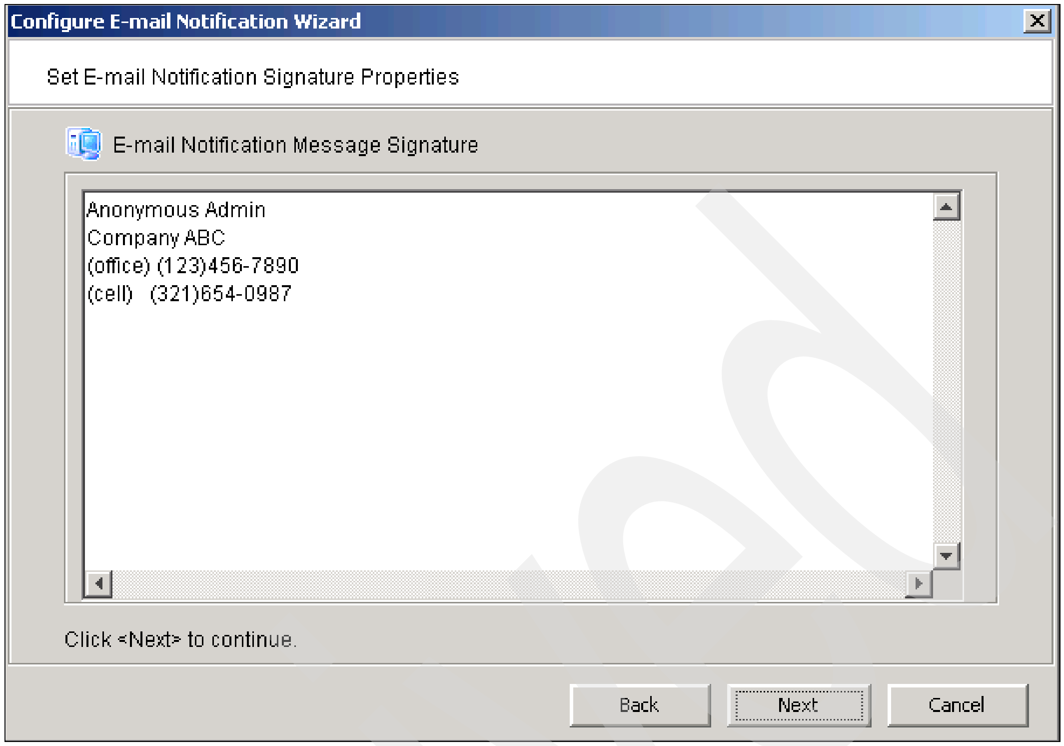



*Figure 11-16 Signature setting*

5. Notification triggers are on the next panel (Figure 11-17 on page 372). These are triggers that can be used to control the data that is reported to you via e-mail or to whom you configure to receive the e-mail notifications.

Select the triggers that you want to enable and click **Next**.

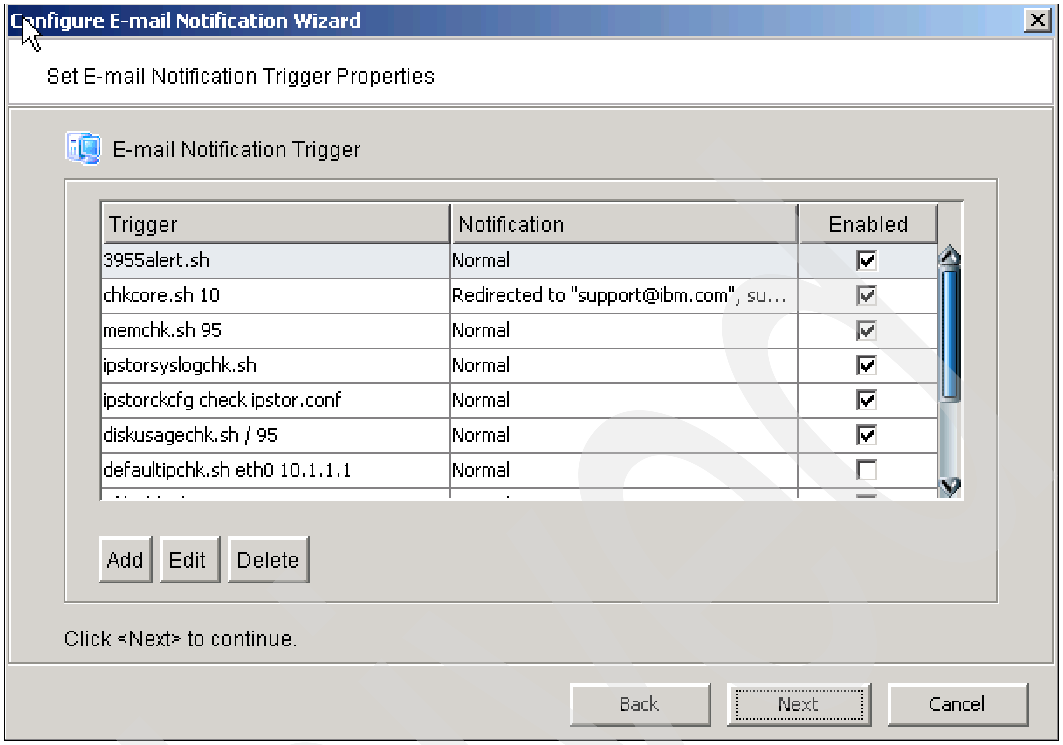



*Figure 11-17 Notification trigger scripts*

6. The next panel (Figure 11-18) allows you to select what data you would like captured as an attachment when the trigger is hit. Some of these items can be large, so it is best to experiment with the data that you wish to capture.

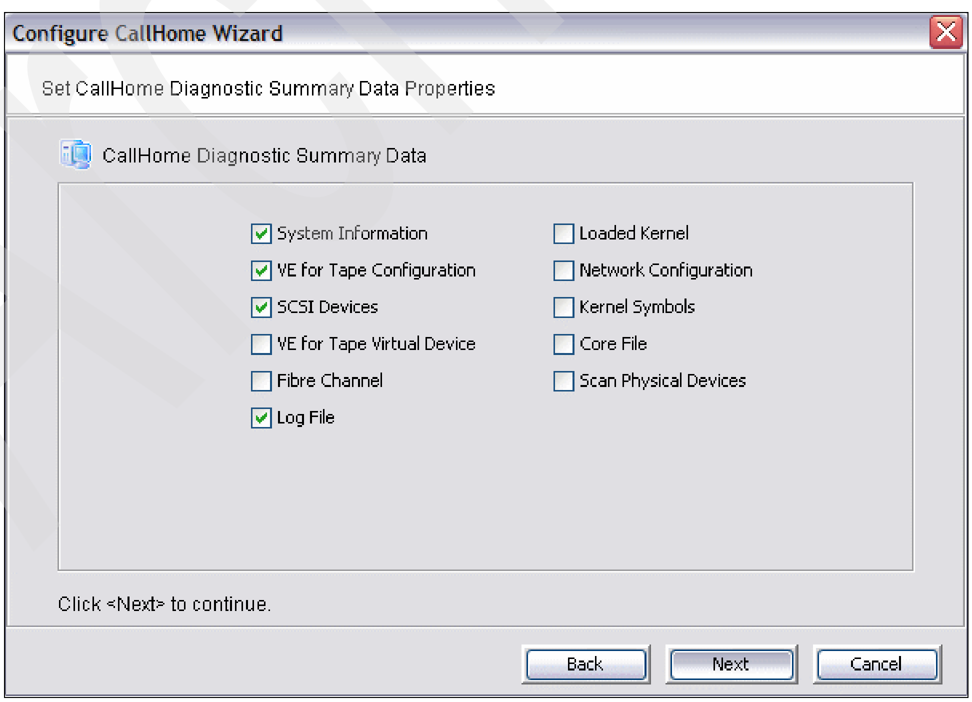



*Figure 11-18 Diagnostic summary properties*

> **Note:** These check boxes are the same as described in 11.3.1, “Diagnostic summary data collection” on page 366.

7. In the next panel (Figure 11-19) you can add which entries to look for in the event log. If any of the events match the syntax then the information is captured as part of the details sent to the person or group configured to receive the e-mail notifications.

   Add or update the list as required and click **Next**.

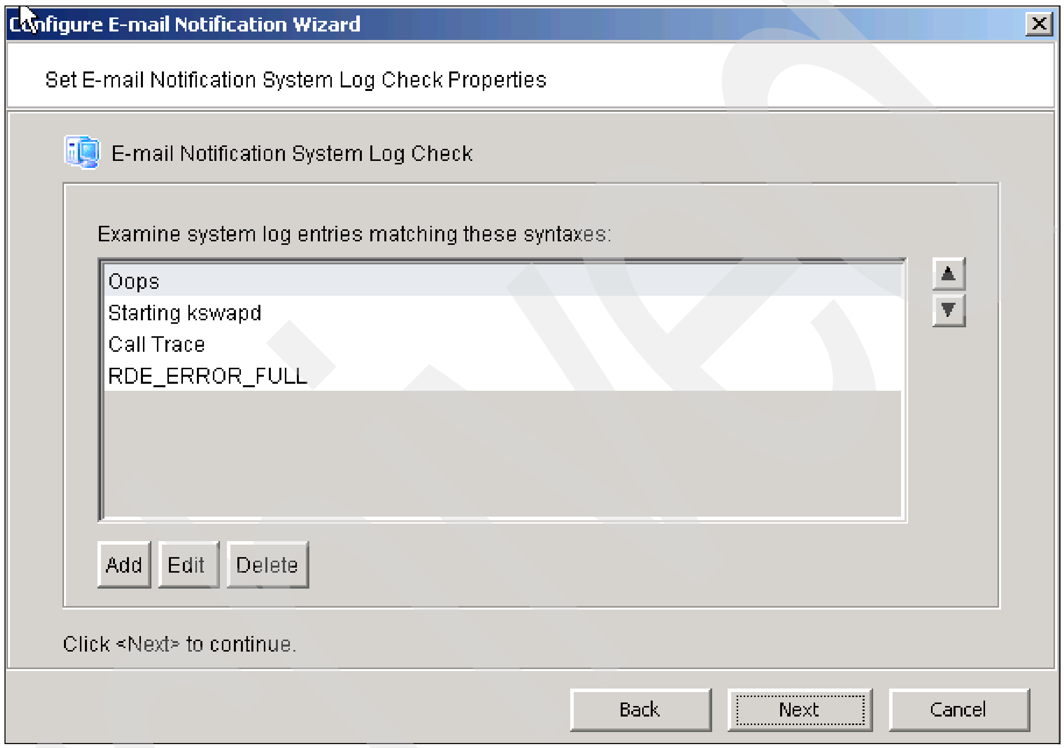



*Figure 11-19 E-mail notification system log check*

8. The next pane (Figure 11-20) allows you to configure items for the trigger event to ignore. We recommend that you take the defaults and modify as necessary in your environment.

   Click **Next**.

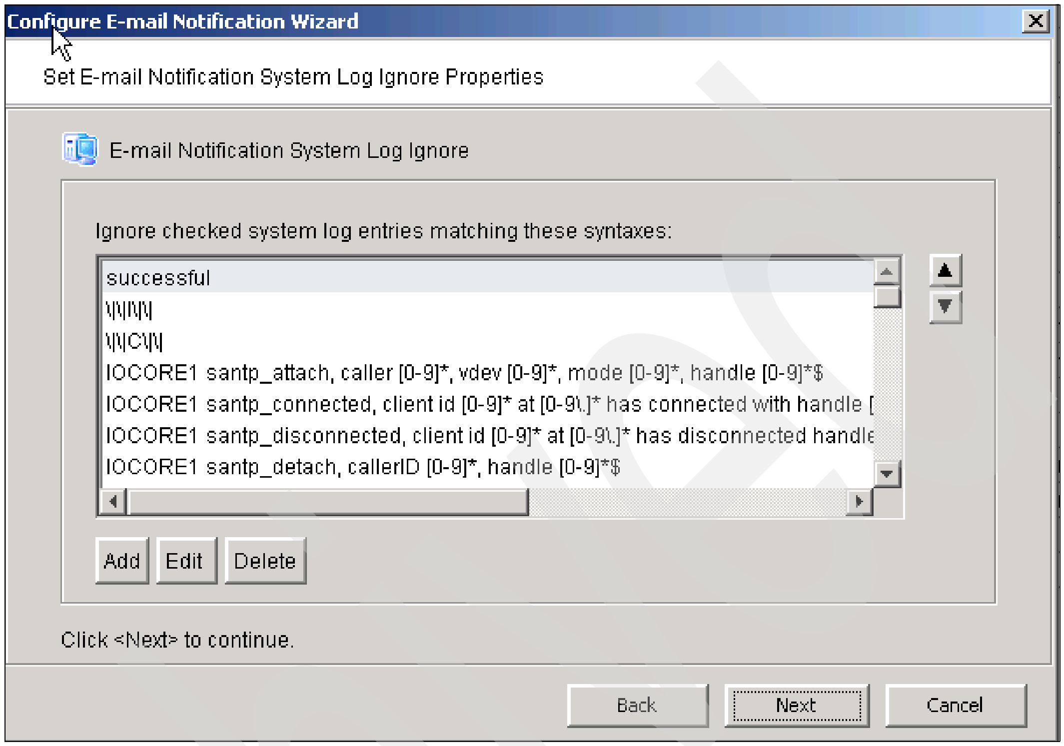



*Figure 11-20 E-mail notification system log ignore*

9. Next you will see a verification panel to confirm your settings. If these options are correct you can select **Finish**. This will commit the e-mail notification configuration.

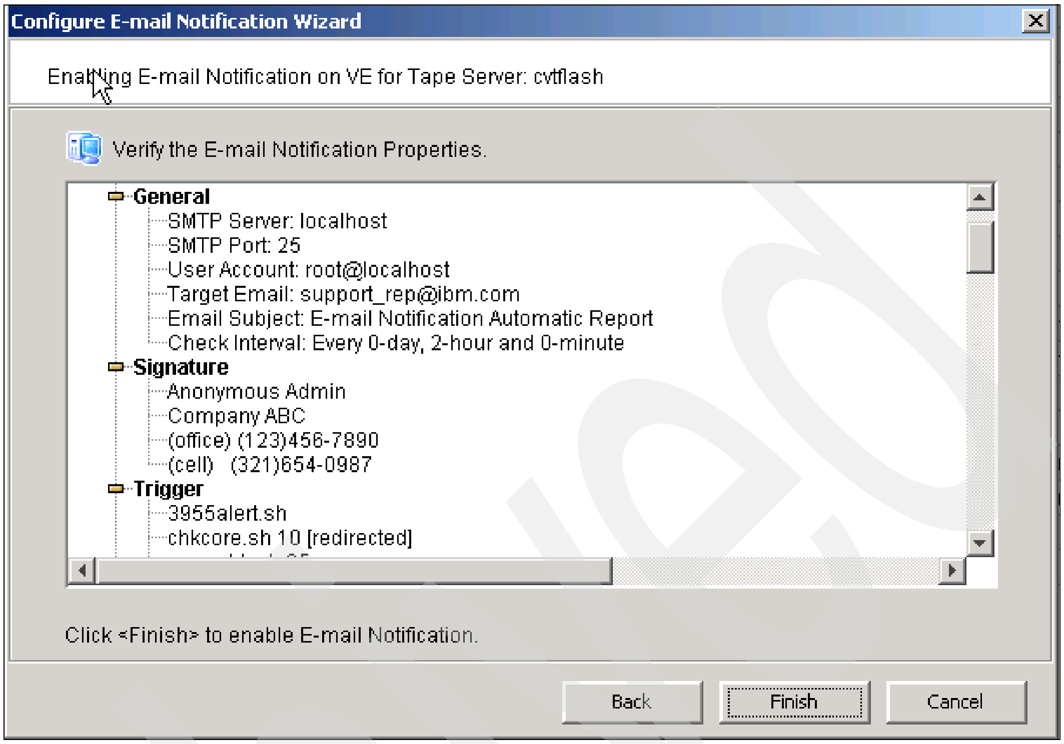



*Figure 11-21 E-mail notification verify*

## Changing e-mail notification settings

Once e-mail notification has been configured, the settings can be easily changed. Use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **E-mail notification**, as shown in Figure 11-14 on page 370. All the options that were previously configured are available to be changed.

## Testing e-mail notification

You can test your e-mail notification configuration by using the Test button. Use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **E-mail Notification** → **General** tab located in the lower right-hand corner. This will send a test e-mail to the person or group configured to receive the Call Home notifications.

*Example 11-1 E-mail notification*

```
Von: root@yourserver [mailto:root@yourserver]
Gesendet: Donnerstag, 19. Juni 2008 11:50
An: Serveradmin, CVT-Organisation
Betreff: Callhome Automatic Report (VTL TS7530) from yourserver


Trigger ipstorsyslogchk.sh reported:
Jun 18 16:12:53 yourserver ipstorcomm [tape_cmd.c:_shrinkVTape64K:4199][8227]:
MGT_INFO: Shrink virtual tape for vid=20000443, sizeMB=81907 Jun 18 16:12:53
bsul0026a01 ipstorcomm [tape_cmd.c:_shrinkVTape64K:4210][8227]: MGT_INFO: Shrink
virtual tape for vid=20000443, actualSizeMB=81920
```

## 11.3.5 IBM Assist On-site (AOS)

AOS is a live remote-assistance tool used to help resolve complex issues. It allows IBM support team members to securely view your desktop and share control of your mouse and keyboard.

You should open a problem via the normal process. The support engineer will decide whether this tool is the correct approach to solve your problem.

### Requirements

The requirements for AOS are:

- Internet connection from the management console of the TS7500 Virtualization Solution
- Internet Explorer® 4.0 or later
- Access to ports 80, 443, and 8200
- Ability to make direct outgoing TCP connections

### How to get support

Fill out the IBM Assist On-site request form from the Web site given below with all needed information. The support representative provides you with a unique security connection code.

For more information and an FAQ see:

http://www-1.ibm.com/support/assistonsite/
http://www-1.ibm.com/support/docview.wss?uid=swg21232485
http://www-1.ibm.com/support/assistonsite/form1.html

# 12

# Operation

In this chapter we provide you with important information for tasks that are part of operations after the TS7530 has initially been installed. These tasks include:

- Reconfiguring Ethernet adapter bonding
- Backing up the configuration
- Reconfiguring failover
- Sharing tapes between different TS7530s in the same physical configuration
- Configuring Enhanced Tape Caching
- Managing data encryption and encryption keys
- Switching Fibre Channel ports between target mode and initiator mode

# 12.1 Reconfiguring Ethernet adapter bonding

**Attention**: During this procedure the server restarts the network and disconnects from the VE console.

If you have at least one four-port Ethernet adapter installed on a server, you can bond multiple ports to share one IP address. This increases available bandwidth for iSCSI and network replication operations while reducing the number of IP addresses required by the TS7500 Virtualization Engine. Ethernet port bonding supports up to two 4-port Ethernet adapters per server. There is a minimum of two ports for each bond. A maximum number of eight bonds is supported. IP addresses cannot be changed after the failover function has been enabled.

In this scenario we reconfigure the previous Ethernet adapter bonding to reconfigure it. You have one 4-port Ethernet adapter.

## 12.1.1 Ready for reconfiguring Ethernet adapter bonding

To be ready for reconfiguring Ethernet adapter bonding gather the following information:

- Which ports you want in each bond. When viewing the rear of the server (Figure 12-1):
  - The right-most adapter (in slot 6) contains, *from top to bottom*, ports 2 through 5.
  - The next adapter to the left (in slot 5) contains, *from top to bottom*, ports 6 through 9.

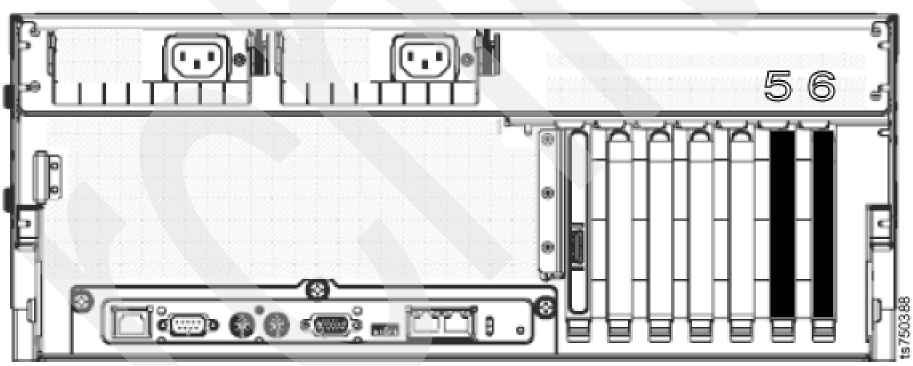



*Figure 12-1 Rear side including 4-port Ethernet adapters*

- IP address for each bond.
- Subnet masks for each bond. Each bond that you create must use a different subnet mask.

**Important:** Bonding ports must be connected to a customer-provided switch that supports 802.3ad link aggregation.

## 12.1.2 Deleting the previous config

To delete the previous config:

1. To delete the previous bonding, right-click the TS7530 Server name and select **System Management** → **Port Bonding** → **Remove Bond**. See Figure 12-2.

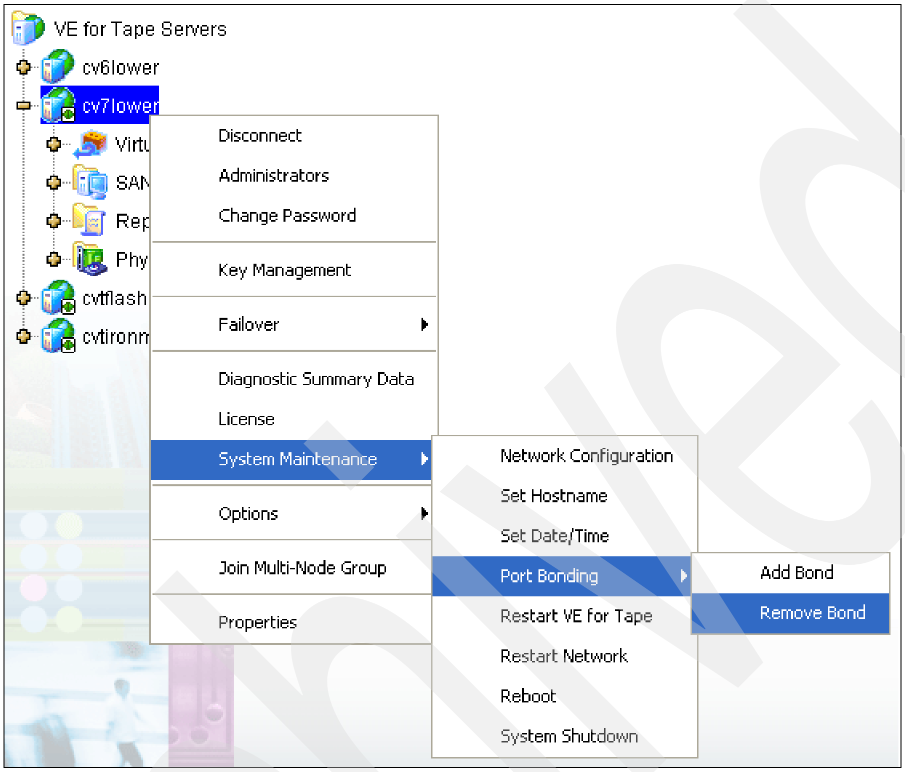



*Figure 12-2 Select Remove Bond*

2. From the panel shown in Figure 12-3, select the previous bond name from the list. In the lab we selected bond0. As previously mentioned, we have one 4-port Ethernet adapter. Click **OK**.

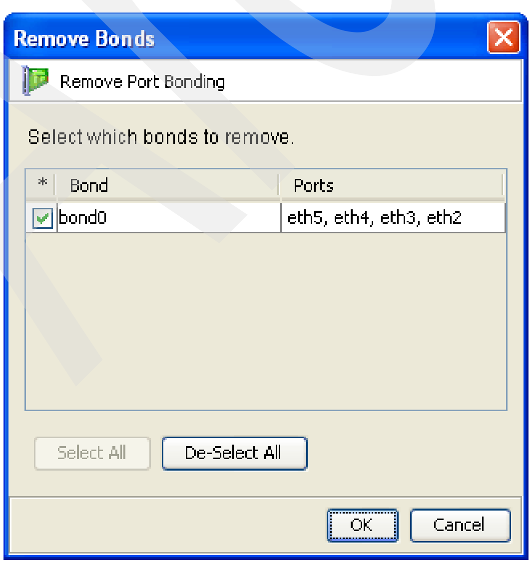



*Figure 12-3 Remove port bonding window*

3. In the panel in Figure 12-4, click **Yes**.

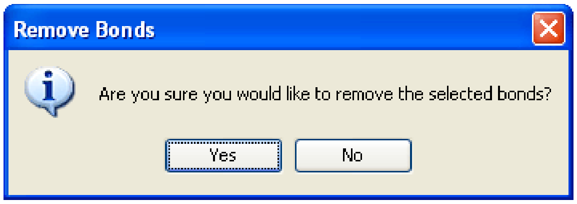



*Figure 12-4 Confirm window*

You will be presented with the result window shown in Figure 12-5.

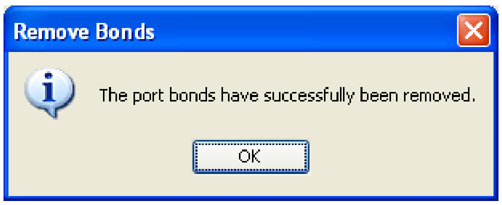



*Figure 12-5 OK window*

## 12.1.3 Add Ethernet bonding

For a TS7530 Virtualization Engine for Tape, to bond multiple ports to use a single IP address, complete the following steps:

1. Connect network cables to the desired ports. You must do this before bonding any ports together.

   In the VE console, right-click the server and then click **System Maintenance** → **Port Bonding** → **Add Bond** (Figure 12-6 on page 381).

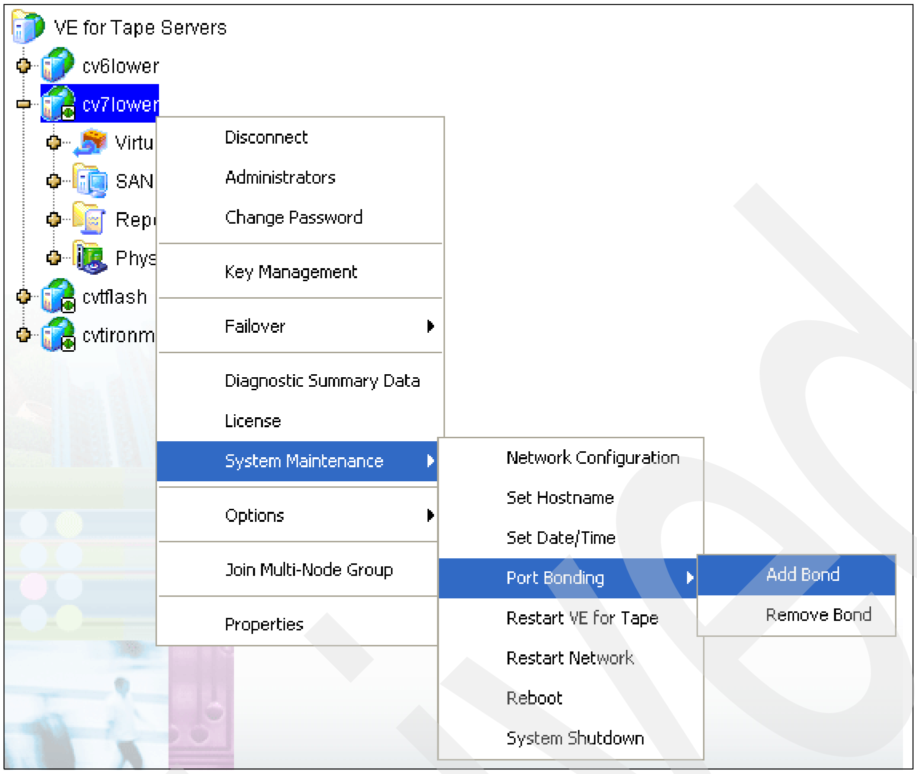



*Figure 12-6 Add Bond window*

2. From the panel shown in Figure 12-7, the Add Port Bond window opens.

   Using bondings provides several advantages over using individual network interfaces, such as:

   – Higher throughput

     Multiple interfaces work as one interface.

   – Fault tolerance

     If one interface in a virtual interface (vif) goes down, your storage system can stay connected to the network using the other interfaces.

   – No single point of failure

     If the physical interfaces in a vif are connected to different switches and a switch goes down, your storage system stays connected to the network through the other switches.

   You can select at least two ports for each bond. In this lab we choose all of four ports, as in Figure 12-7.

   a. In the IP Address field type the IP address of the new bond.
   b. In the Netmask field type the subnet mask of the new bond.
   c. In the Port list select the ports that you wish to bond together.
   d. Click **OK**.

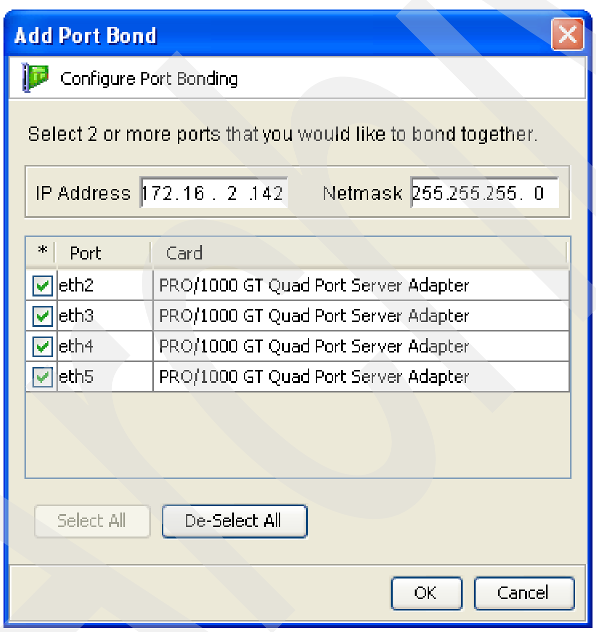



*Figure 12-7 Configuring Port Bonding window*

3. On the panel shown in Figure 12-8, click **Yes**.

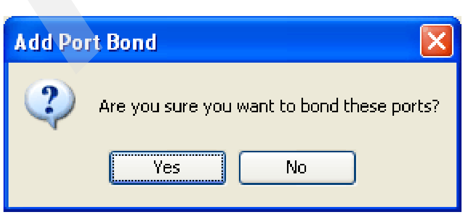



*Figure 12-8 Verification window*

We have made a new bond for the TS7530 Virtualization Engine. See Figure 12-9.


*Figure 12-9 OK window*

## 12.1.4 Verifying the Ethernet bonding

You can verify the bonding status information as follows:

1. Right-click **<your TS7530 server>** then select **System Maintenance** → **Network Configuration** form the panel shown in Figure 12-10.

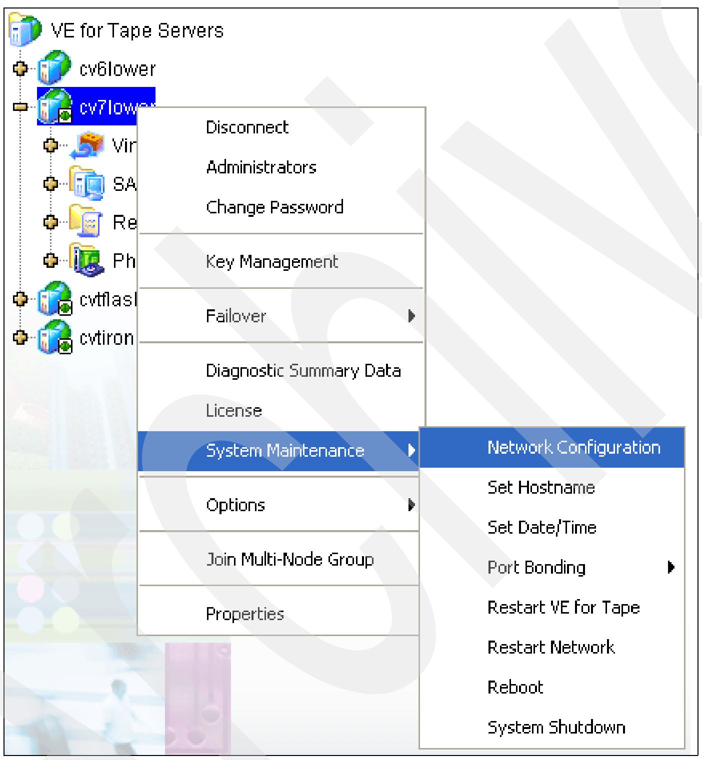



*Figure 12-10 Select Network Configuration window*

2. You can find the new bond0 (or 1, and so on. The number of bonds that you see depends on the number of bonds that you have previously configured.) tab in Figure 12-11. After verifying your bond number, click **Config NIC**.

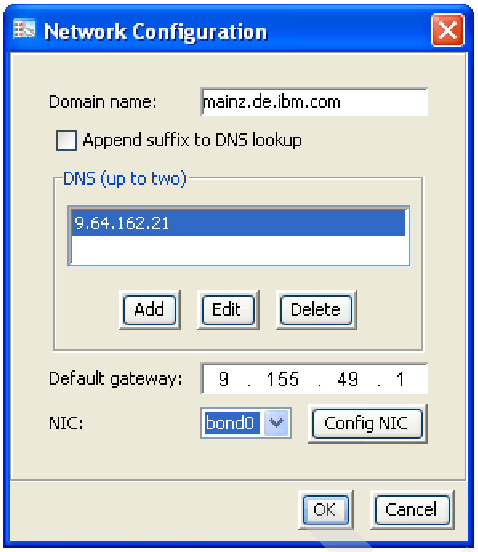



*Figure 12-11 Network Configuration window*

3. We can review the settings of the new bond configuration. You can add, edit, or delete the IP address (Figure 12-12).

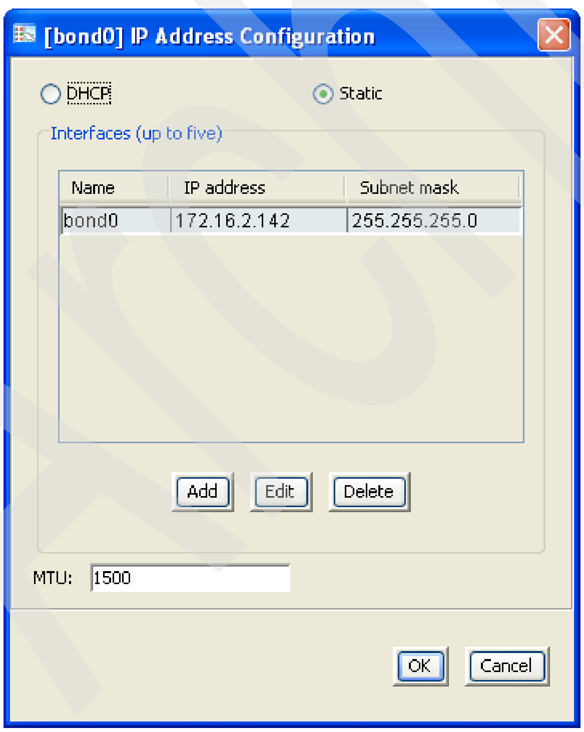
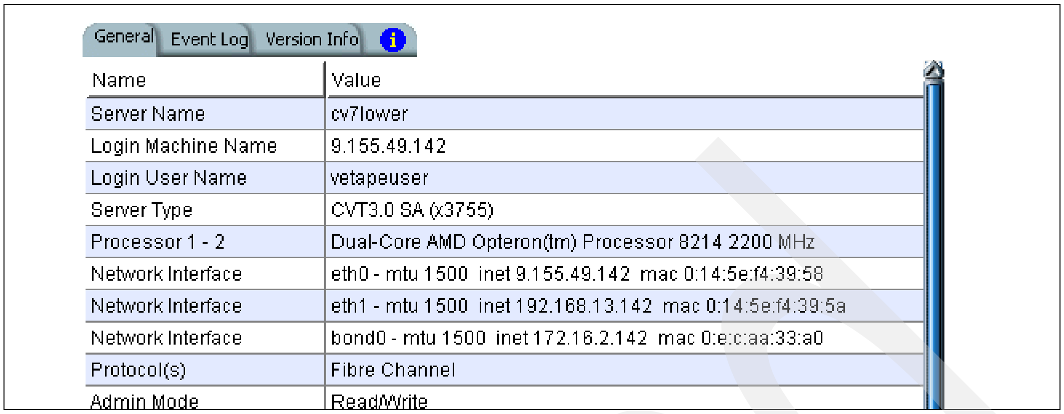



*Figure 12-12 IP Address Configuration*

**Note:** IP addresses cannot be changed after the failover function has been configured.

Also, you can see additional adapters' (eth0, 1 and bond0) information, as in Figure 12-13.




| Name | Value |
|---|---|
| Server Name | cv7lower |
| Login Machine Name | 9.155.49.142 |
| Login User Name | vetapeuser |
| Server Type | CVT3.0 SA (x3755) |
| Processor 1 - 2 | Dual-Core AMD Opteron(tm) Processor 8214 2200 MHz |
| Network Interface | eth0 - mtu 1500 inet 9.155.49.142 mac 0:14:5e:f4:39:58 |
| Network Interface | eth1 - mtu 1500 inet 192.168.13.142 mac 0:14:5e:f4:39:5a |
| Network Interface | bond0 - mtu 1500 inet 172.16.2.142 mac 0:e:c:aa:33:a0 |
| Protocol(s) | Fibre Channel |
| Admin Mode | Read/Write |

*Figure 12-13 NIC bonding*

## 12.2 Configuration backup

The configuration database of the TS7530 Virtualization Engine maintains the configuration of the virtual library. It is important that a copy of the database is saved every time the configuration has been changed. Should a recovery be necessary, the configuration will contain valuable configuration information about your system that is used by IBM support.

You can configure for automatic configuration backup, and you can do a manual configuration backup. We explain both options in this section.

### 12.2.1 Automatic configuration backup

Proceed as follows:

1. The automatic backup of the configuration file is configured using the VE for Tape Console. Right-click **<your TS7530 server>** and then select **Properties**.
2. In the window shown in Figure 12-14 on page 386, select the **Auto Save Config** tab. This is configured to use ftp to transfer the file to a location of your choice. We recommend that a minimum of one copy per day is sent to this location.

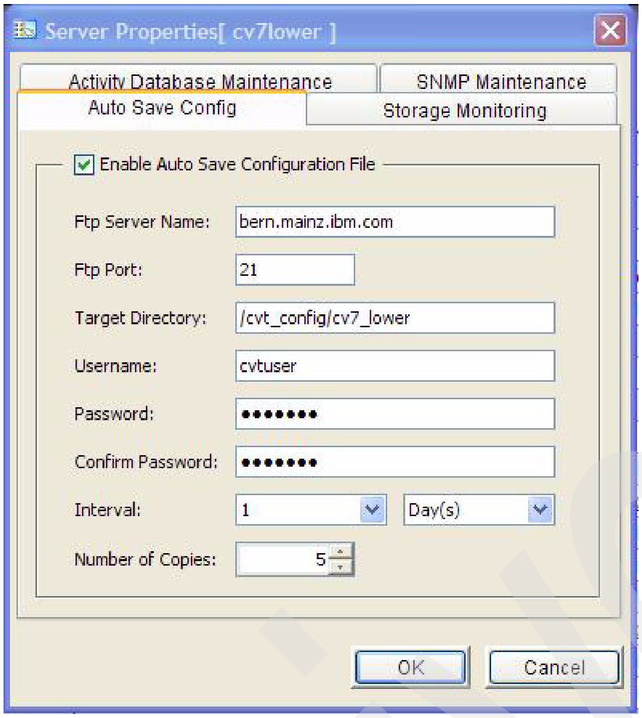



*Figure 12-14 Auto save configuration*

3. The value for number of copies specifies how many copies will be stored and retained on the ftp server. For example, if you specify a value of 5, a maximum of five copies will be stored. The oldest copy will be deleted and replaced by the latest configuration backup
4. It is important to verify that the configuration is valid. The configuration files are saved in the following format:

   `config-YYYY-MM-DD-HH-MM-<IPaddress of TS7530>.tar.gz`

   These files can be unpacked by using the **unzip** or **gunzip** command. If this is done on an AIX, Linux, or UNIX operating system, the command is followed by the use of the **tar** command. If the file is able to be unzipped, then it is a valid archive. Example 12-1 gives you an example of the configuration verification.

*Example 12-1 Configuration verification*

```
user@hostname/var/tmp > ls -lrt
total 3960
-rw-r-----   1 root     sys         871520 May 17 17:00 config-2007-05-17-17-07-9.11.235.105.tar.gz
-rw-r-----   1 root     sys        1154751 May 18 14:08 config-2007-05-18-14-15-9.11.235.111.tar.gz
user@hostname/var/tmp > gunzip config-2007-05-18-14-15-9.11.235.111.tar.gz
user@hostname/var/tmp > ls -lrt
total 1399624
-rw-r-----   1 root     sys         871520 May 17 17:00 config-2007-05-17-17-07-9.11.235.105.tar.gz
-rw-r-----   1 root     sys      715735040 May 18 14:08 config-2007-05-18-14-15-9.11.235.111.tar
user@hostname/var/tmp > tar -xvf config-2007-05-18-14-15-9.11.235.111.tar
x etc
x etc/callhome

...

x etc/backup_fmtrace.txt, 131103 bytes, 257 media blocks.
user@hostname/var/tmp > ls -lrt
total 1399632
-rw-r-----   1 root     sys         871520 May 17 17:00 config-2007-05-17-17-07-9.11.235.105.tar.gz
drwx--S---   7 root     system        1024 May 18 07:05 etc
-rw-r-----   1 root     sys      715735040 May 18 14:08 config-2007-05-18-14-15-9.11.235.111.tar
user@hostname/var/tmp >
```

## 12.2.2 Manual configuration backup

This option gives you the opportunity to make an immediate backup of your configuration. It is best practice to make a manual backup of your configuration prior to installing or removing software patches. It is also a good idea to save the configuration before and after any major configuration changes. If you have more than one node, you will need to gather this information for each node:

1. Using the VE for Tape Console, connect to **<your TS7530 server>**. From the title bar, select **Tools** → **Save Configuration**.

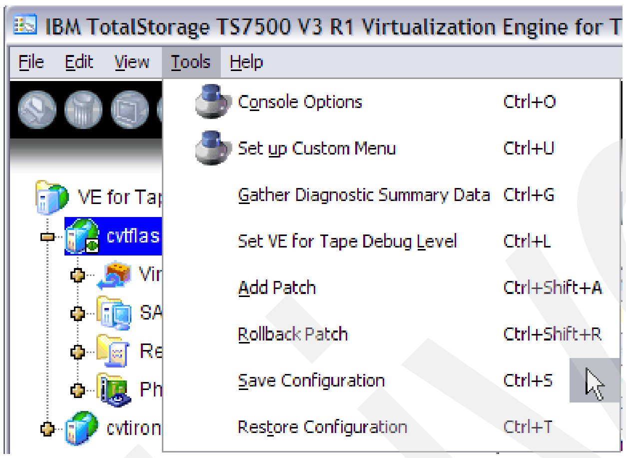



*Figure 12-15 Save configuration*

2. The Save As window opens (Figure 12-16), allowing you to choose the name and location to place the configuration file. Notice that you will *not* be presented with a suggested file name. We therefore recommend that you use the following format:

```
<your TS7530 servername>.date.tgz
```

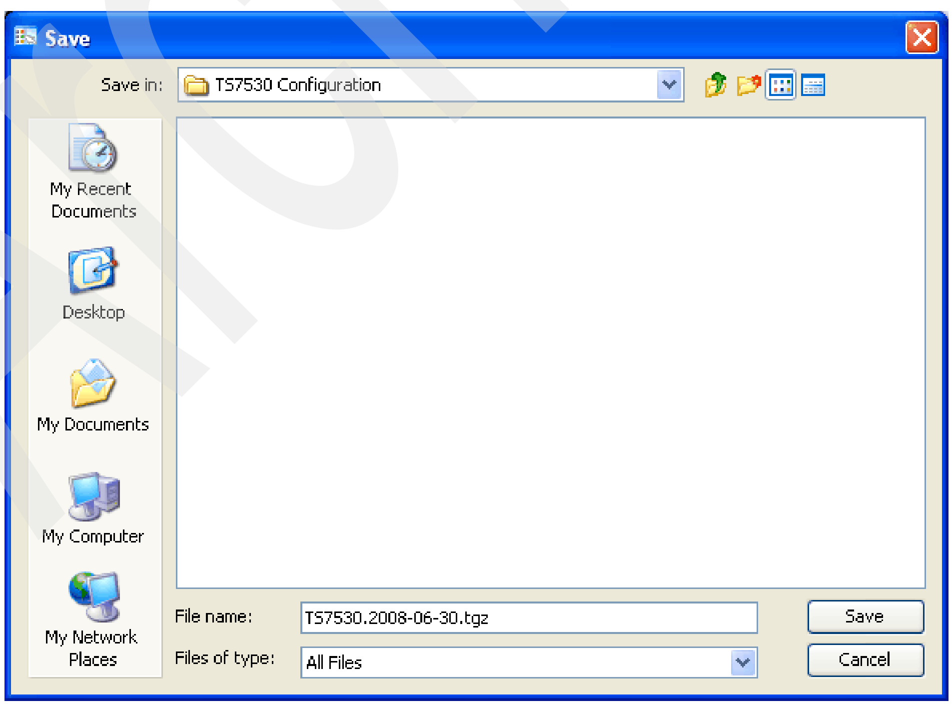



*Figure 12-16 Manual backup of configuration*

## 12.3 Failover

If you have purchased your TS7530 as a highly available configuration, you will find that this has already been configured by the IBM SSR who installed your system. While you are unable to configure the Highly Available configuration, there are a few options you must be aware of when managing a highly available system.

### 12.3.1 Changing failover properties

To access the failover properties, use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **Failover** → **View/Update Failover Options**. The window shown in Figure 12-17 allows you to change the self checking interval and the heartbeat interval. These should be left at the default. Increasing these values will delay the failover checking.

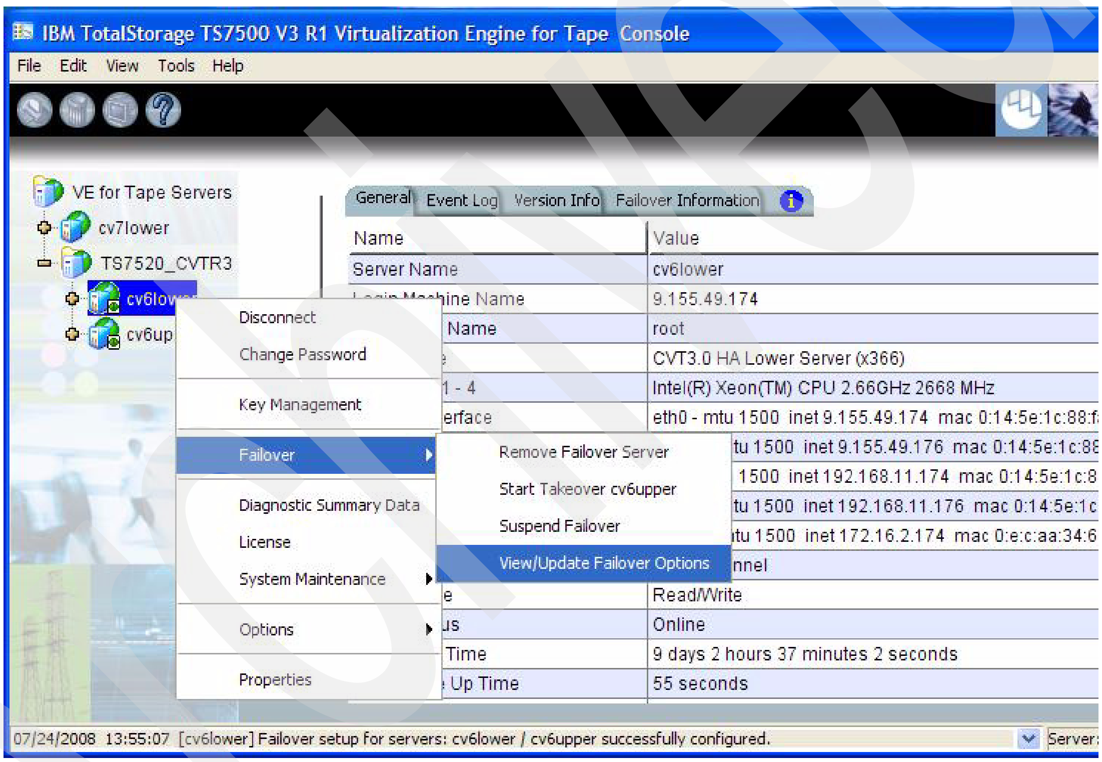


*Figure 12-17 Failover options*

In the window shown in Figure 12-18, it is important that you leave the **Auto Recovery** box unchecked. While checking this check box will cause the node to fail back, it is not a desirable option. If you are currently in the middle of the backup, the node will fail back irrespective of the status of your backup. This will cause the backup to perhaps fail. It is more desirable to leave this option *unchecked*, as it allows you to control at what point the node fails back.

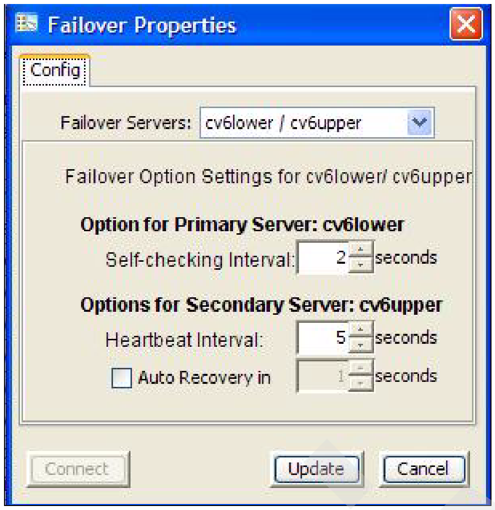



*Figure 12-18 Failover Properties*

## 12.3.2 Suspending and resuming failover

There are certain situations in which you must suspend failover from occurring, for example, network maintenance, hardware installation or replacement, or patch installation.

Use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **Failover** → **Suspend Failover**. This will keep failover from occurring.

To reverse the process, use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **Failover** → **Resume Failover**.

## 12.3.3 Manual failover/takeover

There are certain situations where you will want to initiate a manual takeover of a node, for maintenance purposes. This allows you to move all operations to the alternate node in the failover pair. Note that this action does not wait for current operations to complete. Just like the Auto Recovery option, the takeover is immediate. This procedure must be done from the node where you want to perform the takeover. This node will take over the I/O from the other node in the cluster or failover pair. Follow these steps:

1. Use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **Failover** → **Start Takeover <your TS7530>**.

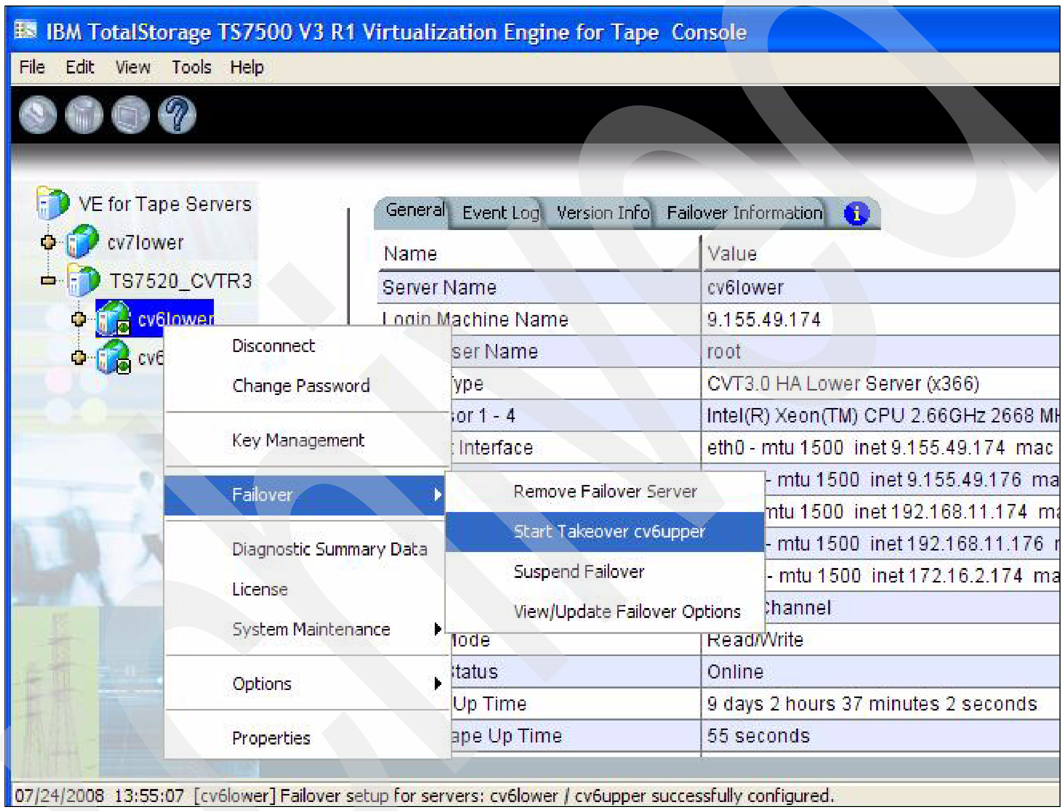



*Figure 12-19 Failover Takeover*

2. In the Failover confirmation window (Figure 12-20), click **Yes**.

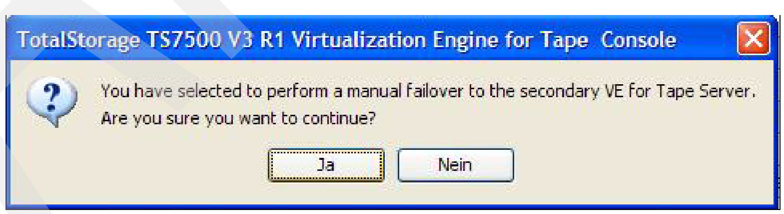



*Figure 12-20 Takeover confirmation*

3. You will see the window in Figure 12-21 once the takeover/failover has occurred. This process can take some time to complete, so be patient. Notice the alert at the bottom notifying you about which node is now servicing the I/O.

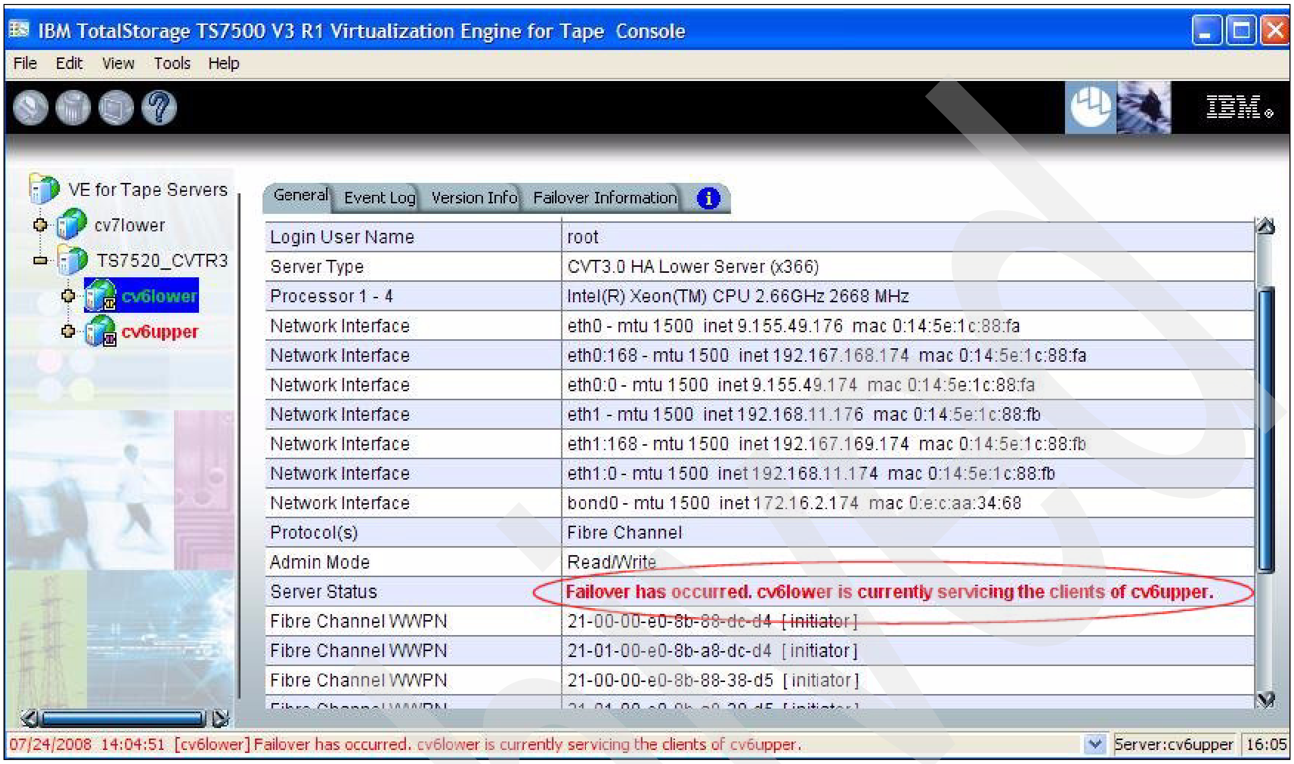


*Figure 12-21 Example of failover/takeover*

To reverse the takeover, use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **Failover** → **Stop Takeover <your TS7530>**. Answer **YES** to the confirmation on the next window. Remember that this can take a period of time to complete, so be patient.

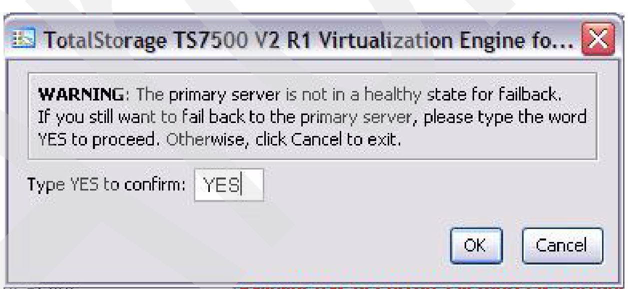


*Figure 12-22 Failover/Takeover confirmation*

## 12.4 Sharing virtual tapes through grouping

Grouping is an option for the TS7530 that allows you to share virtual tapes between TS7530 libraries in the same physical configuration. When tapes are shared within a group and not between failover partners, loss of the node owning the virtual tape will cause the tape to go offline until the owning node has been restored. This behavior is the same for a highly available or failover pair.

## 12.4.1 Setting up a group

To set up a new group:

1. Use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **Create Group,** as shown in Figure 12-23.

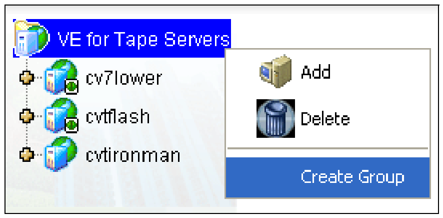



*Figure 12-23 Adding group*

2. In the panel shown in Figure 12-24, type in the name that you want to assign to the new group.


*Figure 12-24 Group name*

3. After inputting the group name, you can see the result, as in Figure 12-25.

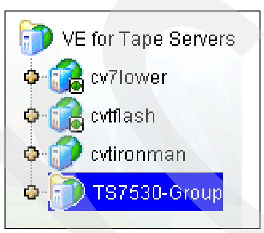



*Figure 12-25 New group TS7530-Group*

4. To join the group, you must use the VE for Tape Console by right-clicking **<your TS7530 server>** and then selecting **Join Group**, as shown in Figure 12-26.

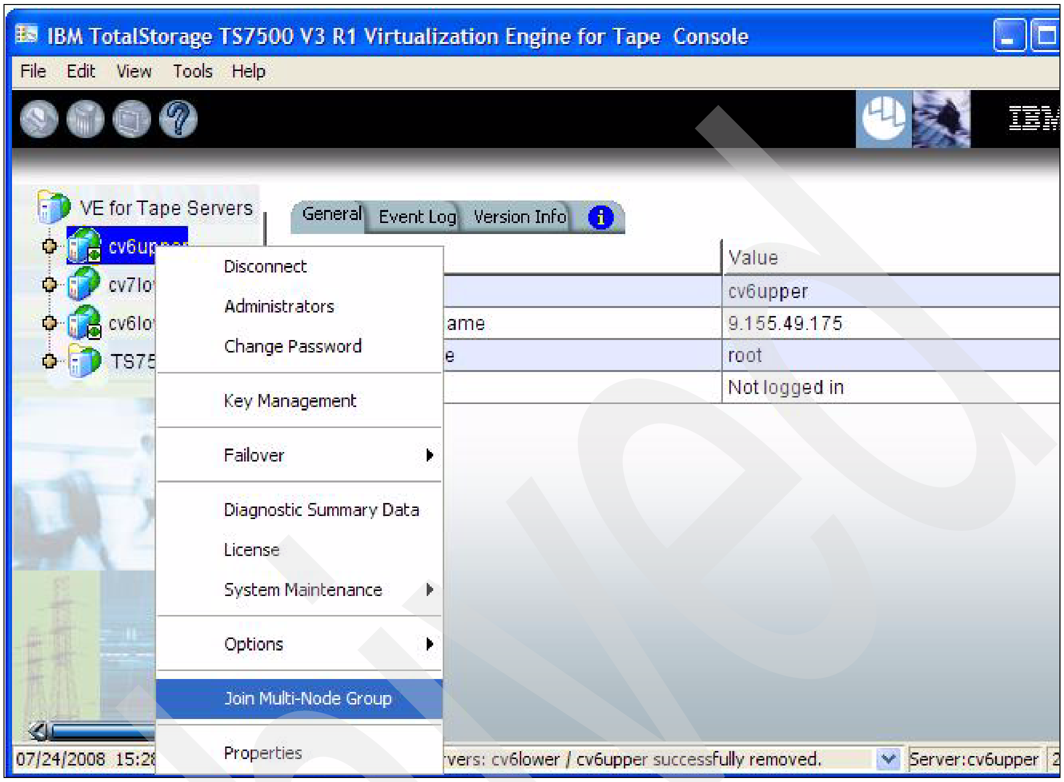



*Figure 12-26 Joining a group*

5. Select the group that you want to join. Repeat this step for each server that you want to join the group. Once you have added nodes to the group, you should see the window shown in Figure 12-27 on the VE for Tape Console window.

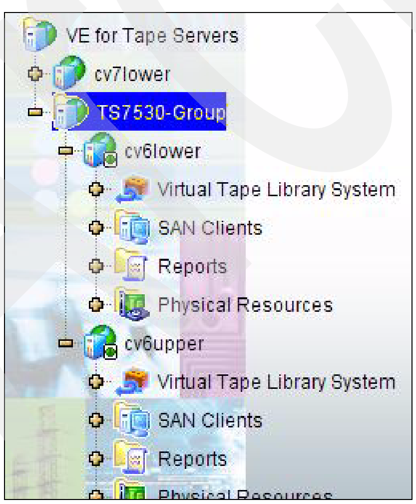



*Figure 12-27 Created group*

## 12.4.2 Moving a virtual volume

To move a virtual tape to another node in the group, you must have virtual tapes in the virtual vault prior to moving. When that has been completed:

1. Use the VE for Tape Console by first selecting **Virtual Vault**, then right-clicking **virtual tape** and then selecting **Move to Remote Server** as shown in Figure 12-28.

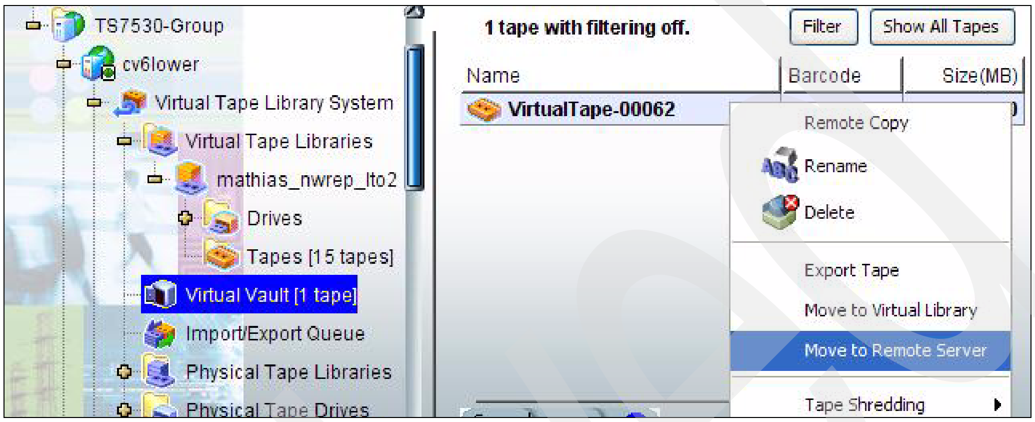



*Figure 12-28 Move virtual tape to remote server*

2. You will then get a window (see Figure 12-29) to verify the tape(s) you want to move. After verifying the selection, click **Next**.

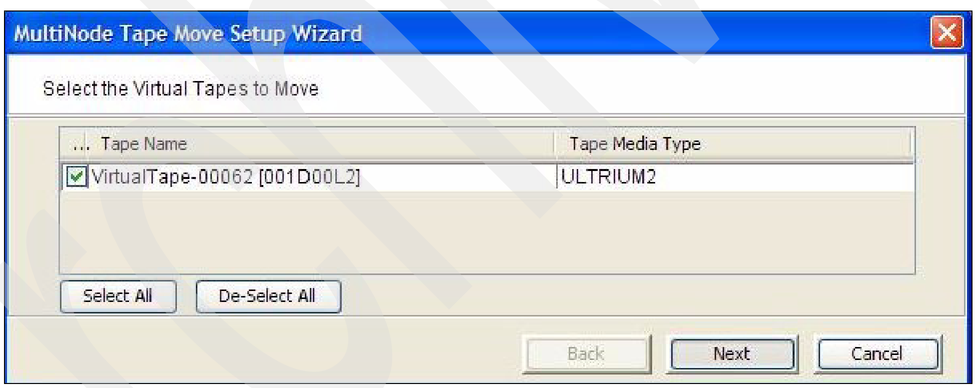



*Figure 12-29 Virtual tape selection*

3. Select the server you want to share the virtual tape with and click **Next**.

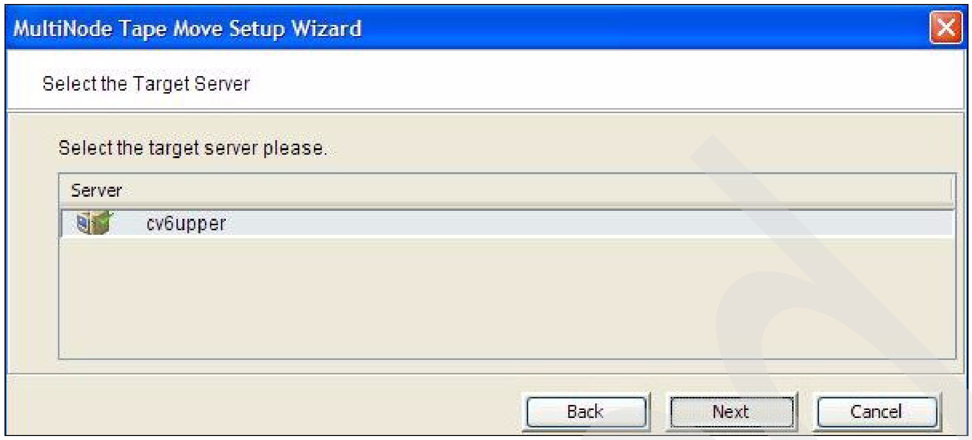



*Figure 12-30 Selecting target server*

4. In the following window (see Figure 12-31), you must then enter the hostname or IP address of the target TS7530 node. Click **Next**.

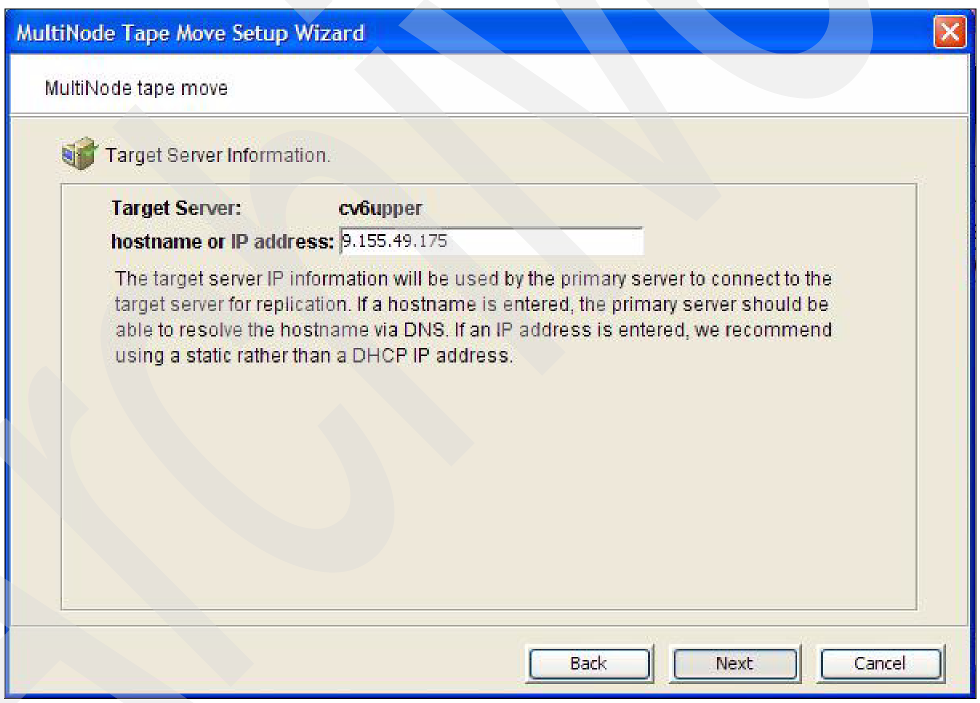



*Figure 12-31 Entering the hostname or IP address of target TS7530 node*

5. The next window is optional. By default the virtual tape is moved to the virtual vault of the target TS7530 node. You can select the virtual library where you want to assign the virtual tape and then click **Next**. See Figure 12-32.

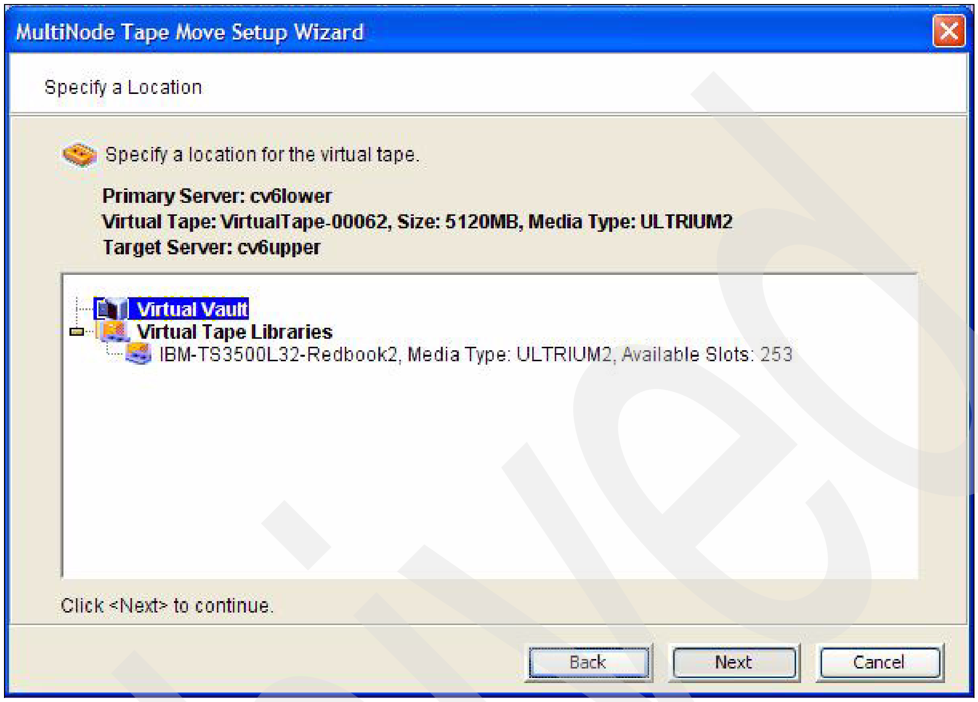



*Figure 12-32 Selecting target location for the virtual tape*

6. You will now see a verification window on which you must click **Next** to continue. This is followed by a window indicating the success or failure of the procedure. Upon completing the process you are able to see the virtual tape has now moved to the target location as shown in Figure 12-33.

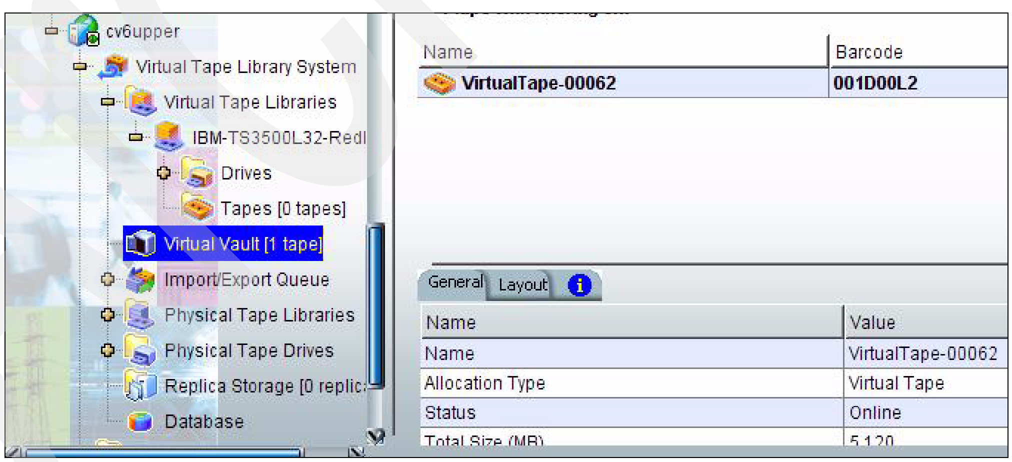



*Figure 12-33 Virtual tape now assigned to target node*

## 12.4.3 Reversing the move

To reverse the process and assign the virtual tape back to the source TS7530 node:

1. The virtual tape must first be moved back to the virtual vault.
2. Once that is complete, right-click the **Virtual Vault** and select **Force ownership return**. See Figure 12-34.


*Figure 12-34 Force ownership return*

3. You then get a window like the one shown in Figure 12-35 to verify the tapes you want to move back to the source node. After verifying the selection, click **Next**.

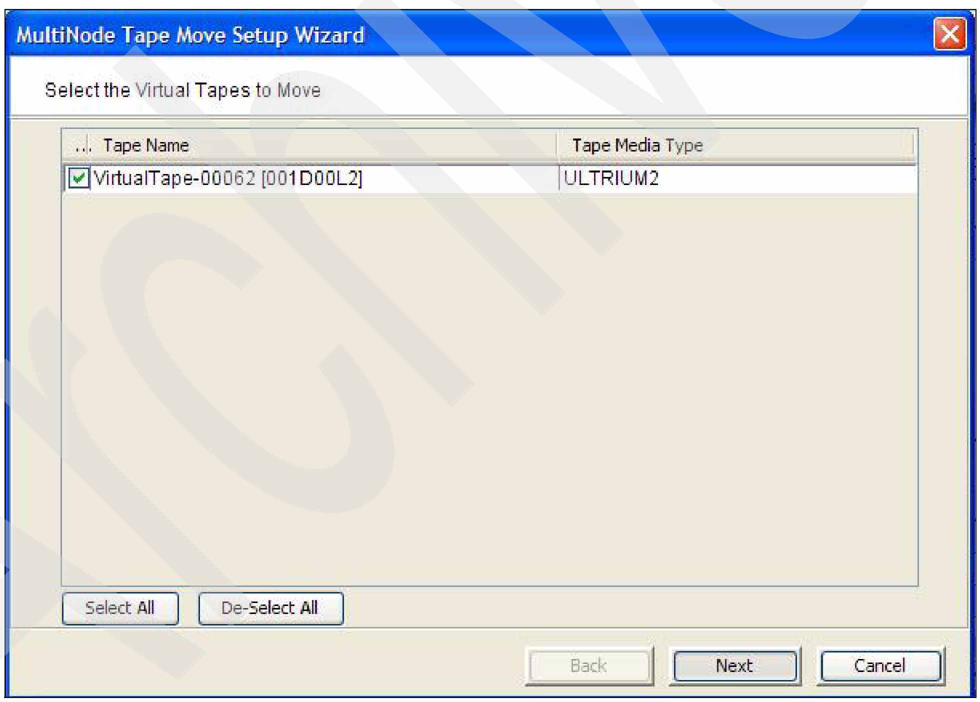



*Figure 12-35 Virtual tape selection*

4. The next window (Figure 12-36) is optional. By default the virtual tape is moved back to the virtual vault of the source TS7530 node. However, you can select the virtual library where you want to assign the virtual tape.

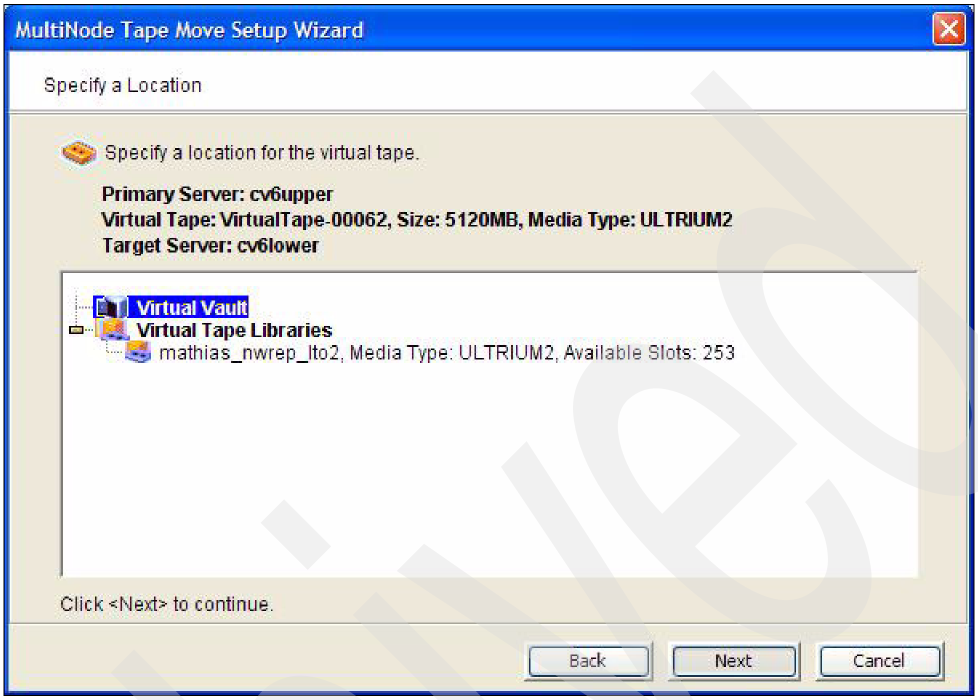



*Figure 12-36 Selecting source location for the virtual tape*

5. You will now see a verification window which you must click **Next** to continue. This is followed by a window indicating the success or failure of the procedure. Upon completing the process you are able to see that the virtual tape has now moved back to the source location.

## 12.4.4 Promote volumes

Having used local or remote replication and remote copy, you must promote your tapes to make them accessible in another virtual library or virtual vault.

Select **<your TS7530> node** → **Storage Replica**. Select virtual tapes to promote, right-click, and select **Promote**, as shown in Figure 12-37.

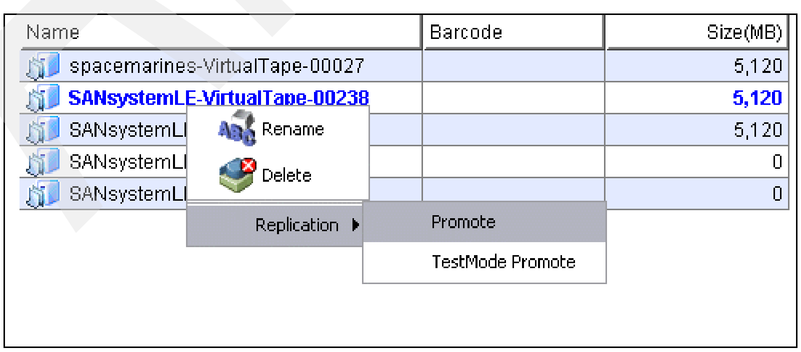



*Figure 12-37 Promote replicate tape*

You will be presented with the Promote verification window shown in Figure 12-38.

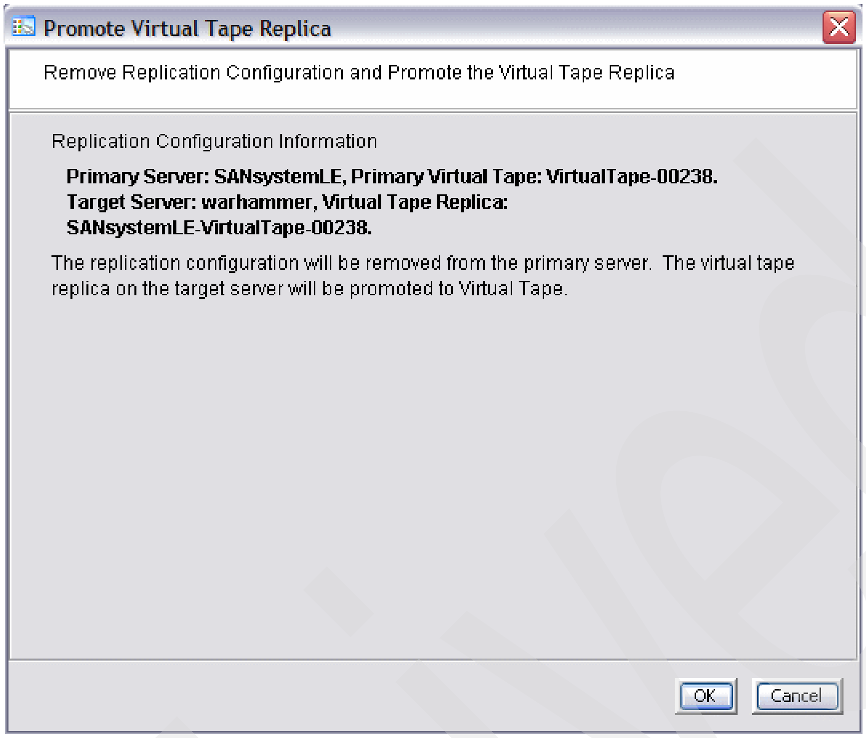



*Figure 12-38 Promote verification window*

Note that there is an option to also Test Promote on the window shown in Figure 12-37 on page 398. Test Promote suspends the replication allowing the verification of the target virtual tape. This does not break the link to the source TS7530.

**Warning**: Due to the potential for data loss, do not define virtual volumes which have the same barcodes as physical volumes in any library that you plan to attach. The virtual volumes used with physical volumes are automatically created during library synchronization. Refer to 12.5.3, "Creating a cache for your physical tapes" on page 404, for details of library synchronization.

## 12.5 Enhanced Tape Caching

The Enhanced Tape Caching function enhances the functionality of the TS7530 Virtualization Engine by acting as a cache to your physical tape library, providing transparent access to data regardless of its location. With the Enhanced Tape caching option, tapes will always appear to be inside virtual libraries and will be visible to the backup application regardless of whether the data is actually on disk or tape. This means that the backup application will always have direct access to data regardless of whether the data is on disk or on physical tape.

When you create a virtual tape library, you can set up the Enhanced Tape Caching policies for the library. For information about virtual library creation, see 6.6, "Virtual libraries" on page 204.

Additional operations that can be performed for Enhanced Tape Caching are:

- Creating or changing a tape cache policy for an existing virtual tape library
- Adding additional cached volumes to an existing cached virtual tape library
- Manually migrating a cached virtual volume to a physical tape volume
- Manually reclaiming the disk space for a cached virtual volume
- Manually resetting (scratching) the cache for a virtual cached volume

Even though you are using Enhanced Tape Caching for your tape library, you can still create uncached virtual tapes that will not be migrated to physical tapes. This can be useful for a single backup that is not part of your normal backup routine. You can create one or more virtual tapes by right-clicking a virtual tape library or on the Tapes object and selecting New Tape(s).

**Restriction:** If you create non-cached virtual tapes in a cached virtual library, the barcodes of the non-cached virtual tapes cannot match the barcodes of your physical tapes.

## 12.5.1 Adding or changing a tape caching policy

To create or change a tape caching policy:

1. Right-click a virtual tape library and click **Enhanced Tape Caching**, as shown in Figure 12-39.

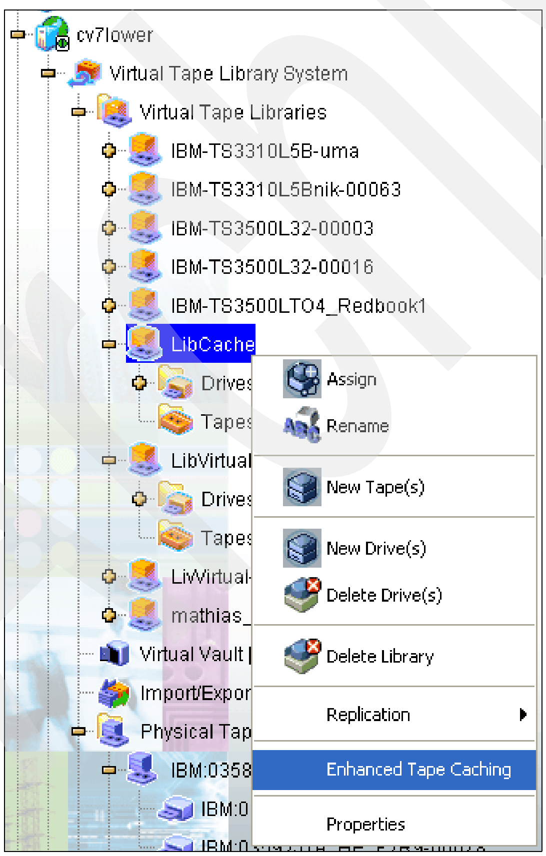



*Figure 12-39 Select Enhanced Tape Caching*

2. Select the **Enable Enhanced Tape Caching** check box and chose either time-based or policy-based triggers, as shown in Figure 12-40 and Figure 12-41 on page 402.

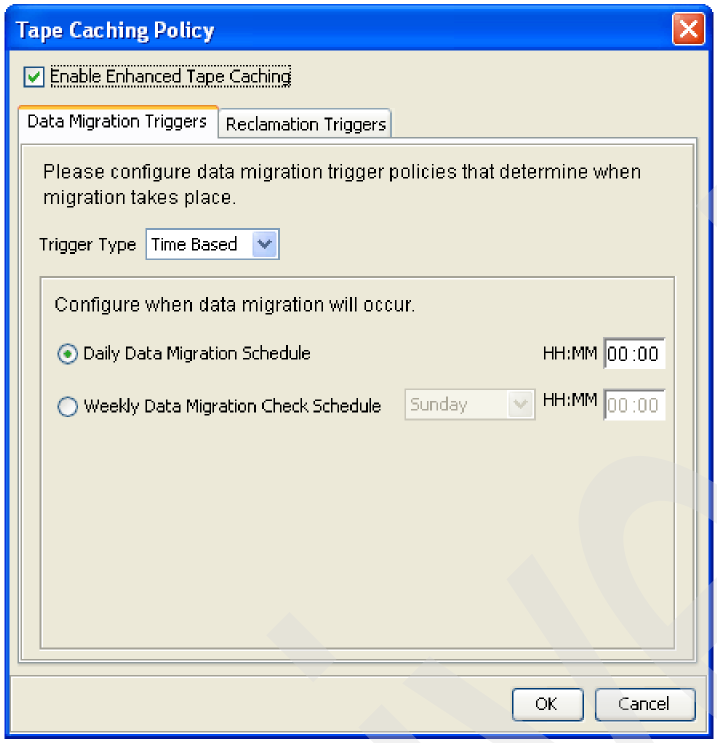



*Figure 12-40 Enable Tape Caching with time-based triggers*

On the Data Migration Triggers tab, select the type of data migration triggers that you want to set. Data migration triggers control when data in the cache will be copied to physical tape. For Time Based triggers, specify when data migration should actually occur.

**Daily Data Migration Schedule** Migration occurs at a specific time of day. Type the hour and minute (in 24-hour format) in the box. For example, if you want the migration to occur at 11:30 p.m., you would type 23:30.

**Weekly Data Migration Check Schedule** Migration occurs on a specific day of the week. Select the day of the week from the list and type the hour and minute (in 24-hour format) in the text box.

**Note:** For daily or weekly migration, if the specified time has already elapsed when the trigger occurs, the migration will occur at the next scheduled day and time.

For policy-based triggers, determine what criteria will trigger migration. Click **And** if all the selected criteria must be met to initiate the data migration, or click **Or** if meeting any one of them will initiate the data migration.

For example, if you select both **Age Based** and **Disk Capacity Based** and click **And** (Figure 12-41), data migration will occur only when both the specified number of days has elapsed and the specified disk capacity has been reached. If you click **Or**, the occurrence of either one of those events will trigger the data migration.

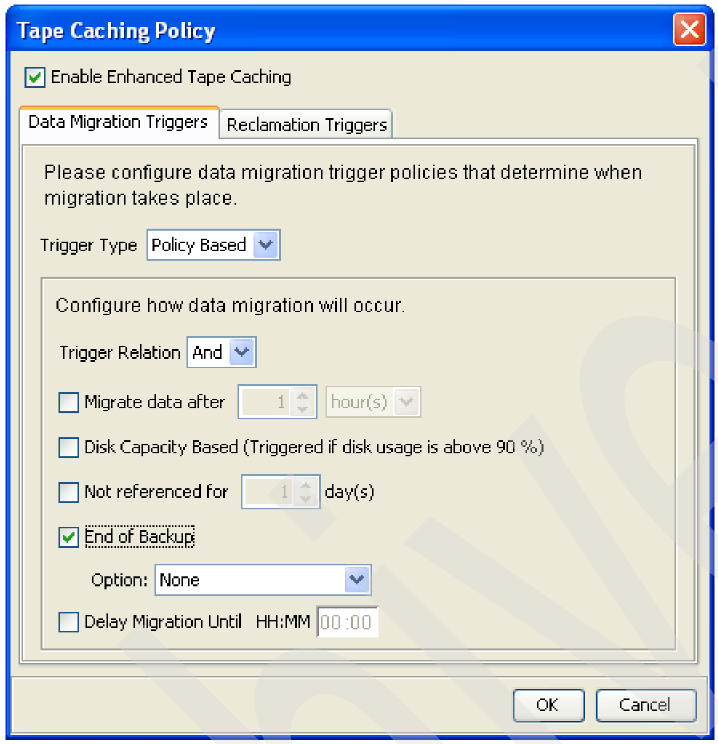


*Figure 12-41 Enable Tape Caching with policy-based triggers*

Make your selection as appropriate:

**Migrate data after** Migration will occur when the data has been on the virtual disk for a specified number of days. Specify the desired number of days in the list box.

**Disk Capacity Based** Migration will occur when the used disk space exceeds the specified disk capacity (default 90%). To specify the amount of used space that will trigger data migration, right-click **Virtual Tape Library System** in the tree, click **Properties**, and type the desired percentage in the Tape Caching Policy Disk Capacity Threshold box. Notice that the Tape Caching Policy Disk Capacity Threshold setting affects other capacity-based actions as well.

**Not referenced for** To migrate data that has not been referenced for a specified number of days, select the number of days.

**End of Backup** Migration will occur when a backup has completed and the virtual tape has been moved out of the virtual drive. If you select **Only When Tape is Full**, migration will only occur if the tape is full.

**Delay Migration Until** Migration is delayed until the time you specify after one of the other policies has been triggered. You can want to select a time when system usage is very light. Type the hour and minute (in 24-hour format) in the box.

3. As shown in Figure 12-42, click the **Reclamation Triggers** tab and specify when the data that has been migrated to physical tape can be deleted to free up cache disk space.

**Attention:** After the reclamation is complete, the tape will become a direct link tape. A direct link tape is not a virtual tape but a link to a physical tape. If your backup application ever writes the direct link tape from beginning of tape (BOT) with label verification or scratch write, the TS7530 Virtualization Engine will automatically create a new, empty cache for the physical tape and will write to the cached virtual tape volume.

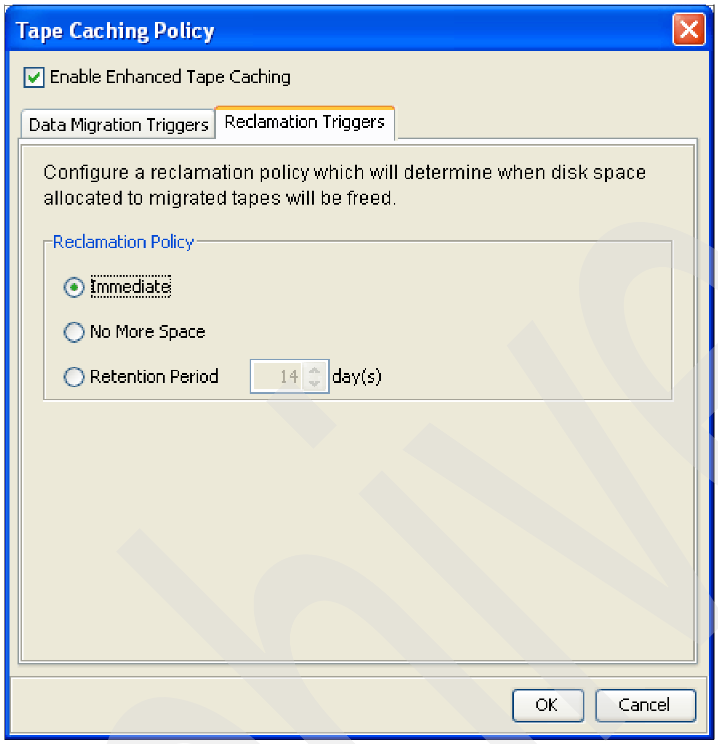



*Figure 12-42 Set reclamation triggers*

Make your selection as appropriate:

**Immediate** Cache disk space is freed up as soon as the data migration is complete.

**No More Space** Cache disk space is freed up when additional space is needed.

**Retention Period** Cache disk space is freed up after a specified number of days has elapsed. Specify the number of days that the data should be retained in the adjacent list.

Click **OK**. This policy takes effect immediately.

**Important:** Once the disk space for a migrated cached virtual tape volume is reclaimed and a direct link tape is created, the data from the physical tape volume associated with the direct link tape cannot be restored into the cache. All access to the data on the physical tape will require a physical tape mount, and all reads and writes (with the exception of a scratch write) are executed against the physical tape volume.

Note that when you move a tape from the virtual tape library to a vault, it retains the Tape Caching policy associated with the original virtual tape library.

4. You can use Enhanced Tape Caching only if you are not currently using the Physical Copy/Network Copy feature on this virtual tape library (Figure 12-43). Click **Yes**.

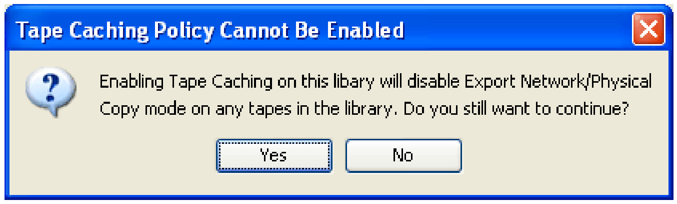



*Figure 12-43 Confirm window*

## 12.5.2 Disable a policy

To disable a tape caching policy:

1. Right-click a virtual tape library and click **Enhanced Tape Caching**.
2. Clear the **Enable Tape Caching Policy** check box. All the options that you previously set are retained, but data migration will not occur automatically until you select this check box again.
3. Click **OK**.

## 12.5.3 Creating a cache for your physical tapes

With the Enhanced Tape Caching option, data is stored on disk before being migrated to physical tape. To write data to cache, you must create a cache for each of your physical tapes. When you create a cache, you are effectively creating a cached virtual tape copy of a physical tape. The cached virtual tape has the same barcode as the physical tape to which it is linked.

When you select **Enhanced Tape Caching** at library creation, the Create Virtual Library Wizard can create the cache. After initial library creation, you can add more physical tape volumes to your virtual library and create cached virtual volumes for those newly added physical volumes.

To create a cache for a physical tape:

1. Right-click your virtual tape library and select **Sync Library** (Figure 12-44).

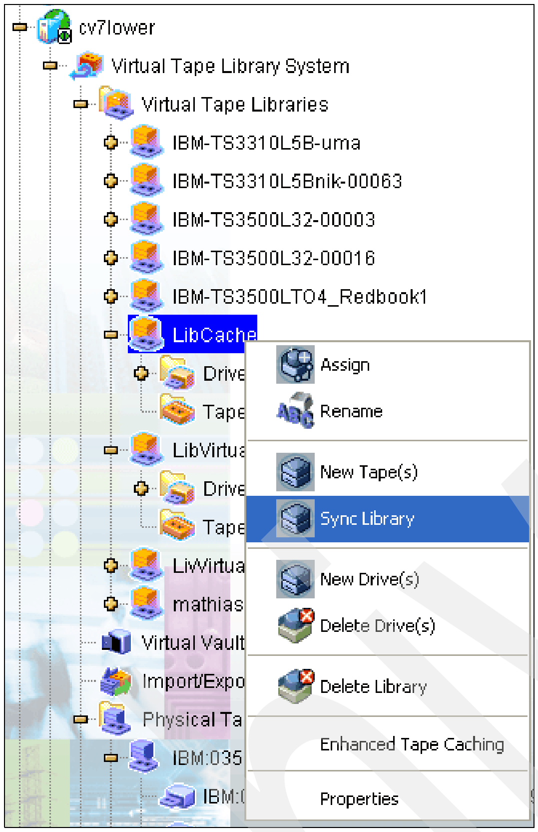



*Figure 12-44 Select Sync Library*

2. If you have multiple libraries, select the appropriate physical library (Figure 12-45).

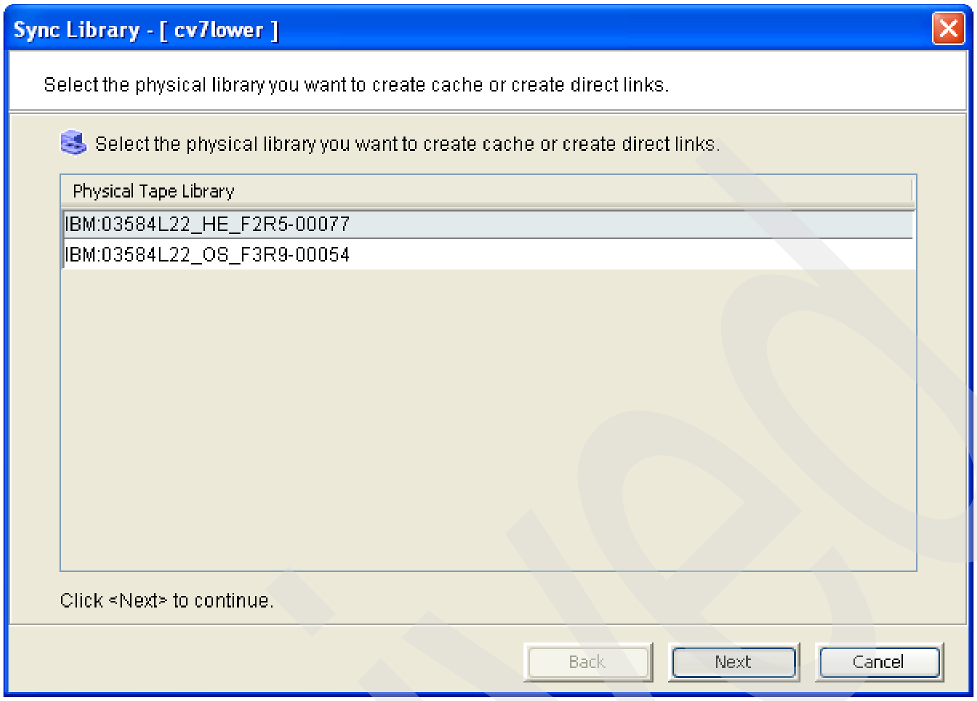



*Figure 12-45 Select the physical tape library for cache creation*

3. Select the physical tapes for which you want to create a cache and click **Next** (Figure 12-46).

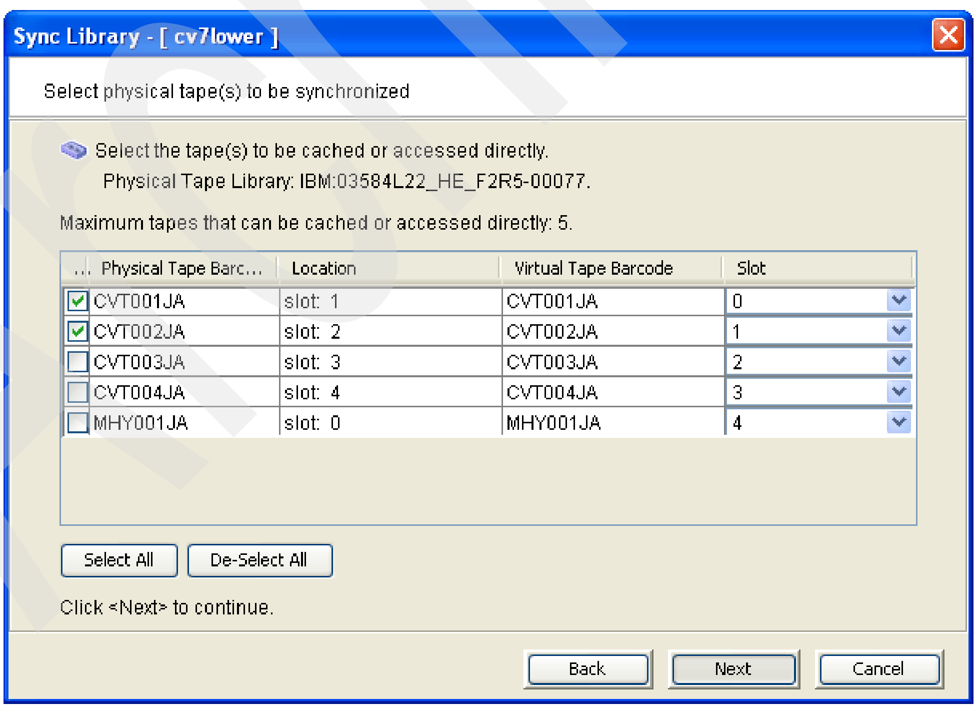



*Figure 12-46 Select the physical tape volumes for cache creation*

4. As shown in Figure 12-47, you have the option of selecting Create Cache or Create Direct Link.

– If you select **Create Cache**, a cached virtual tape volume is created for each physical tape volume selected on the Select physical tapes to be synchronized window (Figure 12-47). If your backup application requires a tape header to identify a tape, you must also select **Copy meta data**.

– If you select **Create Direct Link**, no cached virtual tape volume is created and all reads and writes are performed on the selected physical tape volumes.

– If you have created keys for the TS7530 Secure Tape feature as described in 7.3.2, “Secure Tape software encryption” on page 269, and you want to use the Secure Tape software encryption for the selected physical tape volumes, select **Use encryption/decryption on tape(s)** and then select the appropriate key from the drop-down box.

Click **Next**.

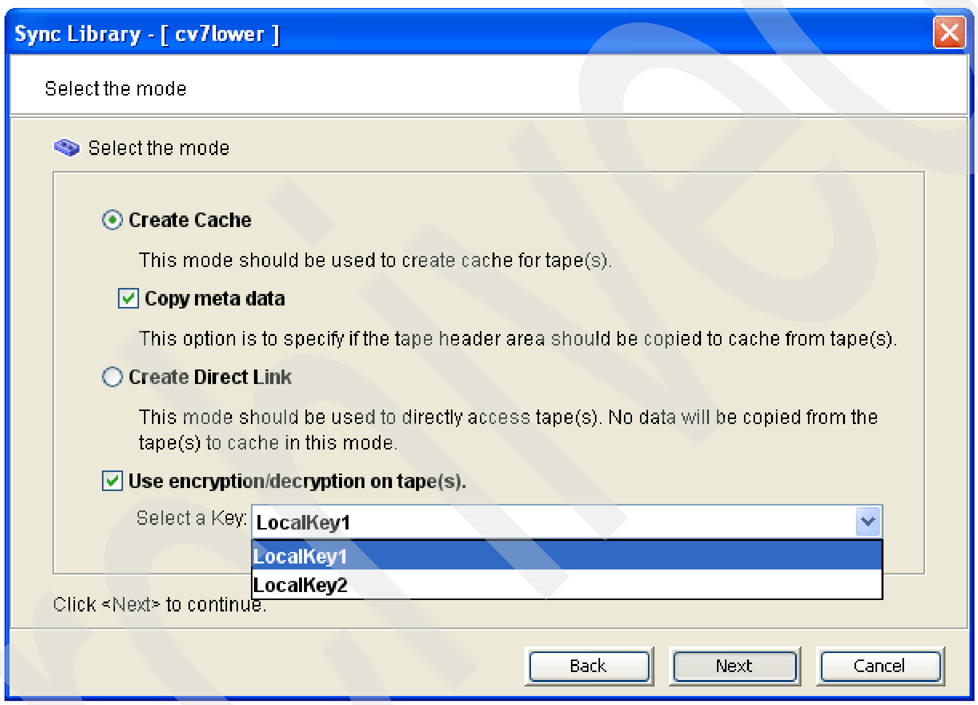



*Figure 12-47 Select the Enhanced Tape Caching mode*

5. Confirm all information (Figure 12-48) and click **Finish**. If advanced tape creation is enabled, specify how the cache should be created.

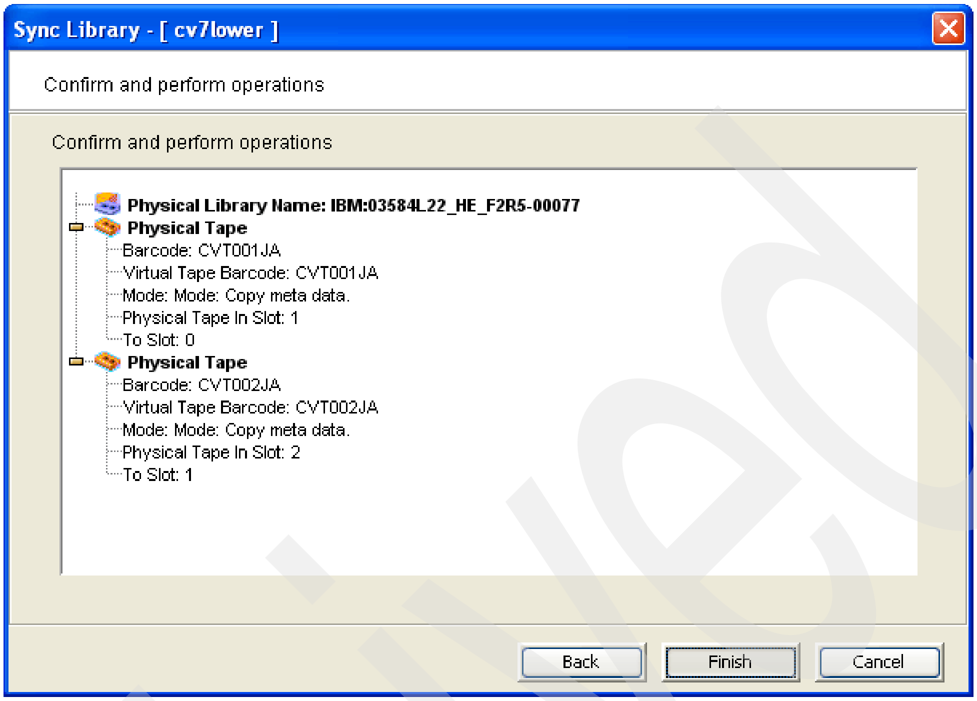



*Figure 12-48 Tape cache creation confirmation window*

## 12.5.4 Manual migration to physical tape

You can manually cause data on a cached virtual volume to be migrated to the physical tape volume with the same barcode.

1. As shown in Figure 12-49, right-click a cached virtual tape volume and select **Migrate to Physical Tape**. Note that migration to physical tape overwrites all data on the physical tape volume with the matching barcode.

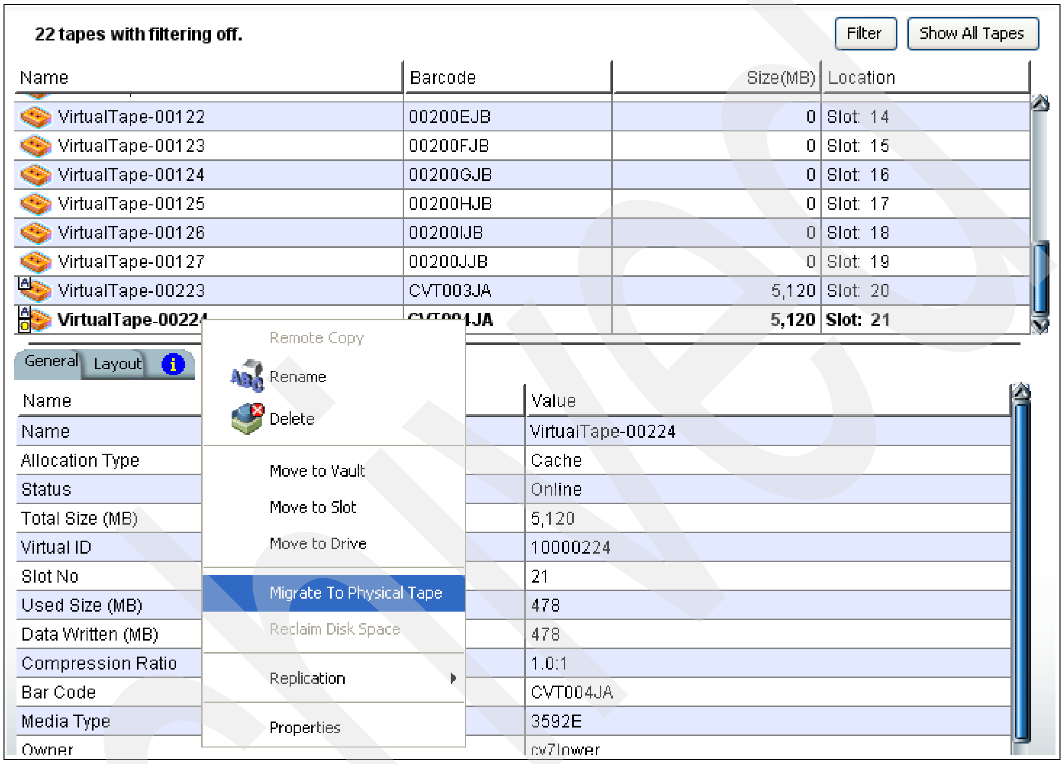



*Figure 12-49 Manual migration to a physical tape volume*

2. The TS7530 presents a verification window, as shown in Figure 12-50. Type `yes` to confirm and click **OK** to continue.

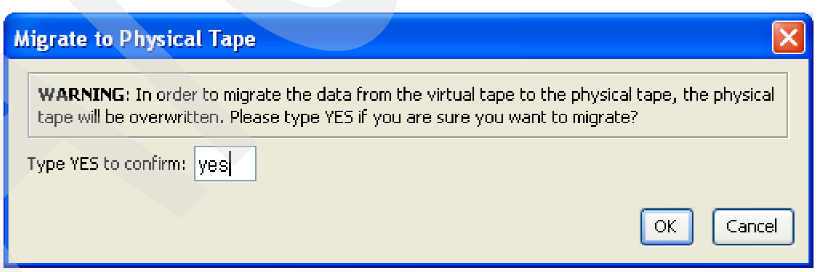



*Figure 12-50 Manual migration verification*

3. When the tape migration request window (Figure 12-51) appears, click **OK**.

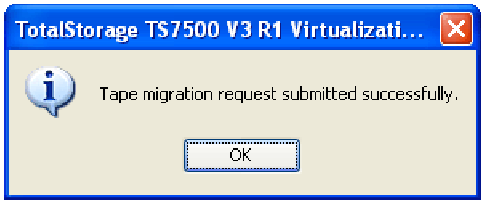



*Figure 12-51 Tape migration request completion*

4. When tape migration job executes, the job is listed in the Import/Output Queue. When you select the migration job, you can monitor the progress of the migration, as shown in Figure 12-52.

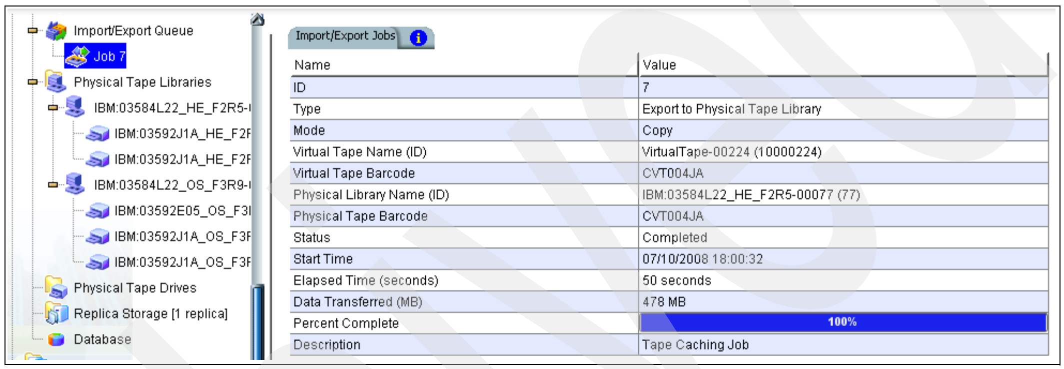



*Figure 12-52 Migration job on input/output queue*

## 12.5.5 Reclaiming disk space manually

You can manually reclaim or delete the data on a cached virtual tape volume that has been migrated to a physical tape volume to free up cache disk space.

To do this for a single cached virtual volume:

1. Right-click a cached virtual volume and select **Reclaim Disk Space** (Figure 12-53). Once disk space has been reclaimed, it will become a direct link tape, which does not occupy disk space.

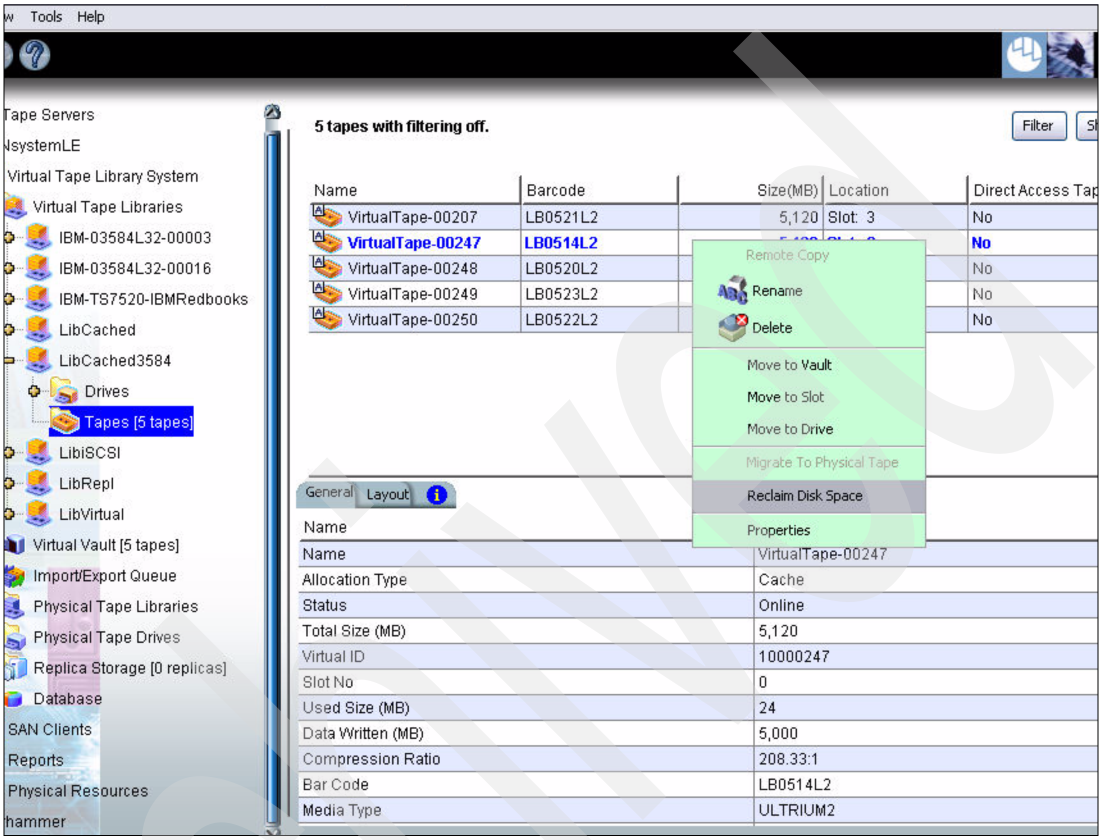



*Figure 12-53 Reclaim disk space for a single cached virtual volume*

2. To confirm the disk space reclamation, type `yes` and click **OK** on the Reclamation confirmation window shown in Figure 12-54.


*Figure 12-54 Reclamation confirmation*

3. After the space is reclaimed the size of the virtual tape volume is reset to zero and the allocation type is Direct Link Tape (Figure 12-55).

**Attention:** After the reclamation is completed, the tape will become a direct link tape. A direct link tape is not an actual tape, but a link to a physical tape. If your backup application ever writes the direct link tape from beginning of tape (BOT) with label verification or scratch write, the TS7530 Virtualization Engine will automatically create a new, empty cache for the physical tape and will write to the cached virtual tape volume.

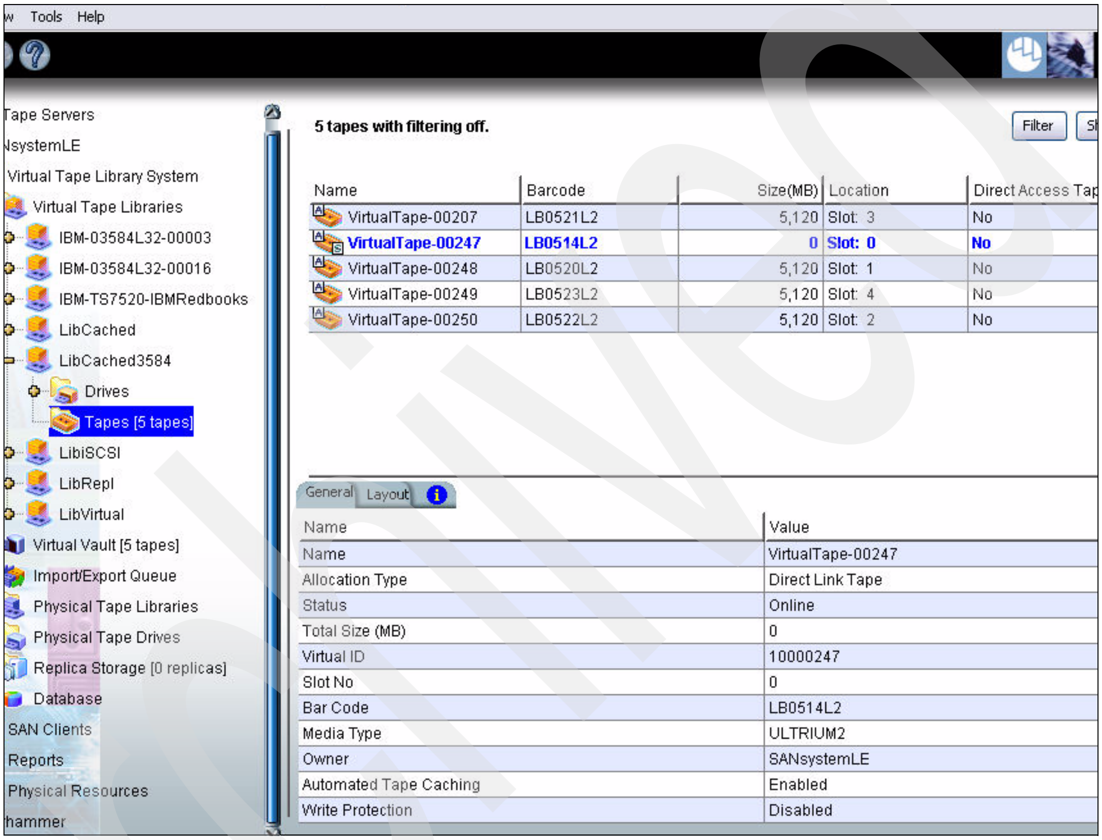



*Figure 12-55 Reclaimed cached virtual volume or Direct Link Tape*

To do this for multiple tape caches, right-click the Virtual Tape Library System object and select **Reclaim Disk Space**.

**Important:** Once the disk space for a migrated cached virtual tape volume is reclaimed and a direct link tape is created, the data from the physical tape volume associated with the direct link tape cannot be restored into the cache. All access to the data on the physical tape will require a physical tape mount, and all reads and writes (with the exception of a scratch write) are executed against the physical tape volume.

## 12.5.6 Renewing cache for a direct link tape

If your backup application ever does a write from beginning of tape or scratch write on a direct link tape (a tape for which cache has been reclaimed), the TS7530 Virtualization Engine automatically creates a new cached virtual volume for the physical tape and writes to the newly created cached virtual volume. This eliminates the direct link. You can also manually renew or recreate the cached virtual tape volume for a direct link tape. The cache is empty and all data is written to the renewed cache. To do this, right-click a direct link tape and select **Renew Cache** (Figure 12-56).

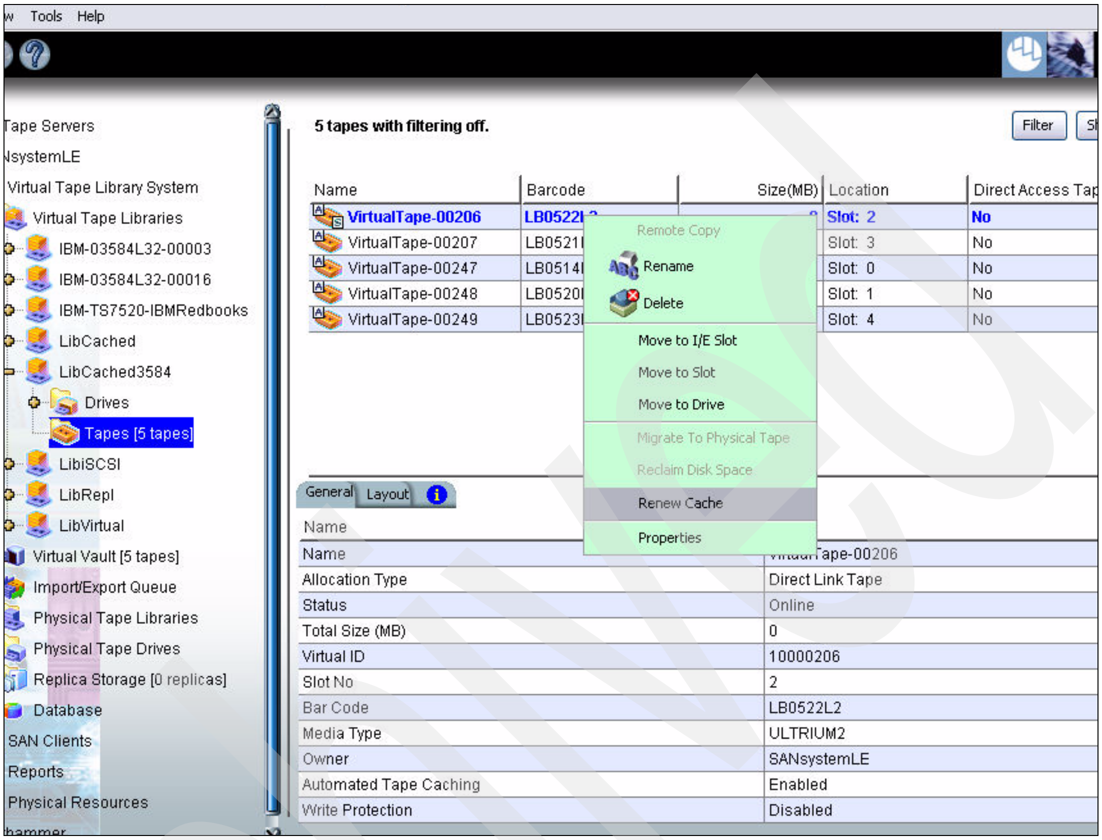



*Figure 12-56 Renew cache for a direct link tape*

## 12.6 Key management

In this section we provide operational details for using the secure tape function of the TS7530 Virtualization Engine.

## 12.6.1 Adding a key

To add a key to use for secure tape data encryption:

1. Right-click the TS7530 Server name and click **Key Management** (Figure 12-57).

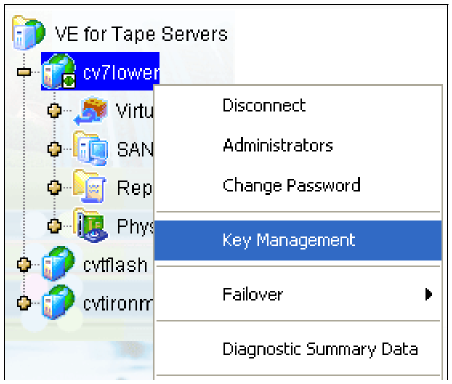



*Figure 12-57 Starting the key management process*

2. Click **New** on the Key Management window (Figure 12-58) to add a key.


*Figure 12-58 Initial key management window*

3. In the window shown in Figure 12-59 on page 415:

   a. Type a unique name for the key (1–32 characters) in the Key Name text box.

   b. Type the phrase (25–32 characters, including numbers and spaces) in the Secret Phrase text box that will be used to encrypt the data.

**Important:** We recommend that you save your secret phrase, because once you have created a key, you cannot change the secret phrase associated with that key.

c. Type a password for accessing the key (10–16 characters) in the New Password and Confirm Password text boxes. The password is case sensitive.

You do not have to provide a unique password for each key. If you use the same password for multiple keys, you have to provide the password only once when you export multiple keys that all use the same password.

**Attention:** You must provide the password to change the key name, password or password hint, or to delete or export the key.

d. Type a hint (0–32 characters) in the Password Hint text box to help you remember the password. This hint appears when you type an incorrect password and request a hint.

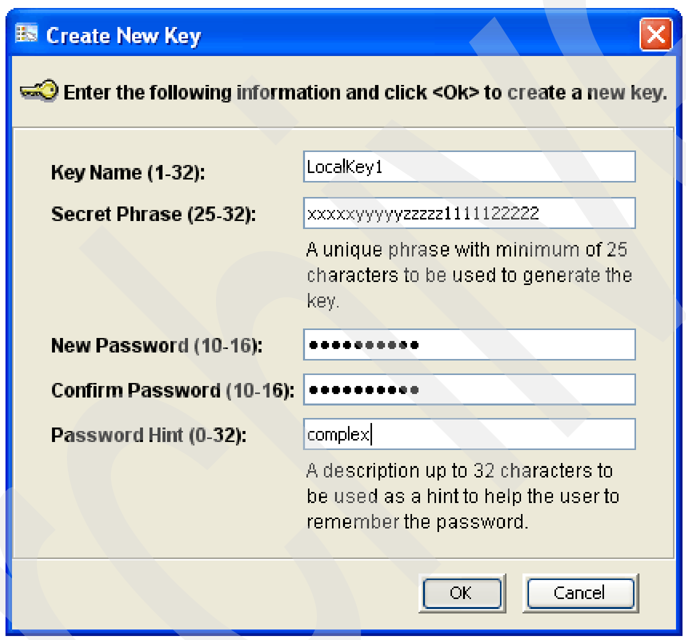



*Figure 12-59 Create New Key*

In our example we created a key named LocalKey1, with a secret phrase of xxxxxyyyyyzzzzz1111122222, the password was ComplicatedKey and the hint was complex.

These keys were created for illustrative purposes and may not comply with the security requirements for your establishment. Follow your local security standards.

**Note:** After we completed the creation of LocalKey1, we created a second key call LocalKey2 with a secret phrase of *aaaaabbbbbccccc4444455555*, the password was *simplesimple* and the hint was *simple*.

4. Click **OK**. Your new key name is displayed on the Key Management window shown in Figure 12-60.


*Figure 12-60 Key Management window with one key*

## Displaying the password prompt

If you enter an incorrect password, the system provides an opportunity to reenter the password and displays the password prompt. If you have forgotten a password, you can enter an incorrect password to have the password hint displayed. When you enter an incorrect password, the following windows appear:

1. Click **OK** on the incorrect password window shown in Figure 12-61.

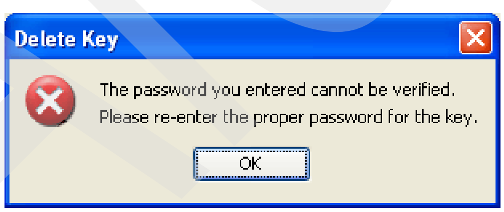



*Figure 12-61 Incorrect password*

2. On the panel in Figure 12-62, click **Yes** to request the hint.

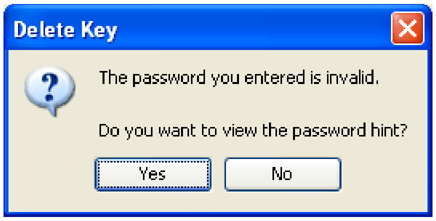



*Figure 12-62 Request password hint*

3. Enter the correct password on the panel shown in Figure 12-63 and click **OK**.


*Figure 12-63 Password entry window with hint*

## 12.6.2 Changing a key name or password

Once you have created a key, you cannot change the secret phrase associated with that key. You can change the name of the key and the password used to access the key and the hint associated with that password.

If you rename a key, you can still use that key to decrypt data that was encrypted using the old key name. For example, if you encrypt data using Key2007, and you change its name to Key2008, you can decrypt the data using Key2008, since the secret phrase is the same.

To change a key name or password:

1. Right-click the TS7530 Server name and select **Key Management** in the navigation tree, as shown in Figure 12-64.

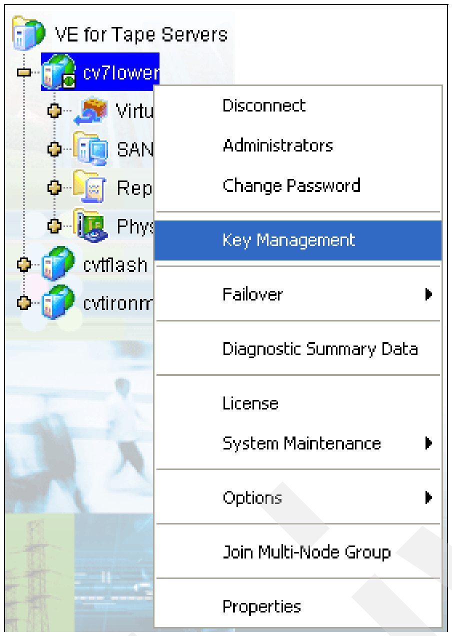



*Figure 12-64 Starting the key management process*

2. Select the key that you need to change in Figure 12-65 and click **Edit**.


*Figure 12-65 Selecting LocalKey1 to edit*

3. In the window shown in Figure 12-66, enter the current password for accessing the key in the Password text box. We entered the password `ComplicatedKey`, which was set when this key was created. Refer to 7.3.2, “Secure Tape software encryption” on page 269. The password is case sensitive.

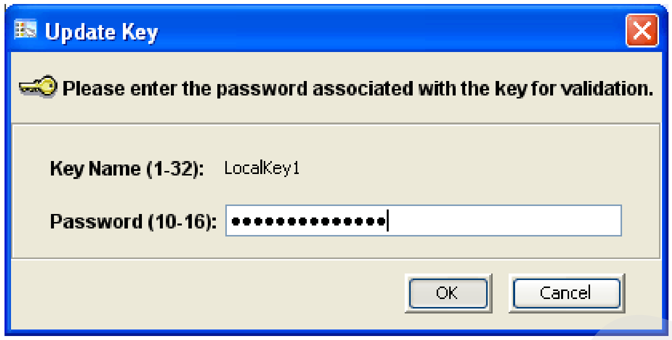



*Figure 12-66 Password prompt for editing a key*

> **Important:** If you closed the Key Management dialog after creating the key, you are prompted for the current password for accessing the key in the Password text box. If you created the key, decided to change the key, and have not exited the Key Management dialog, you are not prompted for the password.

4. You can change the key name, password or password hint in the window shown in Figure 12-67. We changed the password to `complicatedkey` to remove the upper case characters, since the password is case sensitive.

   Click **OK** after you have completed your changes. Figure 12-67

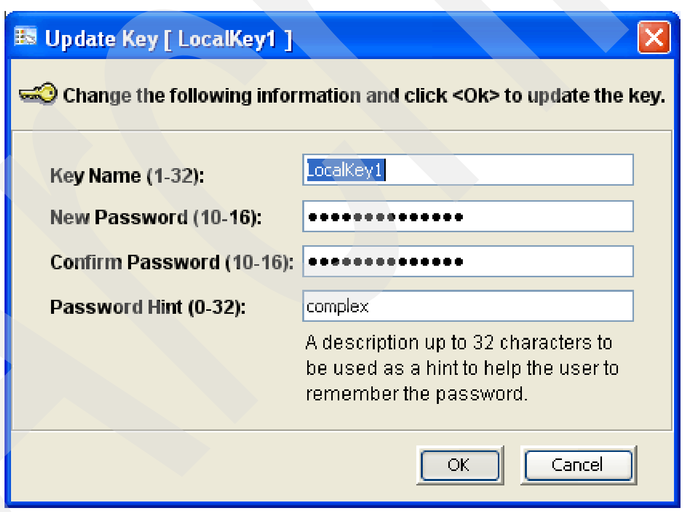



*Figure 12-67 Update Key window*

### 12.6.3 Deleting a key

> **Important:** Once you delete a key, you can no longer decrypt tapes that were encrypted using that key, unless you subsequently create a new key that uses the exact same secret phrase, or import the key with the exact same secret phrase from a key package.

To delete a key:

1. Right-click the TS7530 Server name and select **Key Management** in the navigation tree, as shown in Figure 12-68.

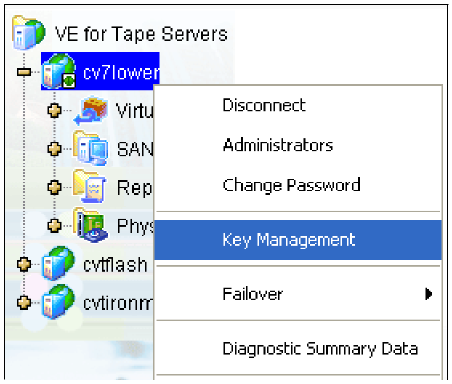



*Figure 12-68 Starting the key management process*

2. From the panel shown in Figure 12-69, select the key that you want to delete from the Key Name list and click **Delete**.


*Figure 12-69 Select key to delete*

3. Type the password for accessing this key in the Password text box. We deleted LocalKey2 so we entered the password *simplesimple* that was set when the key was added. Refer to 7.3.2, “Secure Tape software encryption” on page 269. The password is case sensitive.

4. In the panel in Figure 12-70, type `yes` to confirm and click **OK**.

> **Important:** If you closed the Key Management dialog after creating the key, you are prompted for the current password for accessing the key in the Password text box. If you created the key, decided to change the key, and have not exited the Key Management dialog, you are not prompted for the password.

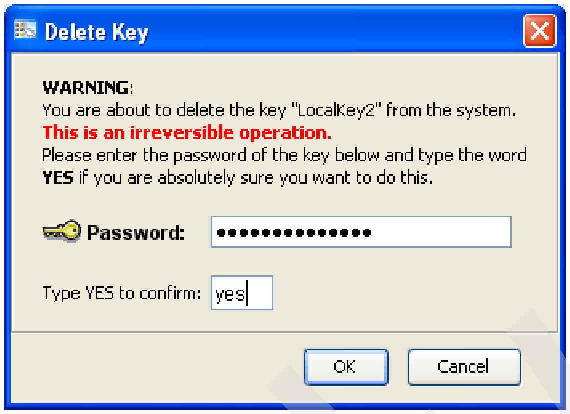



*Figure 12-70 Delete key password entry*

## 12.7 Exporting a key

When you export a key, you create a separate file called a key package that contains one or more keys. You can then send this file to another site that uses a TS7530 Virtualization Engine, and administrators at that site can import the key package and use the associated keys to encrypt or decrypt data.

Creating a key package also provides you with a backup set of keys. If a particular key is accidentally deleted, you can import it from the key package so that you can continue to access the data encrypted using that key.

To export a key:

1. Right-click the TS7530 Server name and select **Key Management** in the navigation tree, as shown in Figure 12-71.

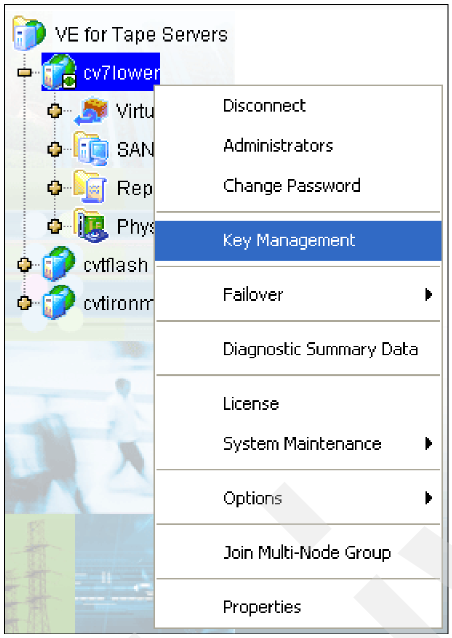



*Figure 12-71 Starting the key management process*

2. Click **Export** on the Key Management window.

3. In the panel in Figure 12-72:

   a. Type the file name to use for this key package (1–32 characters) in the Package Name text box. We used SecureKey1.

   b. Type a three-character hint in the Decryption Hint text box.

   When you subsequently attempt to import a key from this key package, you are prompted for a password. If you provide the correct password, the decryption hint specified here appears correctly on the Import Keys dialog box. If you provide an incorrect password, a different decryption hint appears.

   > **Attention:** You can import keys using an incorrect password, but you will not be able to decrypt any files using those keys.

   Select the keys that you want to include in the key package from the Select Keys to Export list.

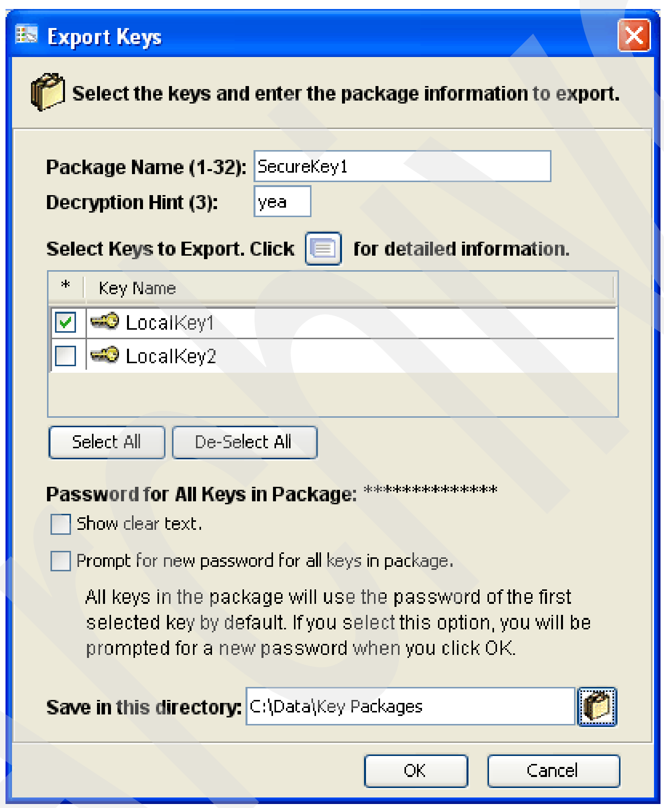



*Figure 12-72 Select a key to include in the key package*

4. When you select a key with a different password, a password check is made. In Figure 12-73 we selected LocalKey2.

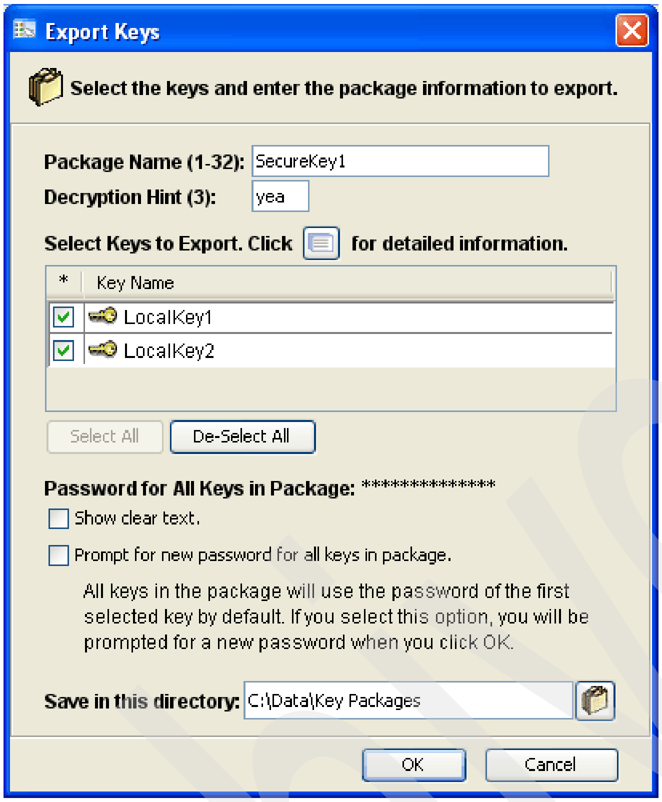



*Figure 12-73 Selecting additional keys for export package*

5. After you enter the password in the Password text box, that password appears in the Password for All Keys in Package area on the Export Keys dialog box as shown in Figure 12-74. By default, the password is displayed as asterisks.

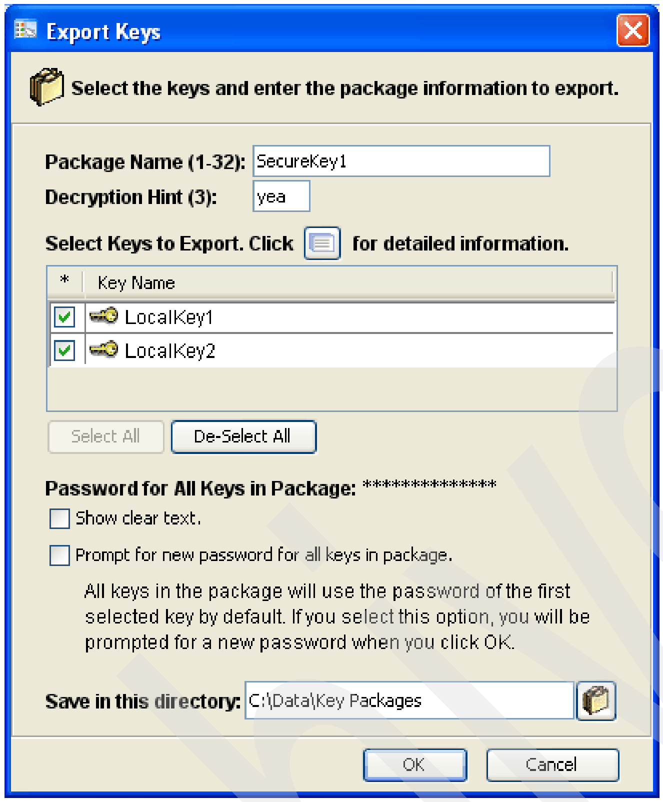



*Figure 12-74 Password for all keys in package displayed as asterisks*

6. To display the actual password, select the **Show clear text** check box as indicated in Figure 12-75. This password is used for all keys in the export package.

   If you selected a key and subsequently decide not to include it in the key package, you can clear the key. You can also clear all selected keys by clicking **De-Select All**.

   Enter the full path of the directory or click the folder button to search for the directory in which to save the export package and click **OK**.

   A file with the specified package name and the extension .key is created in the specified location.

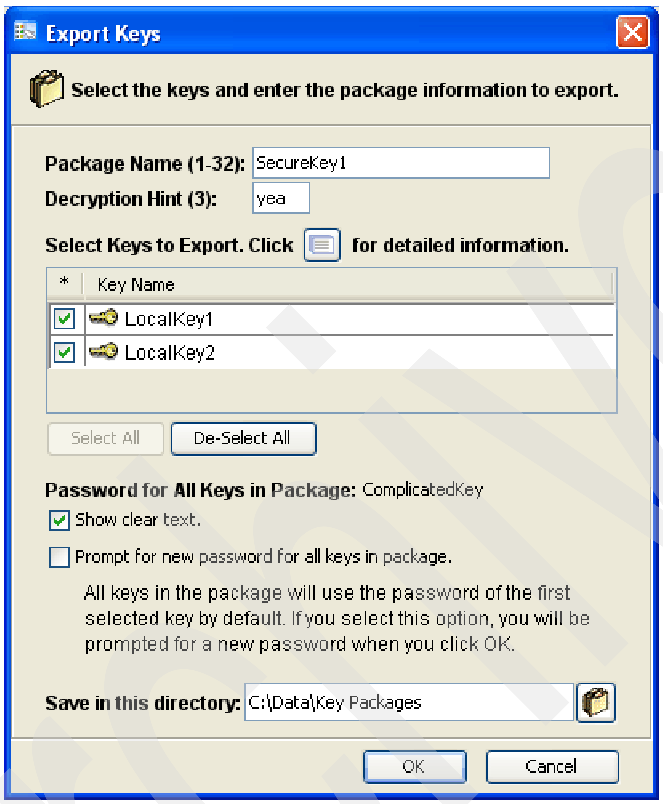



*Figure 12-75 Password for all keys in package displayed as clear text*

Alternatively, you can create a new password for all the keys in the package. In our example we created a second package SecureKey2. To create a new password for an export package:

1. From the window shown in Figure 12-76, select **Prompt for new password for all keys in package** and click **OK**.

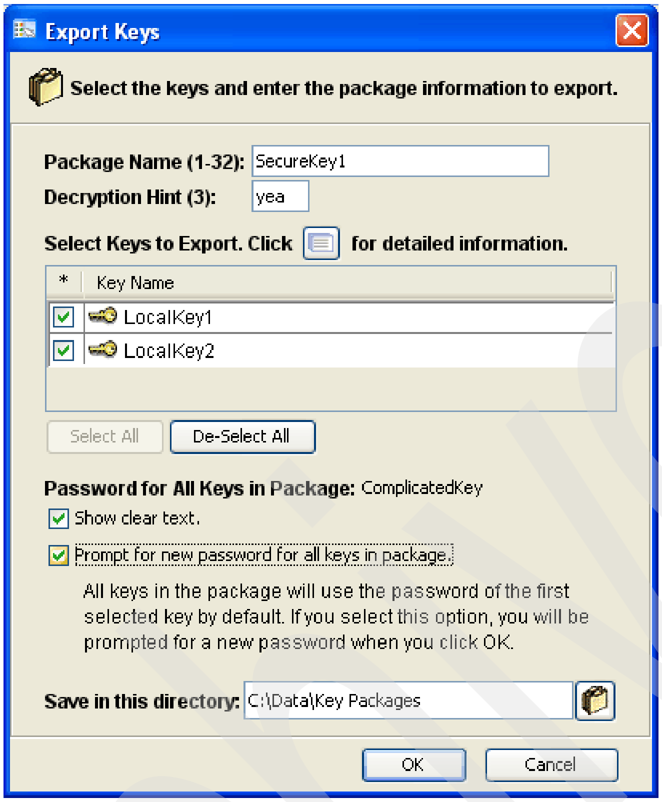



*Figure 12-76 Selecting prompt for new password for all keys in package*

2. Type the new password (10–16 characters) in the New Password and Confirm Password text boxes, type a hint for that password (0-32 characters) in the Password Hint text box, and click **OK**. We changed the password to *simplecomplexkey* and the password hint to *easyhard*. See Figure 12-77.

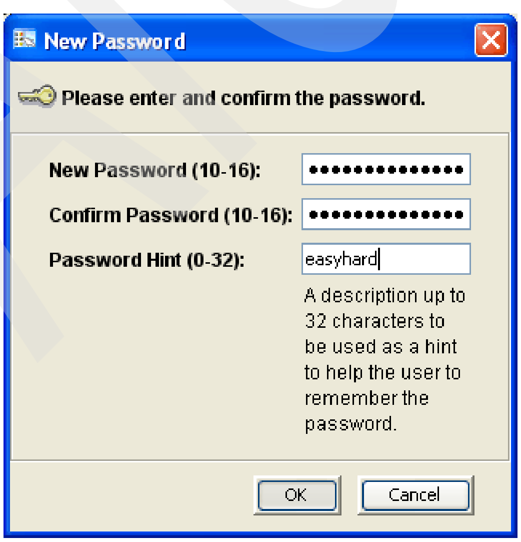



*Figure 12-77 Create new password for export package*

When you import a key from this package, you must use this password. All keys imported from this package will use this new password rather than the password originally associated with each key. You must also provide this password when you subsequently change, delete, or export any key imported from this package.

## Importing a key

Once you have created a key package, you can open that package and specify which keys to import into the TS7530. Once you import a key, you can use that key to encrypt or decrypt data.

To import a key:

1. Right-click the TS7530 Server name and select **Key Management** in the navigation tree, as shown in Figure 12-78.

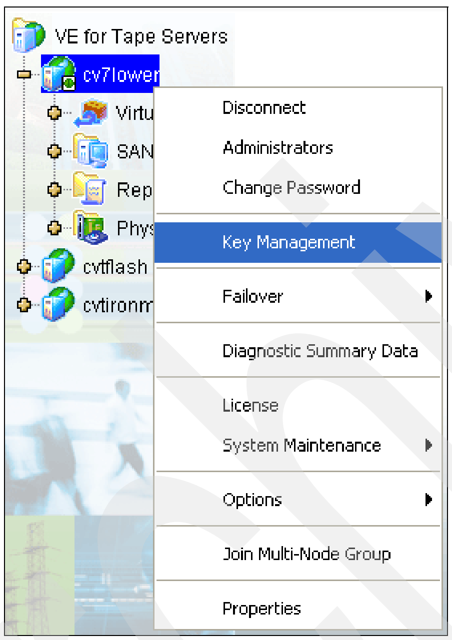



*Figure 12-78 Starting the key management process*

2. Click **Import** on the Key Management window shown in Figure 12-79.


*Figure 12-79 Key Management window*

3. When the Import Keys window is displayed (Figure 12-80 on page 430), perform the following steps:

   a. In the Find Package text box, enter the full path to the key package or click the folder button to search for the path. Click view to display the Package Name, Decryption Hint and Password. In our example, the Package Name is SecureKey1, the Decryption Hint is yea and the Password Hint is complex. This hint is for the password that is associated with all keys in this package.

      All keys in the package are displayed and you can select a single key or multiple keys to import.

      If the Decryption Hint does not match the hint you entered when you created the package, click the **Password** button to display a password prompt window and enter the correct password.

      **Important:** If you provide an incorrect password, you will still be able to import the keys in the package, but you will not be able to use them to decrypt any data that was previously encrypted using those keys.

   b. From the Select Keys to Import list, select the keys that you want to import. You can select only those keys that have a green dot and the phrase Ready for Import in the Status column. A red dot and the phrase Duplicate Key Name indicates that a key of the same name already exists in this instance of TS7530 and cannot be imported.

If you selected a key and subsequently decide not to import it, you can clear the key. You can also clear all selected keys by clicking **De-Select All**. (You can click this button only if the **Show All Keys** check box is cleared.)

> **Important:** A key of the same name might not necessarily have the same secret phrase. For example, you might have a key named MyKey1 with a secret phrase of:
>
> `ThisisthePhraseforkeyMyKey1.`
>
> If the key package was created by another instance of TS7530, it might also have a key named MyKey1, but its secret phrase might be:
>
> `ProtectMyKey1withthisPhrase.`
>
> Since the key names are the same, you will not be able to import the key in the key package unless you rename the existing MyKey1. After you rename the key, you can continue to use it to decrypt tapes that were encrypted using that key, and you can also import the key named MyKey1 from the key package and use it to decrypt tapes that were encrypted using that key.

c. Click **OK**.

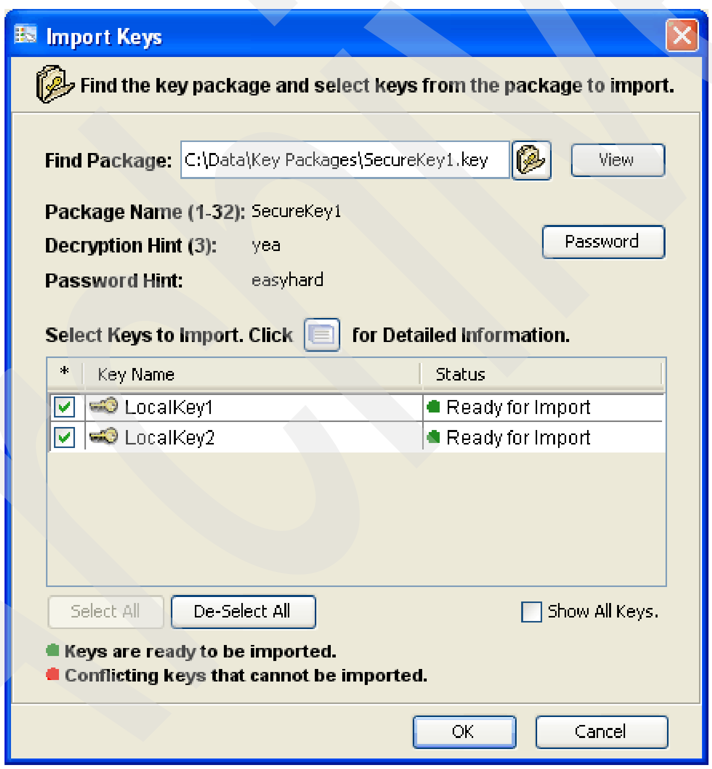



*Figure 12-80 Import key window*

The imported keys appear in the Key Name list on the Key Management dialog box. All keys have the password of the key package. You can edit the passwords as appropriate for your local security standards (see 12.6.2, “Changing a key name or password” on page 417).

## 12.8 Switching Fibre Channel ports between target mode and initiator mode

You can configure the Fibre Channel ports in initiator or target mode. You use initiator mode to connect to tape backup devices or the TS7530-SV6. You also use target mode to communicate with SAN hosts or a -end SAN switch.

You can find the status of the current HBAs as shown in Figure 12-81.

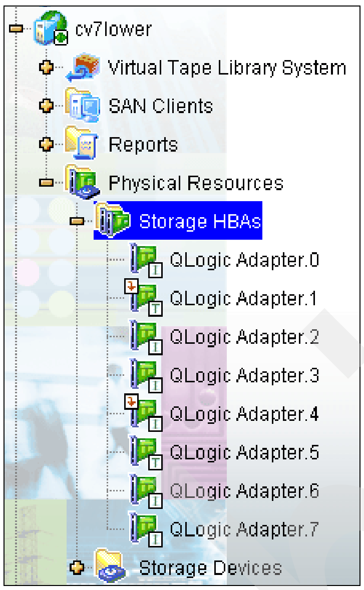



*Figure 12-81 Storage HBAs status window*

Table 12-1 describes the icons that are used to describe storage HBAs in the console.

*Table 12-1 Storage HBAs icon*

| Icon | Description |
|---|---|
| **T** | Indicates that this is a target port. |
| **I** | Indicates that this is an initiator port. |
| **D** | Indicates that this is a dual port. |
| **Red arrow** | Red arrow Indicates that this Fibre Channel HBA is down and cannot access its storage. |

> **Note:** A port in initiator mode with devices attached cannot change to target mode. A port in target mode with virtual tape libraries assigned cannot change to initiator mode.

## 12.8.1 Switching from target mode to initiator mode

In the window shown in Figure 12-82, you can find the status of QLogic Adapter.1 as follows. The icon image of this adapter indicates that this port is down and in target mode.

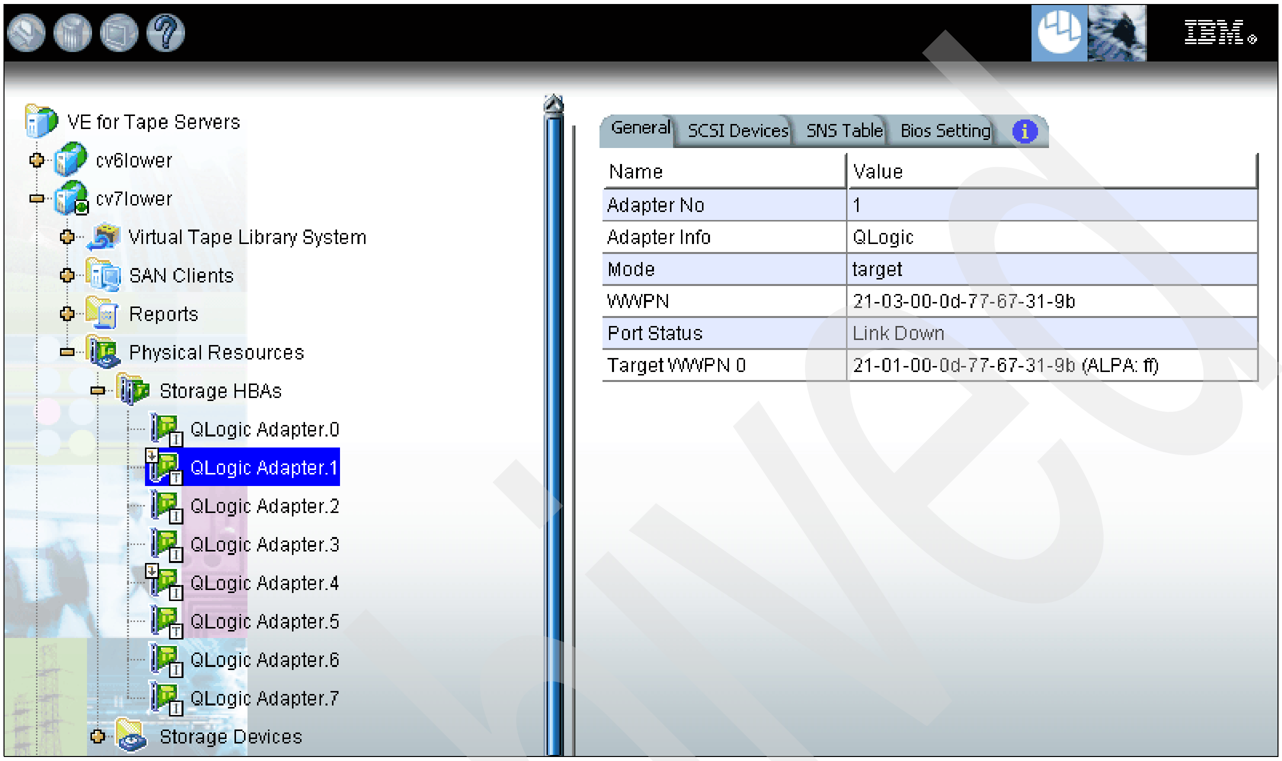



*Figure 12-82 Target mode in the QLogic Adapter.1*

To change a port from target mode to initiator mode:

1. In the VE console, expand the **Physical Resources** list.
2. Expand the **Storage HBAs** list.
3. Right-click the icon for the desired HBA and then click **Disable Target Mode**. See Figure 12-83.

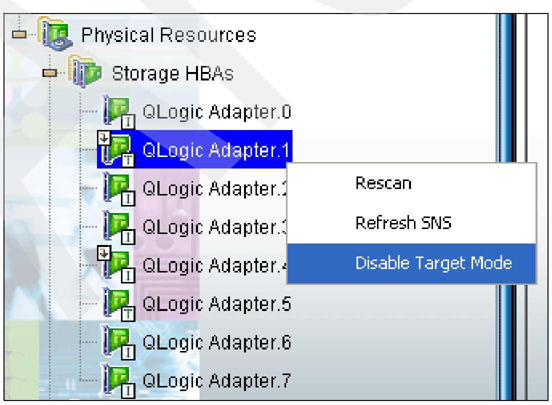



*Figure 12-83 Changing a port from target mode to initiator mode*

On the General tab for the adapter in the VE console, verify that the value for the mode now displays `initiator` (Figure 12-84).

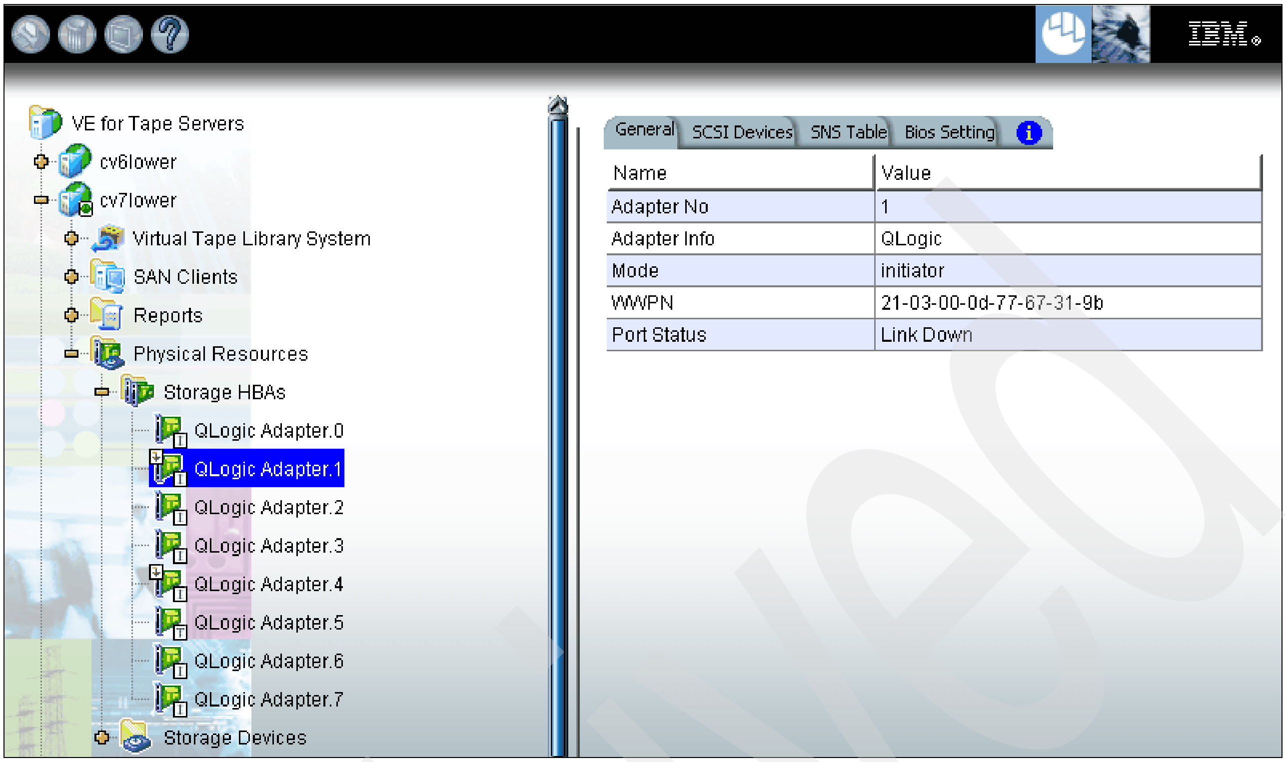



*Figure 12-84 Initiator mode of the QLogic Adapter.1*

## 12.8.2 Switching from initiator mode to target mode

To change a port from initiator mode to target mode:

1. In the VE console, expand the **Physical Resources** list.
2. Expand the **Storage HBAs** list.

3. Right-click the icon for the desired HBA and then click **Enable Target Mode** (Figure 12-85).
4. (Optional) Select Hard-Alpa creation or Soft-Alpa creation. In the Enable Target Mode window, click **Soft alpa creation** method.

> **Attention**: Do not choose the hard alpa creation method unless directed to do so by your IBM service representative.

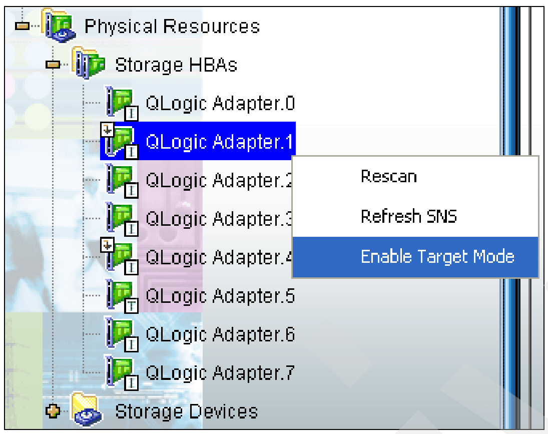



*Figure 12-85 Changing a port from target mode to initiator mode*

On the General tab for the adapter in the VE console, verify that the value for the ode now displays `target` mode (Figure 12-86).

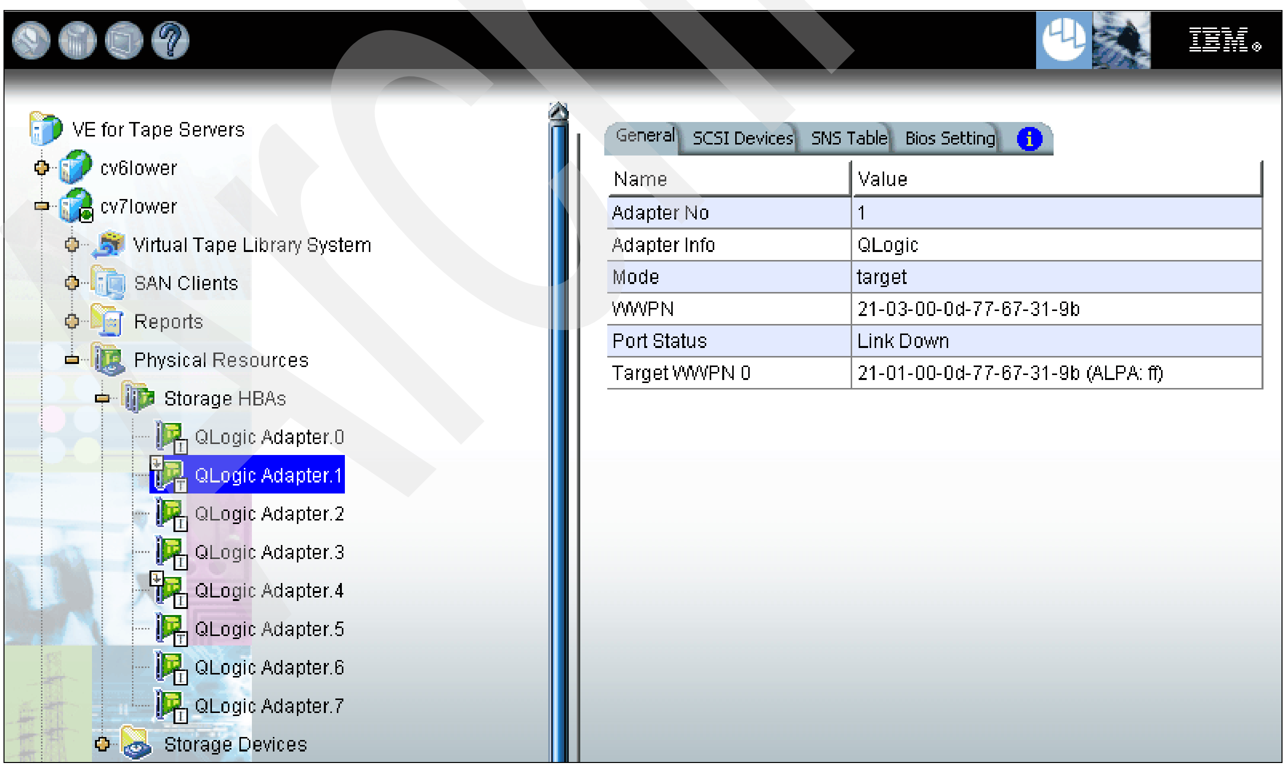



*Figure 12-86 target mode of the QLogic Adapter.1*

13

# Upgrade and migration considerations

In this chapter we discuss upgrade and migration procedures for upgrading a virtualization engine to support new features and functions. We provide an overview of the supported options. Hardware upgrades are usually performed by the IBM System Service Representative (SSR), but we provide an overview of the steps involved for information purposes. We also describe actions that you may need to take during an upgrade or migration.

We discuss the following topics:

- Adding storage and controllers
- Adding additional cards, like hardware compression card or FC cards
- Adding additional nodes
- Adding switches
- Adding or removing patches



## 13.1 Upgrade and migration considerations

Since the first installations of the TS7500 Virtualization Engine, the available hardware has been continuously improved. For instance, the CPU performance increased, new tape drives were supported, disk space increased, and so on. Consequently, the possibilities have altered.

Additional new software functions and updates are required to maximize the effectiveness of the TS7500 Virtualization Engine. Up to now patches provided only limited software updates. Support for new hardware was not given. With the TS7500 Virtualization Engine Version 3 Release 1 it is possible to support new hardware and software functions.

We differentiate between software upgrades and hardware upgrades. Software upgrades are possible from TS7520 Virtualization Engine Version 2 Release 1 or 2 to TS7500 Virtualization Engine Version 3 Release 1 software. Software upgrades include the firmware-based upgrade of all HBAs, the BIOS, the RSA, and the BMC (including the firmware of the cache controller) and secondly the upgrade of the integrated Linux host system on the server node.

Hardware upgrades include adding additional hardware components, like compression cards, FC cards, connection to cache modules with 1 TB disk modules, and so on. For hardware upgrades it is necessary to run the upgrade script from the same build as was installed, that is, upgrade 1463 works only for installation 1463.

In this context we use also the term *migration*. Migration means the change from TS7520 hardware to TS7530 hardware.

There are several options to upgrade the system. Figure 13-1 show the main paths to upgrade the system of the virtualization engines.

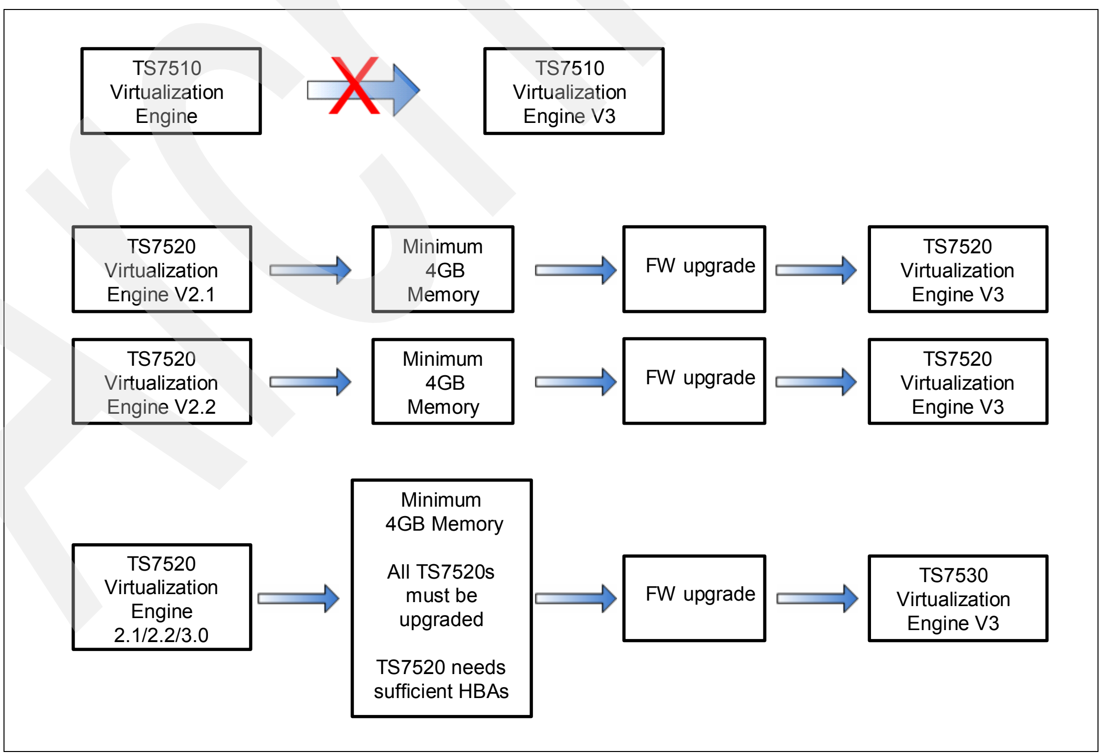



*Figure 13-1 Upgrade paths*

Let us take a more detailed look at the upgrade paths. The old TS7510 system is not upgradeable to/with the new software and hardware options. This means that you cannot use the TS7500 Virtualization Engine software with the TS7510 hardware.

If your current virtualization engine solution is a TS7520 Server with Virtualization Engine Version 2 Release 1 or 2, an upgrade to use the new TS7500 Virtualization Engine Version 3 Release 1 is possible. In this case some requirements should be completed. The important requirement is that the TS7520 server must have at least 4 GB memory. For more prerequisites see 13.3, “Software Upgrade” on page 441.

It is possible to upgrade the hardware. Figure 13-2 shows an overview of which upgrades are supported with the TS7500 Virtualization Engine Version 3 Release 1 for the TS7530 Server hardware.

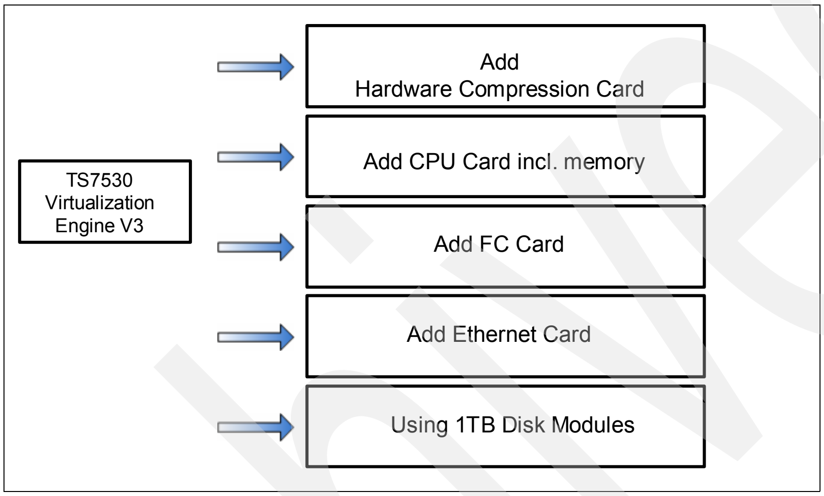



*Figure 13-2 Hardware upgrades for TS7530 with Virtualization Engine V3*

In Figure 13-3, you see the upgrade options for the TS7520 with the TS7500 Virtualization Engine Version 3 Release 1 software.

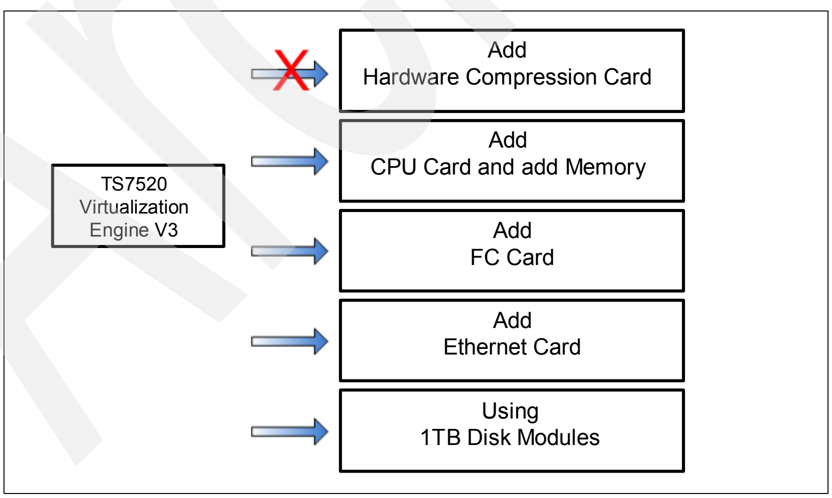



*Figure 13-3 Hardware upgrades for TS7520 with Virtualization Engine V3*

The TS7500 Virtualization Engine is likewise able to handle and support a mixed configuration (hardware or software) of both server models with restrictions. This means that both server models can coexist in a virtualization engine if they are installed in two frames and have the same software level. Figure 13-4 makes this clear.

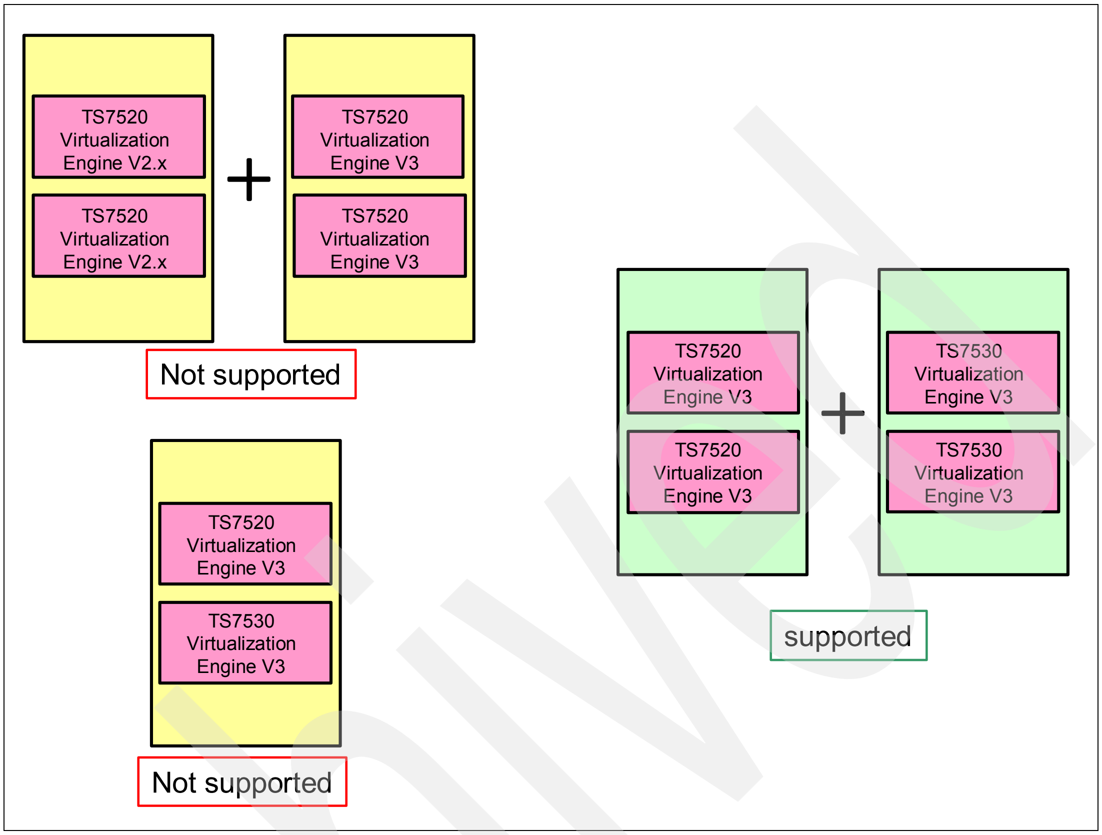



*Figure 13-4 Server configurations*

## 13.2 Update

Patches are downloadable from IBM Internet sites for storage products:

http://www-1.ibm.com/support/search.wss?rs=1310&tc=STST5U&dc=D400&dtm

## Addition and remove of patches in TS7530

This action is executable by the customer. Maintenance must be performed in an outage window and with the procedure provided in the readme file. Adding and rollback are performed using the VE for Tape Console. You should only apply patches when directed or advised by IBM support personnel. Each node must have the same patch level.

1. If you are running with failover enabled, suspend failover prior to adding or removing the patches, as shown in Figure 13-5.

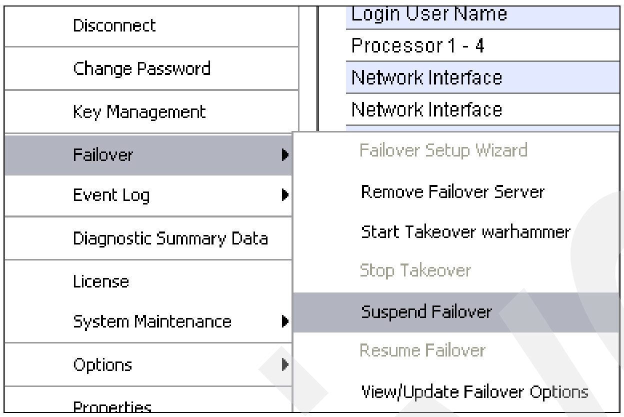



*Figure 13-5 Suspend failover*

2. Using the VE for Tape Console, connect to <your TS7530 server>. From the title bar, select **Tools** → **Add Patch or Remove Patch**. See Figure 13-6.

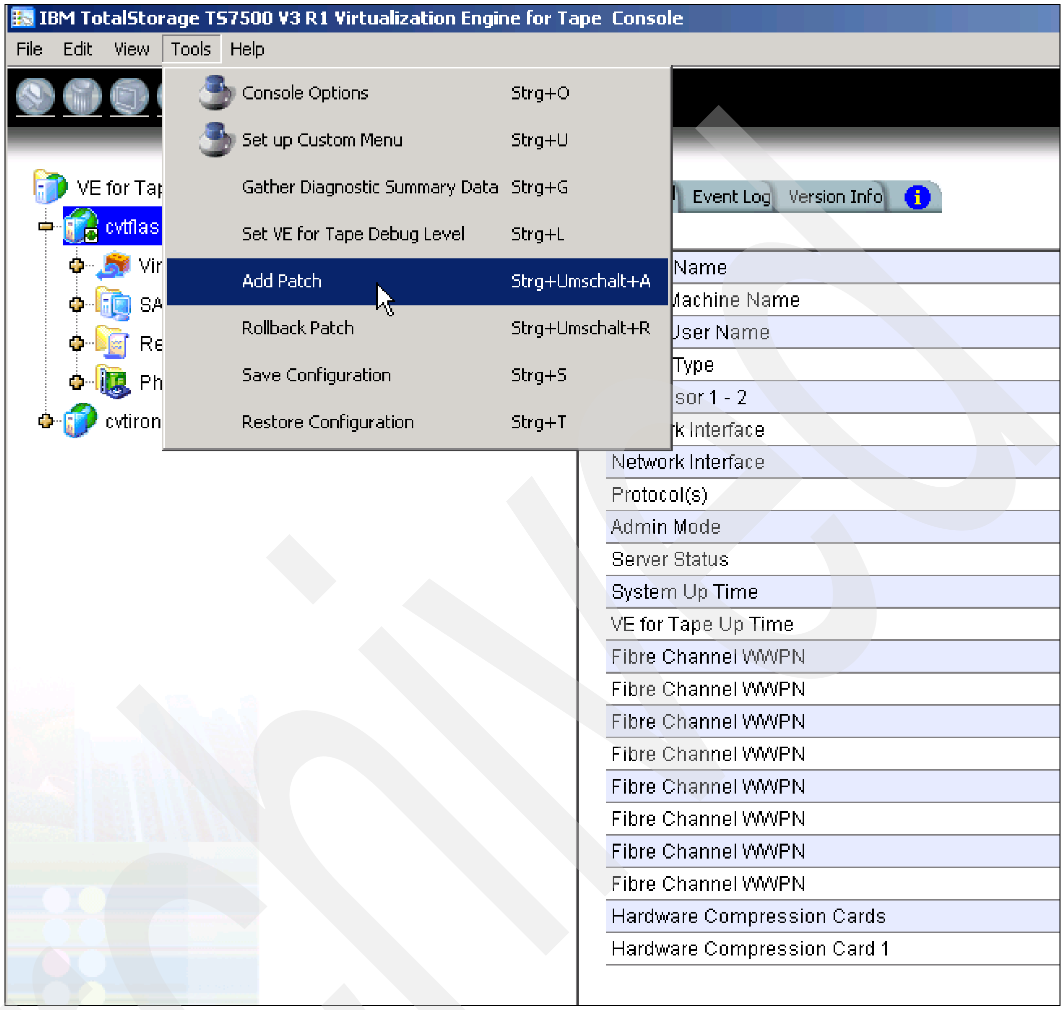



*Figure 13-6 Adding patch or remove patch*

As shown in Figure 13-7, you will see a warning window for either adding or removing a patch.

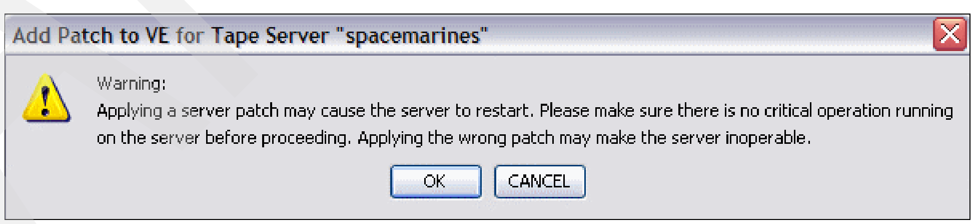



*Figure 13-7 Adding patch warning*

3. Select the patch to add or remove.

4. Verify the success of the action after adding or removing the patch.

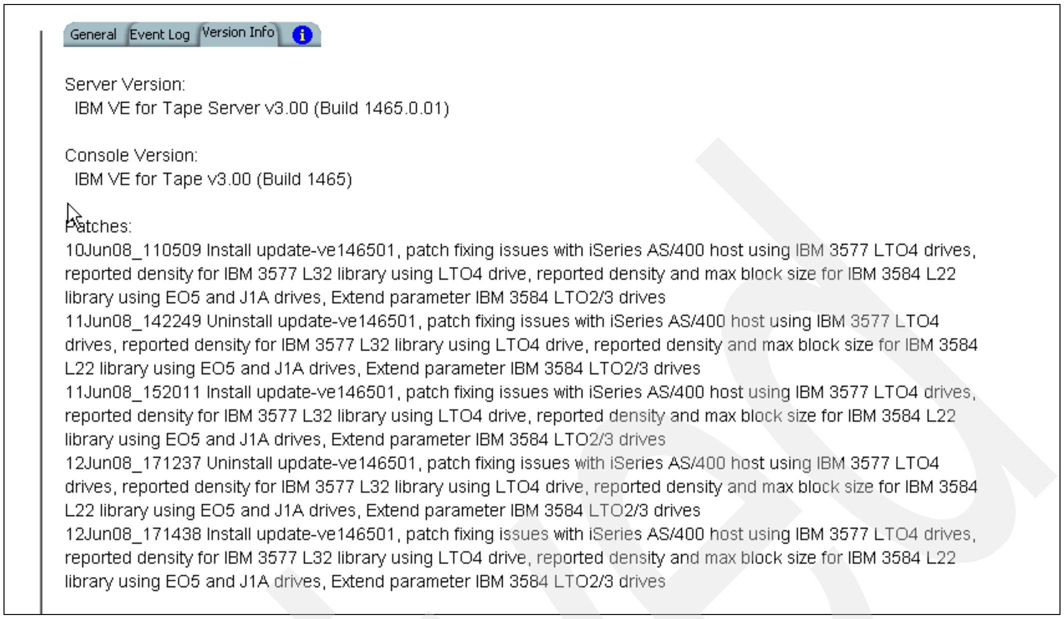



*Figure 13-8 Verify add or remove patch*

## 13.3 Software Upgrade

IBM TS7500 Virtualization Engine Console Version 3 Release 1 is not able to work with older Virtual Engine Server versions. The same is valid for IBM TS 7500 Virtualization Engine Version 2 Release 1 to work with TS7530 hardware. See Figure 13-9 and Figure 13-10 on page 442.

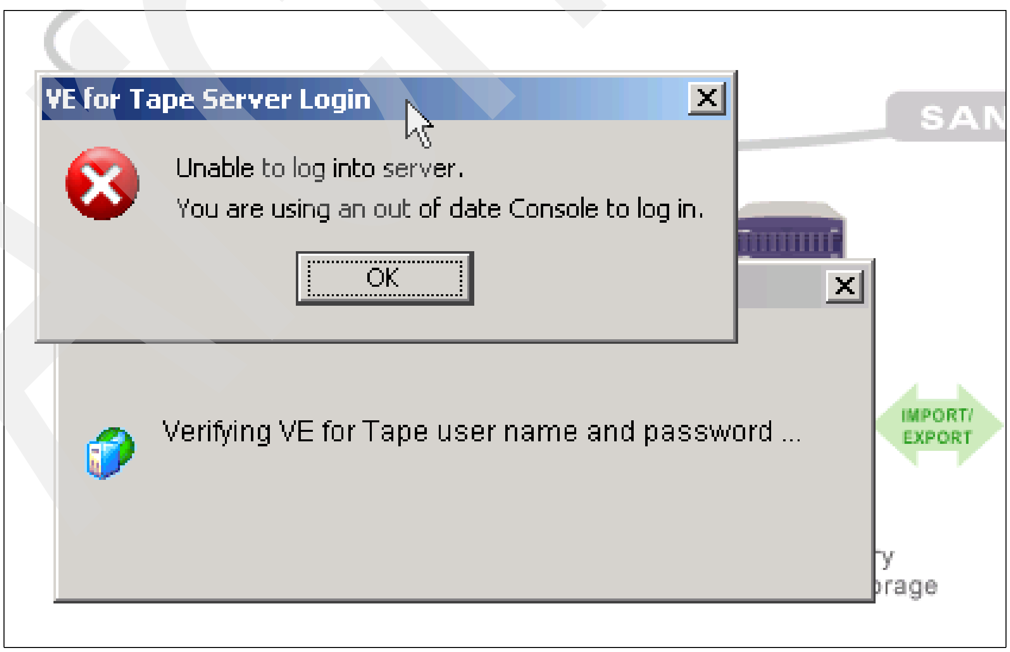



*Figure 13-9 TS7530 hardware with TS7500 VE Version 2 Release 1*

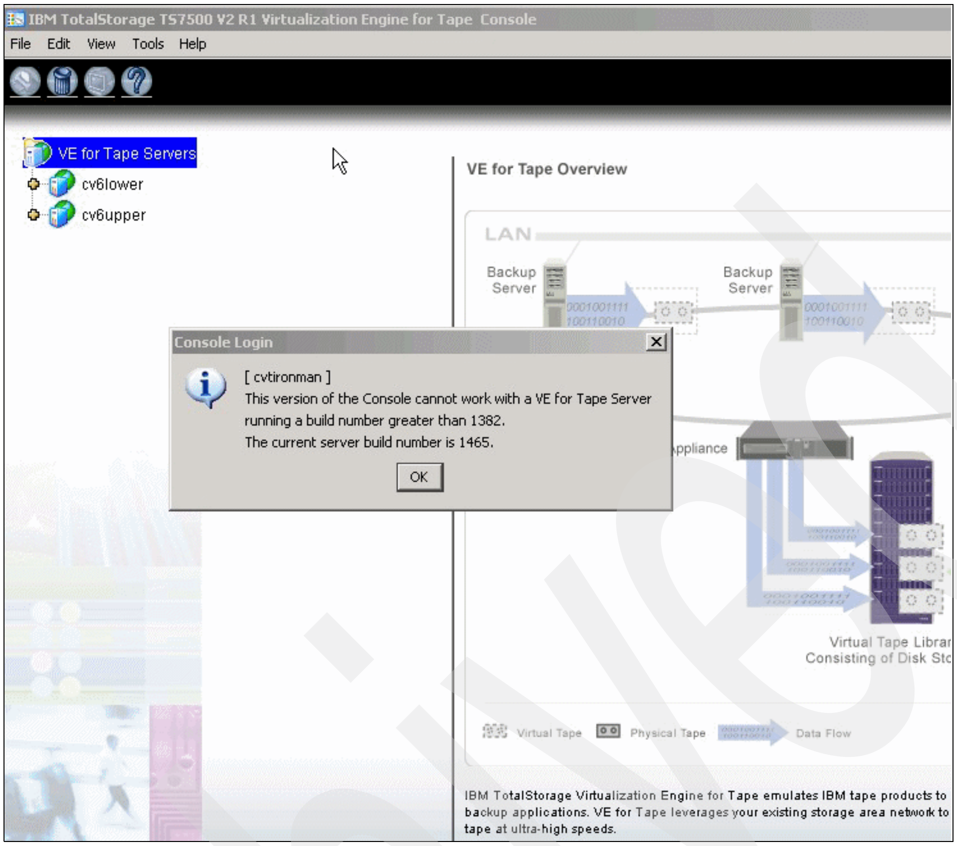



Figure 13-10 TS7520 hardware with TS7500 VE Version 3 Release 1

If you are planning to use the TS7500 Virtualization Engine Version 3 Release 1 a software and firmware upgrade is necessary.

## Upgrading to TS7500 Virtualization Engine Version 3 Release 1

Upgrading the software from the TS7500 Virtualization Engine Version 2 with TS7520 Server to the TS7500 Virtualization Engine Version 3 is non-destructive. Upgrade requires an outage window and is not concurrent. Each node is upgraded individually with the latest software upgrade CD.

This is *only performed by a trained IBM SSR* supported by a migration conversion guide on site and involves the following steps and requirements:

- Verifying that no hardware failures are present.
- Verifying that the system is ready for upgrade (that is, the minimum required memory is installed).
- No tapes may be mounted in any virtual/physical tape drives at time of upgrade.
- No I/O to or from the customer hosts.
- Failover (HA) configuration must be removed prior to upgrade.
- Make a backup configuration of each node. (See 12.2, “Configuration backup” on page 385, for details.)
- Update the Storage Manager on the VE Console.

- Update firmware on the server.
- Update the SV6 controller.
- Update the VE-Basic Linux system.

After the upgrade is complete, you must install the latest TS7530 VE for Tape Console on your management console. In addition, you must perform the following steps:

1. Make another backup configuration of each node.
2. Verify that the network configuration of each node is correct.
3. Verify that libraries, reports, and other configurations have been maintained.
4. Use the Hardware Upgrade CD to re-establish failover in the case of an HA system.

# 13.4 Hardware upgrades

Hardware upgrade will only function properly for the same build as what was installed, that is, hardware upgrade 1463 works only for installation 1463, because for every newly installed hardware component running of a update script is necessary.

Before any hardware upgrade, the system should be in a healthy state.

**Note:** Only IBM SSR can upgrade the hardware.

## 13.4.1 Adding storage

For some features (that is, replication or for further virtual tapes) it is necessary to add more storage. There are two possibilities to add storage:

- A cache drawer
- A cache controller

It is permitted to add cache modules with divergent cache sizes to an existing configuration, but it is not permitted to mix divergent disk drive modules in the same cache module. This means that the existing configuration contains a cache controller filled with 500 GB disks. Adding a cache drawer filled with 1 TB disks is possible, but removing of eight of the sixteen 500 GB from the cache controller and replacing that with 1TB is not possible.

The TS7500 Virtualization Solution supports serial advanced technology attachment (SATA) disk drive modules (DDM) with size of 500 GB, 750 GB or 1 TB. Dependent on disk size and RAID-level variability, cache sizes can be added as shown in Table 13-1.

*Table 13-1 Cache sizes*

| Disk drive module | RAID Level | Unformatted capacity | Usable capacity |
|---|---|---|---|
| 500 GB | RAID 5 | 8 TB | 6.5 TB |
| 750 GB | RAID 5 | 12 TB | 9.75 TB |
| 1 TB | RAID 5 | 16 TB | 13 TB |
| 1 TB | RAID 6 | 16 TB | 11 TB |

After physical installation and configuration of the added new storage it is needed to scan and prepare the new disk for usage. This step is executable from the customer by means of the the VE Console.

1. Select **<your TS7500> node** → **Physical Resources** → **Storage HBAs**. Right-click and select **rescan** to rescan all HBAs for new devices, as shown in Figure 13-11.

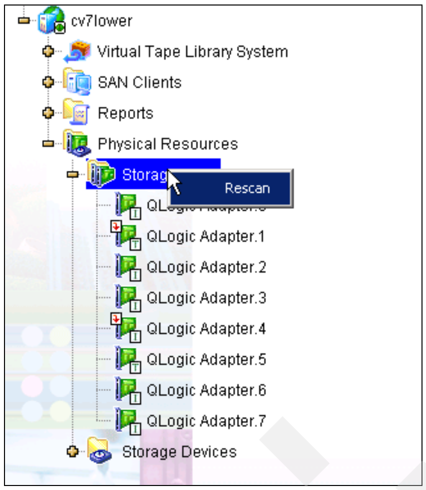



*Figure 13-11 Rescan of all HBAs*

You might only want to scan a particular HBA. To do so right-click the specific HBA, select **Rescan**, and use option **Discover New Devices**, as shown in Figure 13-12.

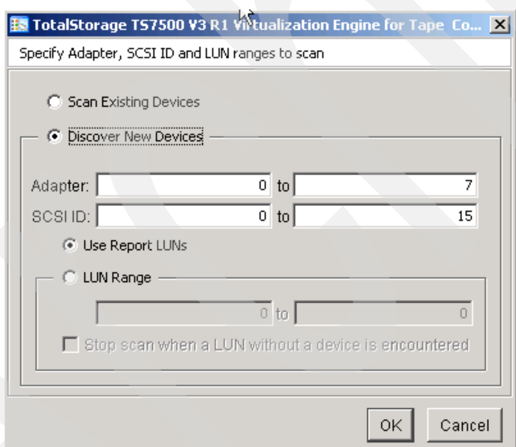



*Figure 13-12 Rescan option for particular HBA*

2. After scanning for new devices, you will be able to see the new devices. Now it is necessary to prepare the new devices for usage. In the VE console expand **Storage Devices** so that Fibre Channel Devices is visible. Right-click the this topic and select **Prepare Devices**, as shown in Figure 13-13.

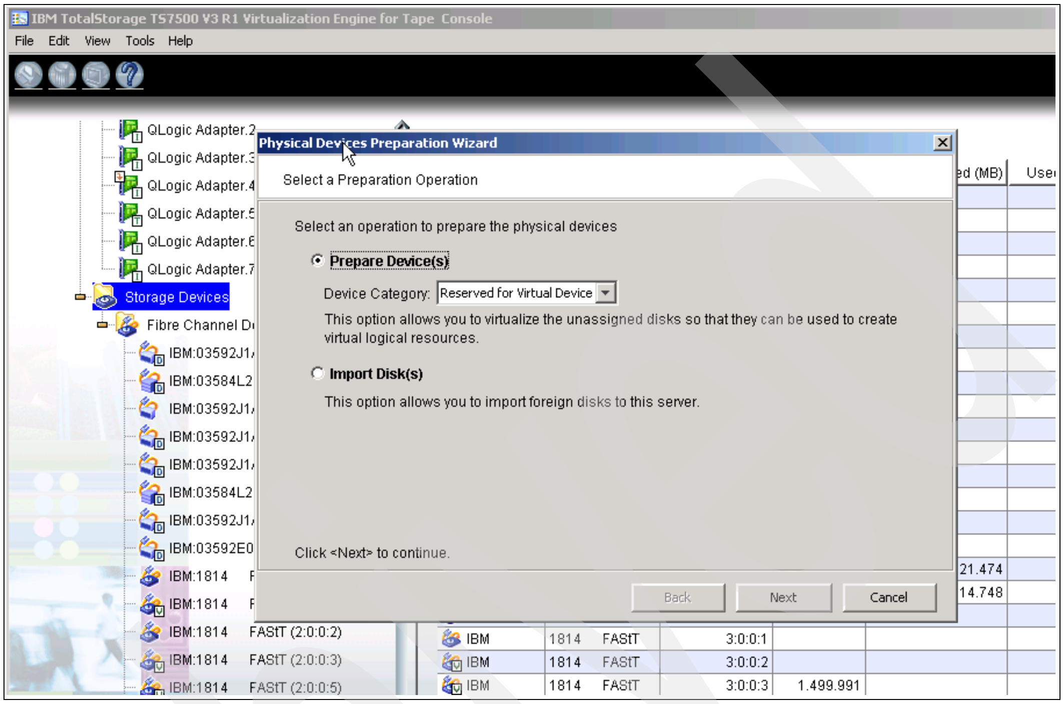



*Figure 13-13 Prepare devices*

3. Select **Reserved for Virtual Device**. This option allows you to virtualize the unassigned disks so that they can be used to create virtual logical resources. Follow the wizard and select the physical devices to be virtualized.

4. Now is time to verify that the newly virtualized devices display in the list of devices. Virtualized devices are indicate by a green V beside the Fibre Channel device icon (Figure 13-14).

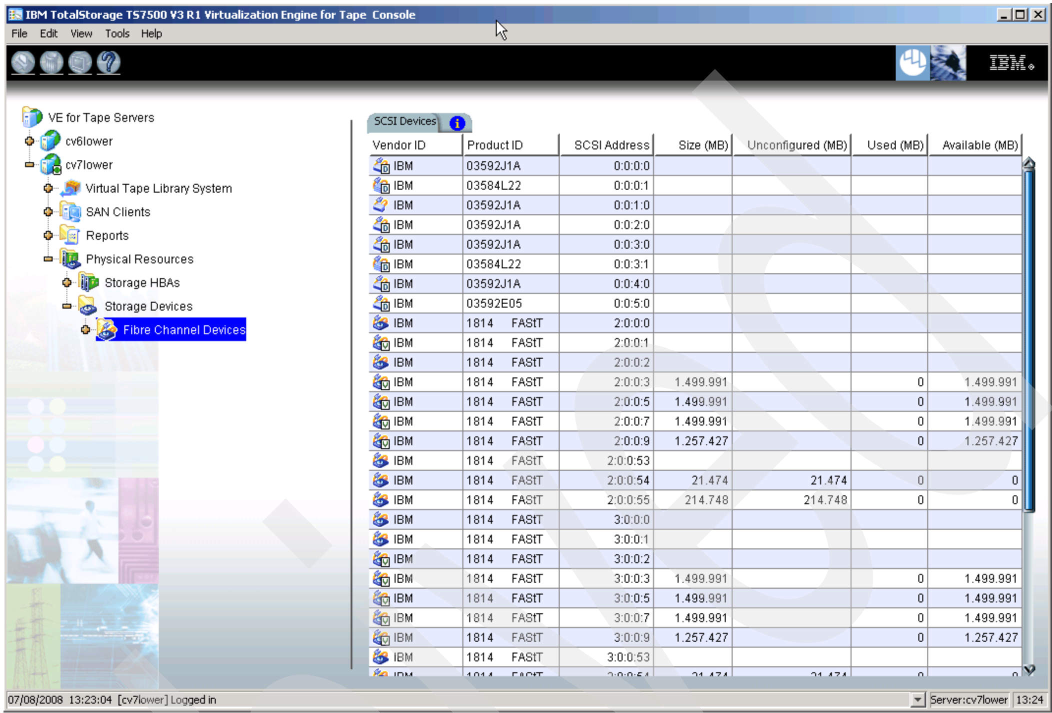



*Figure 13-14 Green V on virtualized devices*

5. If you are not seeing the devices as expected, you can check with WWPNs the HBA is capable of seeing by refreshing the SNS. The SNS is equivalent to the name server listing for this HBA, essentially demonstrating what is zoned and available to this HBA.

   Select **<your TS7500> node** → **Physical Resources** → **Storage HBA**. Right-click the adapter and select **Refresh SNS**, as shown in Figure 13-15.

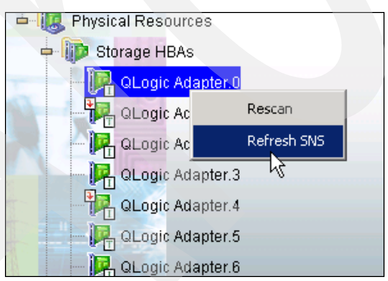
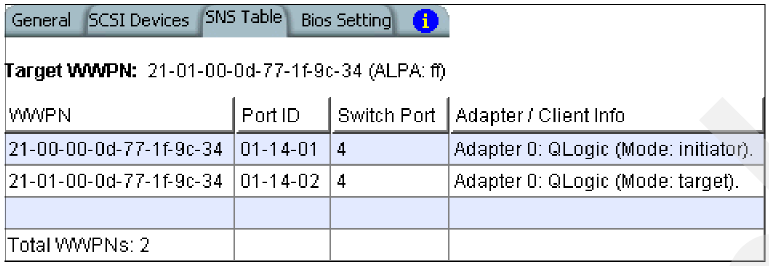



*Figure 13-15 Refresh SNS*

6. Select the HBA and look to the panel on the left side. Select the **SNS Table** tab from the window shown in Figure 13-16.





| WWPN | Port ID | Switch Port | Adapter / Client Info |
|---|---|---|---|
| 21-00-00-0d-77-1f-9c-34 | 01-14-01 | 4 | Adapter 0: QLogic (Mode: initiator). |
| 21-01-00-0d-77-1f-9c-34 | 01-14-02 | 4 | Adapter 0: QLogic (Mode: target). |
| | | | |
| Total WWPNs: 2 | | | |

*Figure 13-16 SNS Table*

## 13.4.2 LUN import and discharge

At installation, the configuration of base frames is complete, therefore the enlistment and discharge of LUNs are not necessary at this time. When adding expansion frames, you must add the LUNs to the proper server:

**Import** Add LUNs to the specific TS7500.
**Discharge** Remove LUNs from the TS7500 and put them in an unassigned state.

Look at the LUNs. If they are configured on the TS7500, you see the information shown in Figure 13-11. Notice that a small V indicates that this server is the owner. A small F indicates that another server is the owner of the LUN.

Select **<your TS7500> node** → **Physical Resources** → **Storage Devices** → **Fibre Channel Devices** → **Import or Discharge,** as shown in Figure 13-17.



*Figure 13-17 Import LUN*

Note that you also have the ability to Erase the LUN. This is obviously a highly destructive step as all virtual tapes associated with that LUN will become unusable. Only use with direction of IBM support. The node running the command will also become the owner of the LUN.

We recommend for recovery purposes that LUNs in the base frames remain equally balanced as installed. Use of the expansion frames to change the balance of the amount of storage available for each server is possible and should be discussed when the expansion frame is added. Considerations such as load and throughput should also be considered, providing the most balanced system and one that will fit your needs.

Remember to save your configuration before and after adding the LUNs.

### 13.4.3 Adding frames

If adding more storage modules or extension with additional server nodes it is necessary to add more frames to the existing configuration.

There are different frame types. The first type is the base frame, which contains server nodes, cache controller, and cache modules. The second type is the expansion frame, which contains only the cache controller and cache modules.

Adding a second base frame is needed if the existing configuration extended to a 4-node configuration. A mix of one TS7520 and one TS7530 base frame is supported.

Only if the last base frame is completely filled with supported components (two CV7 servers, two cache controllers, and six cache drawers) is adding from a expansion frame possible. This is a additional requirement.

For both cases the optional Fibre Channel kit for the first base frame is needed.

After frames are added by an IBM SSR the next steps depend on the type of the new frame (that is, cabling of new server nodes or cache controller). For more information about general cabling see *IBM Virtualization Engine TS7500 Installation Roadmap Guide,* GC27-2178.

### 13.4.4 Adding nodes

In the case of implementing a failover solution or a 4-node solution it may be necessary to add new TS7500 servers.

The TS7500 Virtualization Engine is able to support a maximum of four nodes in stages of one, two, and four servers. Each server in a multi-node configuration needs at least one cache controller. Each base frame can contain a maximum of two servers.

> **Note:** You cannot intermix one TS7520 Model CV6 server and one TS7530 Model CV7 server in the same frame.

A mix of two TS7520 CV6 servers in the first base frame and two TS7530 CV7 servers in the second base frame is supported.

For the 4-node configuration, the optional Fibre Channel kit for the first base frame is needed.

IBM SSR installs the new physical server nodes and connects them to the previous configuration depending on ordered features. For more information about general cabling see *IBM Virtualization Engine TS7500 Installation Roadmap Guide,* GC27-2178.

After completing and verifying the installation the new server must be configured as described in 6.2, “Basic Initialization through RSA” on page 182. This means that you must set the hostname, network IPs, input licence keys, and so on.

Now it is possible to perform the enhanced configuration (for example, failover or build multi-node groups). For more information about these steps see 7.1, “Failover/failback” on page 254 and *7.9, “Four-way node support” on page 279.

### 13.4.5 Add or remove Fibre Channel cards

If adding more FC cards to increase the available FC ports for host or library connection or removing FC cards the adapter numbers will change. If you use the adapter numbers as shown in the Virtualization Engine Console notice the above fact. Table 13-2 through Table 13-8 on page 451 show the QLogic adapter numbers displayed in the VE console for a TS7530 Server with all possible FC card combinations.

> **Note:** QLogic Fibre Channel cards can be added or removed, but they cannot be added and removed simultaneously. To remove *and* add HBAs two separate steps are needed.

*Table 13-2 Qlogic adapter numbers with two 4-port Fibre Channel cards*

| PCI Express slot 1 (top to bottom) | PCI Express slot 2 (top to bottom) |
|---|---|
| 2 | 6 |
| 3 | 7 |
| 0 | 4 |
| 1 | 5 |

Qlogic adapter numbers 2, 3, 6, and 7 are connected to the cache components and must always be set to initiator mode.

*Table 13-3 Qlogic adapter numbers with three 4-port Fibre Channel cards*

| PCI Express slot 1 | PCI Express slot 2 | PCI Express slot 3 |
|---|---|---|
| 6 | 10 | 2 |
| 7 | 11 | 3 |
| 4 | 8 | 0 |
| 5 | 9 | 1 |

Qlogic adapter numbers 6, 7, 10, and 11 are connected to the cache components and must always be set to initiator mode.

*Table 13-4 Qlogic adapter numbers with two 4-port and one 2-port Fibre Channel cards*

| PCI Express Slot 1 | PCI Express Slot 2 | PCI Express Slot 5 or 6 |
|---|---|---|
| 4 | 8 | 0 |
| 5 | 9 | 1 |
| 2 | 6 | |
| 3 | 7 | |

Qlogic adapter numbers 4, 5, 8, and 9 are connected to the cache components and must always be set to initiator mode.

*Table 13-5 Qlogic adapter numbers with two 4-port and two 2-port Fibre Channel cards*

| PCI Express slot 1 | PCI Express slot 2 | PCI Express slot 5 | PCI Express slot 6 |
|---|---|---|---|
| 6 | 10 | 0 | 2 |
| 7 | 11 | 1 | 3 |
| 4 | 8 | | |

| PCI Express slot 1 | PCI Express slot 2 | PCI Express slot 5 | PCI Express slot 6 |
|---|---|---|---|
| 5 | 9 | | |

Qlogic adapter numbers 6, 7, 10, and 11 are connected to the cache components and must always be set to initiator mode.

*Table 13-6 Qlogic adapter numbers with three 4-port and one 2-port Fibre Channel card*

| PCI Express slot 1 | PCI Express slot 2 | PCI Express slot 3 | PCI Express slot 5 or 6 |
|---|---|---|---|
| 8 | 12 | 4 | 0 |
| 9 | 13 | 5 | 1 |
| 6 | 10 | 2 | |
| 7 | 11 | 3 | |

Qlogic adapter numbers 8, 9, 12, and 13 are connected to the cache components and must always be set to initiator mode.

*Table 13-7 Qlogic adapter numbers with three 4-port and two 2-port Fibre Channel cards*

| PCI Express slot 1 | PCI Express slot 2 | PCI Express slot 3 | PCI Express slot 5 | PCI Express slot 6 |
|---|---|---|---|---|
| 10 | 14 | 6 | 0 | 2 |
| 11 | 15 | 7 | 1 | 3 |
| 8 | 12 | 4 | | |
| 9 | 13 | 5 | | |

Qlogic adapter numbers 10, 11, 14, and 15 are connected to the cache components and must always be set to initiator mode.

The WWPN for each physical port on each FC card is never changed if FC cards are added or removed. So if you use SAN zoning based on WWPN no changes are needed. The WWPN includes a value to identify the physical port. The second WWPN-value block identifies the physical port number. Physical port numbers start on the top with 0. In Table 13-8 you see an example of physical port assignment, adapter number, and WWPN.

*Table 13-8 WWPN assignment*

| **Physical port (from top to bottom)** | **Adapter number for FC card (configuration as in Table 13-2 on page 449)** | **WWPN** |
|---|---|---|
| 0 | 2 | 21-00-...... |
| 1 | 3 | 21-01-...... |
| 2 | 0 | 21-02-...... |
| 3 | 1 | 21-03-...... |

## 13.4.6 Compression card

In the case of adding hardware compression cards to increase write and read performance on the TS7530 CV7 server notice that only one or two hardware compression cards are supported and that each compression card has its own slot in the server, as you can see in Table 13-9.

*Table 13-9 Special slot for compression cards*

| **Slot number** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| Compression card | | | 2 | 1 | | |

Keep in mind that with multi-node configurations each server should have the same number of installed hardware compression cards. This prevents degrading system performance because if you try to use hardware compression without a compression card installed, the server writes uncompressed data to virtual devices.

It is not possible to install hardware compression cards in the TS7520 CV6 Server.

Compression cards can only be installed by an IBM SSR. After the installation you can enable the hardware compression option as described in 7.10, “Hardware compression” on page 280.

## 13.4.7 Adding interconnection FC switch

For all TS7500 Virtualization Engine advance configurations (for example, 4-node or additional extended frame the optional FC Switch kit included) two FC switches are needed.

**Note:** The Fibre Channel switches are only for internal connection and cannot be used for host or physical tape connection.

# Part 5

# Appendices



A

# Introduction to IBM Open System Tape

This appendix provides an overview of the Linear Tape-Open (LTO) initiative and the corresponding IBM System Storage LTO Ultrium product line as well as the IBM System Storage Enterprise Tape products for Open Systems environments.

We cover the following topics:

- An overview of the IBM System Storage Tape LTO models available:
  – IBM TS2230 Tape Drive
  – IBM TS2240 Tape Drive
  – IBM TS2340 Tape Drive
  – IBM TS3100 Tape Library
  – IBM TS3200 Tape Library
  – IBM TS3310 Tape Library
  – IBM TS3500 Tape Library
- An overview of the other IBM System Storage Enterprise Tape models:
  – IBM TS1100 Tape Drive Family including TS1120 and TS1130
  – IBM TS3400 Tape Library
- An overview of Tape Drive Encryption provided with the IBM TS1120 Tape Drive and the IBM LTO Ultrium 4 Tape Drive
- Server and operating system platforms, and storage management software
- Connectivity examples, such as:
  – Direct SCSI attachment
  – SCSI bus performance
- A discussion of HBAs and drivers
- LVD and SAS interfaces
- A discussion of HD68 versus VHDCI

# LTO overview

The Linear Tape-Open (LTO) program is a joint initiative of Hewlett-Packard, IBM, and Quantum Technology. In 1997, the three companies set out to enable the development of best-of-breed tape storage products by consolidating state-of-the-art technologies from numerous sources. The three companies also took steps to protect client investment by providing a four-generation road map and establishing an infrastructure to enable compatibility between competitive products.

The LTO technology objective was to establish new open-format specifications for high capacity, high performance tape storage products for use in the midrange and network server computing environments, and to enable superior tape product options.

The LTO program cooperation goes beyond the initial three companies. LTO format specifications have been made available to all who want to participate through standard licensing provisions. LTO program technology has already attracted a number of other industry leaders, so that LTO-specified products (tape drives and tape storage cartridges) will reach the market from multiple manufacturers, not just the Technology Provider Companies. This is critical to meeting an open market objective, and is accomplished through open licensing of the technology.

Cooperation is also evident in the LTO program requirement that all products produced by licensees be technically certified annually. The primary objective of this certification is to help determine whether LTO format cartridges will be exchangeable across drives produced by different LTO Ultrium manufacturers. In other words, LTO compliant media from any vendor can be read and written in LTO compliant drives from any vendor.

All three consortium members (IBM, HP, and Quantum) are now shipping LTO Ultrium products, and numerous other licensees are shipping hardware and media.

The Linear Tape-Open organization home page is:

`http://www.lto.org`

For more information about LTO technology, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-594646.

The IBM LTO home page is:

`http://www.ibm.com/storage/lto`

The LTO Ultrium road map (Figure A-1) shows the evolution of LTO technology. At the time of writing, IBM Ultrium generation 3 and 4 products are offered. The information in the road map is given as an indication of future developments by the three consortium members, and is subject to change.

**Important:** Hewlett-Packard, IBM, and Quantum reserve the right to change the information in this migration path without notice.

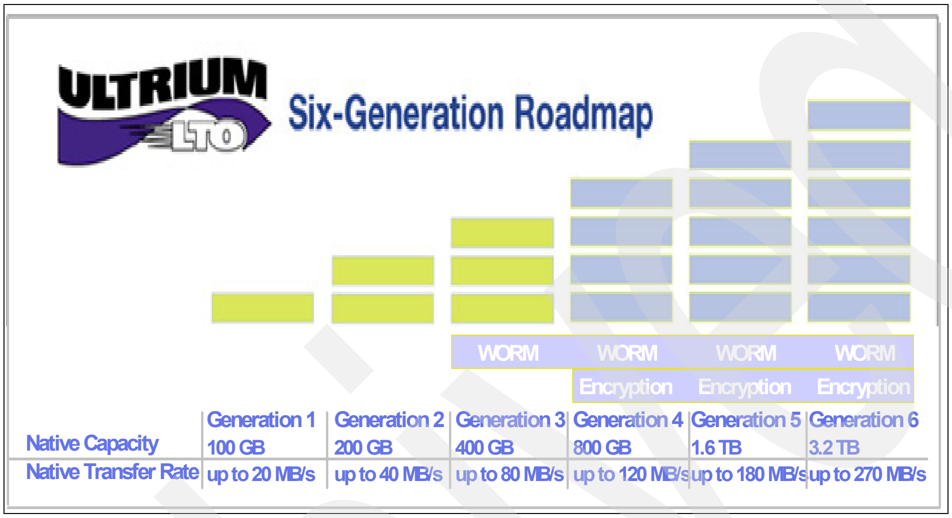



*Figure A-1 LTO Ultrium road map*

## LTO Ultrium models

For the remainder of this IBM Redbooks pubication we use the term LTO as a generic term for different generations of the LTO Ultrium tape drives.

As the specific reference to the IBM System Storage TS1040 LTO Ultrium 4 Tape Drive, we use the term LTO4.

The IBM System Storage LTO family consists of:

- IBM TS2230 Tape Drive
- IBM TS2340 Tape Drive
- IBM TS3100 Tape Library
- IBM TS3200 Tape Library
- IBM TS3310 Tape Library
- IBM TS3500 Tape Library

These models are shown in Figure A-2.

Figure A-2 The LTO product family

Some existing models have two drive options and can have IBM LTO3 and LTO4 drives installed.

These are the four generations of LTO Ultrium tape drives and cartridges:

- LTO1 was the first generation of the LTO technology with a tape capacity of 100 GB per cartridge in a native format, and capacity of 200 GB using 2:1 compression.
- LTO2 is the second generation of the LTO technology with a tape capacity of 200 GB per cartridge in native format, and capacity of 400 GB using 2:1 compression.
- LTO3 is the third generation of the LTO technology with a tape capacity of 400 GB per cartridge in native format, and capacity of 800 GB using 2:1 compression. A WORM (write-once, read-many) version of the LTO3 cartridge is also available.
- LTO4 is the fourth generation of the LTO technology with a tape capacity of 800 GB per cartridge in native format, and capacity of 1600 GB using 2:1 compression. A WORM (write-once, read-many) version of the LTO4 cartridge is also available.

## Media compatibility

Figure A-3 depicts the media compatibility characteristics for the last three generations of LTO tape.

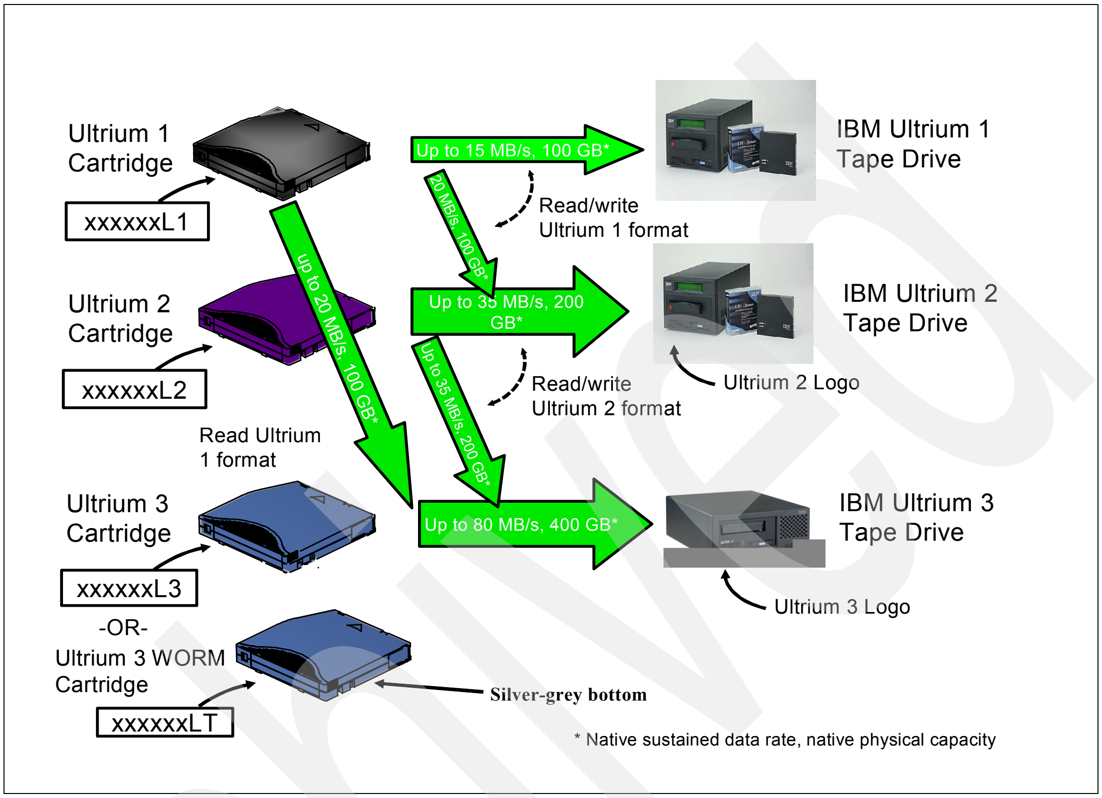



*Figure A-3 LTO generation media compatibility*

### LTO2

The LTO2 Tape Drive is compatible with the cartridges of its predecessor, the LTO1 Tape Drive. Cartridge compatibility for the LTO2 Tape Drive is as follows:

- Reads and writes LTO2 format on LTO2 cartridges
- Reads and writes LTO1 format on LTO1 cartridges
- Does not write LTO2 format on LTO1 cartridges
- Does not write LTO1 format on LTO2 cartridges

### LTO3

The LTO3 Tape Drive is compatible with the cartridges of its predecessors, the LTO2 and LTO1 Tape Drive. Cartridge compatibility for the LTO3 Tape Drive is as follows:

- Reads and writes LTO3 format on LTO3 cartridges
- Reads and writes LTO2 format on LTO2 cartridges
- Reads LTO1 format on LTO1 cartridges
- Does not write LTO3 format on LTO2 cartridges
- Does not write LTO2 format on LTO3 cartridges

### LTO4

The LTO4 Tape Drive is compatible with the cartridges of its immediate predecessors, the LTO3 and LTO2 Tape Drives. Cartridge compatibility for the LTO4 Tape Drive is as follows:

- Reads and writes LTO4 format on LTO4 cartridges
- Reads and writes LTO3 format on LTO3 cartridges
- Reads LTO2 format on LTO2 cartridges
- Does not write LTO4 format on LTO3 cartridges
- Does not write LTO3 format on LTO4 cartridges
- Does not write or read on LTO1 cartridges

### WORM tape format

Beginning with LTO3, Write Once Read Many (WORM) functionality provides for non-erasable, non-rewritable operation with tape media and is designed for long term tamper resistant record retention.

The IBM LTO3 specification for WORM includes the use of low level encoding in the Cartridge Memory (CM), which is also mastered into the servo pattern as part of the manufacturing process. This encoding is designed to prevent tampering.

Data can be appended at the end of a WORM cartridge to which data was previously written, allowing the full use of the high capacity tape media.

LTO3 WORM cartridges can be used with any LTO3 tape drive with the appropriate microcode and firmware. LTO3 non-WORM and WORM cartridges can coexist in the same library.

The same description holds for the LTO4 WORM cartridges. They can be used by any LTO4 tape drive, and can coexist with non-WORM cartridges. Additionally, the LTO4 drive can read and write WORM and non-WORM LTO3 cartridges.

## IBM System Storage TS2230 Tape Drive

The IBM System Storage TS2230 Tape Drive (3580 Model H3L or H3S) is an external stand-alone or rack mountable unit and is the entry point to the family of IBM Linear Tape-Open (LTO) Tape products. The IBM System Storage TS2230 Tape Drive is designed for backup and restore of midrange Open Systems applications. The IBM System Storage TS2230 Tape Drive incorporates the IBM System Storage LTO3 half-high T880V Tape Drive, which has a native physical capacity of 400 GB, or 800 GB with 2:1 compression.

The TS2230 is the first member of the IBM LTO Tape Family that uses the new half-high LTO3 Tape Drive. It has the same characteristics of the full-high tape drive except the native transfer rate which is 60 MB/s compared to 80 MB/s for the full-high LTO3 drive. In addition to the standard LTO3 data cartridges, Write Once Read Many (WORM) cartridges are supported and recognized when loaded.

The IBM System Storage TS2230 Tape Drive is available with a Low Voltage Differential (LVD) Small Computer System Interface (SCSI). The LVD SCSI interface has a native maximum data transfer rate of up to 60 MB/s.

The TS2230 can be attached to IBM System p, IBM System i, IBM System p, IBM System x, Microsoft Windows, HP-UX, Sun Solaris, UNIX, Linux, and PC servers. To determine the latest update of supported servers, visit the Web at:

http://www-03.ibm.com/servers/storage/tape/compatibility

Figure A-4 shows the front view of the TS2230.


*Figure A-4 Front view of IBM TS2230 Tape Drive*

For more information about IBM TS2230 Tape Drive, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-59466.

## IBM System Storage TS2240 Tape Drive

The IBM System Storage TS2240 Tape Drive (3580 Model H4S) is an external stand-alone or rack-mountable shelf unit, designed for the family of IBM Ultrium Tape products. The TS2240 Tape Drive is a high-capacity data-storage device that offers high-performance and is designed for backup and restore by midrange Open Systems applications. The TS2240 Tape Drive incorporates the Linear Tape-Open (LTO) IBM System Storage Ultrium 4 Half-High Tape Drive, which writes cartridges with a native physical capacity of 800 GB.

The TS2240 Tape Drive Model H4S uses a 3 Gbps Serial-Attached SCSI (SAS) interface for connecting to the Open Systems servers. The TS2240 Model H4S has a single-port SFF-8088 interface for connecting to Open Systems servers.

Write Once Read Many (WORM) cartridges are supported and recognized when loaded.

The TS2240 Tape Drive Model H4S is encryption-capable and supports Application-Managed Encryption (AME). The TS2240 Tape Drive can use the T10 encryption method. Encryption is only supported with the LTO Ultrium 4 Data Cartridge.

Figure A-5 shows the front view of the TS2240.


*Figure A-5 Front View of IBM TS2240 Tape Drive*

For more information about IBM TS2230 Tape Drive, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-59466.

## IBM System Storage TS2340 Tape Drive

The TS2340 Tape Drive is an external stand-alone or rack mountable unit and is the entry point for the family of IBM LTO tape products. The TS2340 Tape Drive provides an excellent migration path from digital linear tape (DLT or SDLT), 1/4-inch, 4 mm, or 8 mm tape drives.

IBM TS2340 is an LTO tape drive designed to increase maximum tape drive throughput native data rate performance up to 120 MB/s. In addition, with the use of the LTO4 data cartridge, the LTO4 Tape Drive doubles the tape cartridge capacity up to 800 GB native physical capacity (1600 GB with 2:1 compression). IBM LTO4 Tape Drives can read and write LTO3 data cartridges and can read LTO2 data cartridges. In addition, the LTO4 SAS Tape Drive is encryption-capable and designed to support Application-Managed Encryption.

The TS2340 Tape Drive Model L43 uses a SCSI Ultra160 LVD attachment, and the Model S43 uses a 3 Gbps Serial-Attached SCSI (SAS) interface for connections to a wide spectrum of open system servers. The new models attach to IBM System p, IBM System i, IBM System p, IBM System x, MicroSoft Windows, HP-UX, Sun Solaris, UNIX, and PC servers.

Figure A-6 shows the IBM TS2340 Tape Drive.

*Figure A-6 IBM TS2340 Tape Drive*

For more information about IBM TS2340 Tape Drive, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

## IBM System Storage TS3100 Tape Library

The TS3100 Tape Library (Machine Type 3573, Model L2U), is a single drive or a dual drive entry level desktop or a rack mounted unit (requiring two rack units of a industry standard 19 inch rack). A total of 22 cartridges can be stored in two removable magazines. A single dedicated mail slot (I/O station) is available for importing and exporting cartridges. The TS3100 Tape Library is available with a choice of two tape drive interfaces, either SCSI LVD or 4 Gbps Native Fibre Channel.

IBM TS3100 supports either one IBM LTO3 full-high tape drive with a native capacity of 400 GB, two IBM LTO3 half-high tape drives with a native capacity of 400 GB or one IBM LTO4 tape drive with a native capacity of 800 GB. With IBM LTO4 tape drive, the IBM TS3100 also has 3 GB SAS (Serial Attached SCSI) attachment interface. Standard features are a barcode reader and a remote management unit (RMU).

The IBM TS3100 also supports Application-Managed Encryption on SAS and Fibre Channel LTO4 drives using LTO4 media.

The TS3100 Tape Library can be attached to IBM System p, IBM System i, IBM System x, Microsoft Windows, HP-UX, Sun Solaris, UNIX, Linux, and PC servers.

It provides ability to configure the number of logical libraries up to the number of tape drives. This provides a maximum capability of two logical libraries for the TS3100 with two half-high drives.

Available as a standard feature, a *Remote Management Unit* (RMU) provides an Ethernet port, so that the library can be configured as a TCP/IP device in the network. Library status can be sent to the network as Simple Network Management Protocol (SNMP) traps. The IBM System Storage Tape Library Specialist enables network access (via Web browser) to the library for more detailed status and for updating the firmware of the library. All library Operator Panel functions can be accessed using the IBM System Storage Tape Library Specialist.

Figure A-7 shows the IBM TS3100 Tape Library.

*Figure A-7 IBM TS3100 Tape Library*

For more information about IBM TS3100 Tape Library, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-59466.

## IBM System Storage TS3200 Tape Library

The TS3200 Tape Library (Machine Type 3573, Model L4U), is a midrange level desktop or a rack mounted unit (requiring four rack units of a industry standard 19 inch rack). A total of 44 cartridges can be stored in four removable magazines. A single dedicated mail slot (I/O station) is available for importing and exporting cartridges. The TS3200 Tape Library is available with a choice of two tape drive interfaces, either SCSI LVD or 4 Gbps Native Fibre Channel.

IBM TS3200 supports either two IBM LTO3 full-high tape drives with a native capacity of 400 GB, four IBM LTO3 half-high tape drives with a native capacity of 400 GB, two IBM LTO4 tape drives with a native capacity of 800 GB or a mix of IBM LTO3 and LTO4 full-high tape drives. With IBM LTO4 tape drive, the IBM TS3200 also has 3 GB SAS (Serial Attached SCSI) attachment interface. Standard features are a barcode reader and a remote management unit (RMU).

The IBM TS3200 also supports Application-Managed Encryption on SAS and Fibre Channel LTO4 drives using LTO4 media. Designed for high system availability, the optional control path feature can assure continued host connectivity even if one path goes down.

The TS3200 Tape Library can be attached to IBM System p, IBM System i, IBM System x, Microsoft Windows, HP-UX, Sun Solaris, UNIX, Linux, and PC servers.

It provides ability to configure the number of logical libraries up to the number of tape drives. This provides a maximum capability of four logical libraries for the TS3200 with four half-high drives.

Available as a standard feature, a *Remote Management Unit* (RMU) provides an Ethernet port, so that the library can be configured as a TCP/IP device in the network. Library status can be sent to the network as Simple Network Management Protocol (SNMP) traps. The IBM System Storage Tape Library Specialist enables network access (via Web browser) to the library for more detailed status and for updating the firmware of the library. All library Operator Panel functions can be accessed using the IBM System Storage Tape Library Specialist.

Figure A-8 shows the IBM TS3200 Tape Library.


*Figure A-8 IBM TS3200 Tape Library*

For more information about IBM TS3200 Tape Library, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

## IBM System Storage TS3310 Tape Library

The TS3310 Tape Library is a highly expandable IBM LTO library which allows you to start small with a 5U base unit available in desktop or rack mounted configurations. Over time, as your requirement for tape backup expands, you can add additional 9U expansion modules, each of which contains space for additional cartridges, tape drives and a redundant power supply. The entire system grows vertically. Available configurations include the 5U base library module alone or with up to four 9U modules.

The TS3310 Tape Library offers a broad range of configuration possibilities. The smallest configuration includes a base unit with one or two tape drives, either IBM LTO3, LTO4 or a mix, 30 storage slots and 6 I/O slots. This will be upgradeable to a fully configured rack mounted library 41U high with up to 18 IBM LTO3 or LTO4 tape drives, tape storage (396 slots) and up to 54 I/O slots.

The IBM TS3310 also supports Application-Managed Encryption, System-Managed Encryption (SME) and Library-Managed Encryption (LME) on SAS and Fibre Channel LTO4 drives using LTO4 media. Designed for high system availability, the optional control path feature can assure continued host connectivity even if one path goes down.

The TS3310 Tape Library can be attached to IBM System p, IBM System i, IBM System x, Microsoft Windows, HP-UX, Sun Solaris, UNIX, Linux, and PC servers.

It provides ability to configure the number of logical libraries up to the number of tape drives. This provides a maximum capability of 18 logical libraries for the IBM TS3310.

Available as a standard feature, a *Remote Management Unit* (RMU) provides an Ethernet port, so that the library can be configured as a TCP/IP device in the network. Library status can be sent to the network as Simple Network Management Protocol (SNMP) traps. The IBM System Storage Tape Library Specialist enables network access (via Web browser) to the library for more detailed status and for updating the firmware of the library. All library Operator Panel functions can be accessed using the IBM System Storage Tape Library Specialist.

Figure A-9 shows the IBM TS3310 Tape Library 5U base unit.

*Figure A-9 IBM TS3310 Tape Library 5U base unit*

For more information about IBM TS3310 Tape Library, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

## IBM System Storage TS3500 Tape Library

The IBM System Storage TS3500 Tape Library (Figure A-10 on page 466) leverages the LTO and Enterprise 3592 drive technologies within the same library. The TS3500 was previously known as the IBM TotalStorage 3584 Tape Library and still has the machine type 3584.

The IBM System Storage TS3500 Tape Library provides tape storage solutions for the large, unattended storage requirements from today's mid-range up to enterprise (z/OS and Open Systems) environment. This chapter only covers information relating to the TS3500 Tape Library library attachment in an Open Systems environment. For information about TS3500 Tape Library attachment to a z/Series environment, refer to the Redbooks publication, *IBM TS3500 Tape Library with System z Attachment A Practical Guide to Enterprise Tape Drives and TS3500 Tape Automation*, SG24-6789.

Combining reliable, automated tape handling and storage with reliable, high-performance IBM LTO tape and TS1120 drives, the TS3500 Tape Library offers outstanding retrieval performance with typical cartridge move times of less than three seconds.

The TS3500 Tape Library can be partitioned into multiple logical libraries. This makes it an excellent choice for consolidating tape workloads from multiple heterogeneous open-system servers and enables the support for z/Series attachment in the same library.

In addition, the TS3500 Tape Library provides outstanding reliability and redundancy, through the provision of redundant power supplies in each frame, an optional second cartridge accessor, control and data path failover, and dual grippers within each cartridge accessor. Both library and drive firmware can now be upgraded non-disruptively, that is without interrupting the normal operations of the library.

The TS3500 supports Tape Encryption on the following tape drives: IBM System StorageTS1040 Tape Drive, and the IBM System StorageTS1120 Tape Drive. The three different Encryption methods are supported: Application-Managed Encryption, System-Managed Encryption (SME) and Library-Managed Encryption (LME) by the TS3500.


*Figure A-10 IBM System Storage TS3500 Tape Library*

## TS3500 frames L53 and D53 for IBM LTO Fibre Channel drives

The TS3500 Tape Library Models L53 and D53 integrate the TS1030 and TS1040 LTO 4 Gbps Fibre Channel Tape Drive. The Model L53 frame includes an enhanced Frame Controller Assembly (FCA) with two power supplies (for redundancy), an optimized dual-gripper cartridge accessor, on-demand storage slot capacity, and 16-slot I/O stations. The Model D23 frame can be attached to current or installed frame models.

### TS3500 Tape Library Model L53

The L53 can be installed on its own as a complete library enclosure, or it can have up to 15 expansion frames attached to it. This frame provides the major library components for the whole library, whether it has single or multiple frames. It also provides cartridge storage capacity for LTO media and it can be equipped with IBM LTO 1, 2, 3, and 4 tape drives. The expansion frames must be added to the right of the L53 frame.

The number of LTO cartridge storage slots ranges from 64 to 287. With the minimum configuration, there are just 64 slots available for use, but the maximum of 287 slots are already physically installed. Additional slots can be added for use by simply enabling through a license key.

The Intermediate Capacity feature (FC1643) gives a total amount of usable cartridge slots of 129. This feature is required to add a Full Capacity feature (FC1644), which gives the capacity of 287 cartridge slots. The full capacity feature is in turn required to add an

Additional I/O Slots feature (FC1658 for LTO or FC1659 for 3592) or to attach an optional expansion frame.

This gives a maximum data capacity for the L53 of 229 TB native (up to 458 TB with 2:1 data compression).

Up to 12 IBM LTO drives can be installed. LTO1, LTO2, LTO3, and LTO4 tape drives can be installed in the same frame. As you add more than four drives or install the additional I/O station, there is an incremental reduction in storage slots. It is also possible to install the LTO FC Drive Mounting Kit (FC1514) in advance, to simplify future tape drive installation, but it will also reduce the number of available slots.

Each TS3500 Model L53 has a standard 16-slot LTO cartridge input/output station for importing or exporting cartridges from the library without requiring re-inventory or interruption of library operations. Optional features can provide 16 additional input/output slots for LTO (FC1658) or 3592 media (FC1659). The lockable library door can be opened for bulk-loading IBM LTO tape cartridges. Re-inventory of the cartridges is done in fewer than 60 seconds per frame each time the library door is closed. A barcode reader mounted on the autochanger scans the cartridge labels at less than one minute per frame. A door lock is included to restrict physical access to cartridges in the library.

### TS3500 Tape Library Model D53

The D53 frame has the same footprint as the model L53.

The D53 cannot be installed on its own. It must be connected to a library with a base frame and optionally multiple expansion frames. Up to 16 frames can be connected together.

If one or more tape drives are installed in the D53, then the Enhanced Frame Control Assembly Feature (FC1451) is required along with the LTO Fibre Drive Mounting Kit (FC1514). This feature provides the hardware and firmware required to support IBM LTO drives within the D53 and also provides a redundant AC line feed for the L frame accessor. The Frame Control Assembly Feature is also required if LTO Fibre Drive Mounting Kit (FC1504) is installed.

You can easily configure D53 frames according to future requirements. By installing the Enhanced Frame Control Assembly (FC1451), the D53 frame is ready to host LTO drives. The LTO Fibre Drive Mounting Kit (FC1514) prepares the drive slots for hosting an LTO drive. This enables you to install or move LTO drives without any additional hardware changes.

A fully configured IBM TS3500 Tape Library with one L53 frame and 15 D53 frames supports up to 192 drives. An L53 base frame and 15 D53 expansion frames with a minimal drive configuration provides a maximum capacity of 6887 storage slots with a total capacity of 5.5 PB without compression.

The base L23 or L53 is always on the left and as many as 15 additional D53 and D23 expansion frames can be added to the right side. During the installation of additional D53 frames, the x-rail of the L frame where the accessor resides will be extended, so that the accessor can move through the new installed frame.

If a D53 is being added to an installed L32 or D32 frame, feature FC1610 is required, since the D53 is a shorter frame. This feature includes a short rear side cover for the Model D32/L32 frame and the Model D23/D53 front and rear side covers.

An additional 16-slot input/output station for LTO media should be ordered via feature FC1658 if attaching a D53 expansion frame to an L23 base frame.

An additional 4 I/O station door can be installed in a Dx3 frame. This requires Feature Code 1451, and up to three Dx3 frames can be installed with this feature. Figure A-11 shows the 4 I/O station D-Frame. On the right upper corner there is a LED status panel located. The LEDs represents the amount of cartridges per I/O station and if the I/O station is locked. The I/O door has a total amount of 64 slots, 16 slots per I/O station.

The 4 I/O station door reduces the frame storage slot capacity by 160 for a model D23 and by 176 for a model D53. The I/O stations increase the maximum library I/O station slots from 32 to 224 due to a maximum of three D23 or D53 I/O frames in a sixteen frame library. The D23 and D53 models are compatible with existing models L22, L32, L52, D22, D32, and D52.

Figure A-11 shows a graphical overview of the 4 I/O station door using the Web user interface. In our example there are five cartridges imported in the upper right I/O station, and when you put your cursor on the data cartridge, it will show you the volume label.

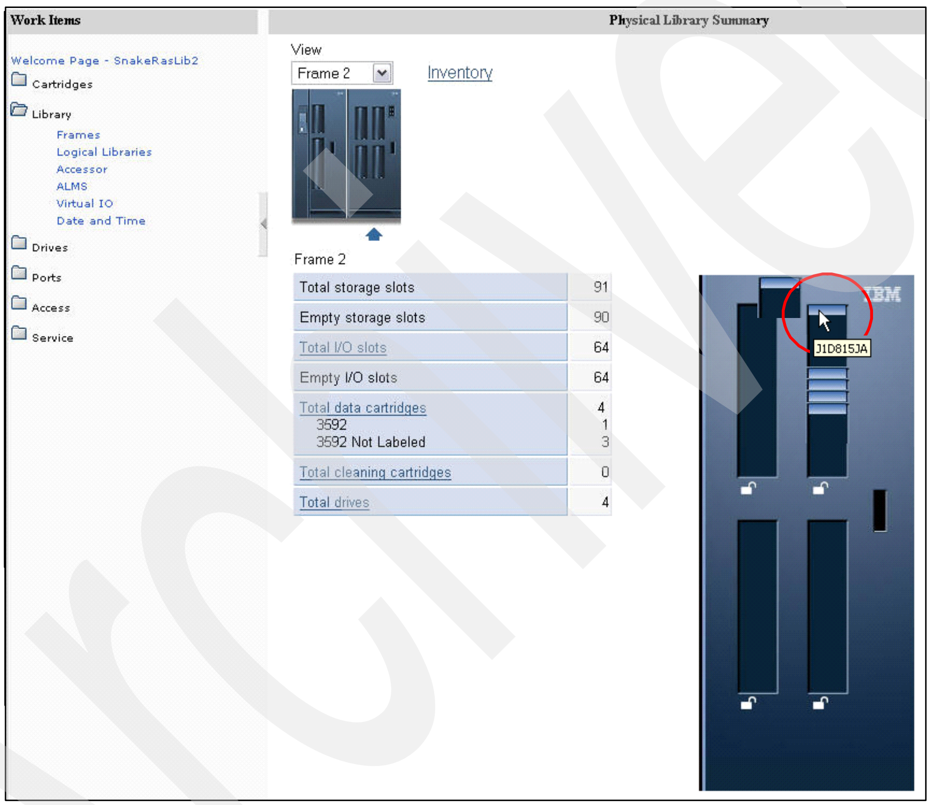



*Figure A-11 A graphical overview of the 4 I/0 door using the Web user interface*

## IBM TS3500 Tape Library frames L23 and D23

The Model L23 and D23 frames integrate the IBM TotalStorage 3592 Tape Drive with 4 Gbps dual-ported switched fabric Fibre Channel attachment. The TS3500 Tape Library Model L23 and D23 frames can be attached to LTO Frames (L53 and D53), and, therefore, TS1120 and LTO tape drives can be intermixed within the same TS3500 Tape Library.

The TS1120 Tape Drive used in the IBM TS3500 Tape Library Models L23 and D23 is designed for automation and uses a tape cartridge with a form factor similar to the IBM 3590 tape cartridges. The TS1120 Tape Drive has a dual-ported 4 Gbps Fibre Channel interface and has a native data rate of up to 100 MB/s. The TS1120 Tape Drives are designed to provide high levels of performance, functionality, and cartridge capacity supporting the 3592 tape format, including Write Once Read Many (WORM) media support.

### IBM System Storage TS3500 Model L23 Frame

The TS3500 Model L23 provides cartridge slots for 3592 media and support for up to twelve TS1120. This model has the same footprint as the model L53. Data capacity for the model L23 using 3592 data cartridges is 17 to 78 TB native. The L23 can be installed on its own as a complete library enclosure, or up to 15 Model D23 or D53 can be attached to it. The library capacity and number of drives can be expanded to meet changing requirements.

The L23 frame provides the major library components for the whole library, whether it has single or multiple frames. The expansion frames must be added to the right of the L53 frame.

The number of 3592 cartridge storage slots ranges from 58 to 260. The minimum configuration provides 58 slots available for actual use, although all 260 slots are already physically installed. To enable the additional slots for use (up to the total of 260), obtain an additional license key by ordering one of the following Capacity On Demand features. The Intermediate Capacity feature (FC1643) gives a total amount of usable cartridge slots of 117. This feature is required to add a Full Capacity feature (FC1644), which gives the capacity of 260 cartridge slots. The Full Capacity feature is required to add an additional I/O Slots feature (FC1658 or FC1659) or to attach the optional expansion frame models D23 or D53.

Up to 12 IBM TS1120 Tape Drives can be installed. Adding more than four drives or drive mounting kits, or installing the additional I/O station, will reduce the number of storage slots available for use. You can also install the 3592 FC Drive Mounting Kit (FC1513) in advance, which will simplify future tape drive installation. This kit reduces the storage slots to the appropriate number and provides the power supply and necessary cables for installing a TS1120 drive.

Each L23 has a standard 16-slot 3592 cartridge input/output station for importing or exporting cartridges from the library without requiring re-inventory or interruption of library operations. Optional features can provide 16 additional input/output slots for LTO media. The lockable library door can be opened for bulk-loading cartridges. Re-inventory of the cartridges is done in fewer than 60 seconds per frame each time the library door is closed. A barcode reader mounted on the autochanger scans the cartridge labels at less than one minute per frame. A door lock is included to restrict physical access to cartridges in the library.

### IBM System Storage TS3500 Model D23 frame

The D23 frame has the same footprint as the Model L23. The D53 cannot be installed on its own. It must be connected to a base frame and optionally other expansion frames. Up to 16 frames can be connected.

If one or more tape drives are installed in the D23, then the Enhanced Frame Control Assembly Feature is also required (FC1451). This feature provides the hardware and firmware required to support IBM 3592 drives within the D23 and provides a redundant line feed for the L23 or L53 accessor.

You can easily configure D23 frames according to future requirements. By installing the Enhanced Frame Control Assembly (FC1451), the D23 frame is ready to host TS1120 tape drives. The 3592 Fibre Drive Mounting Kit (FC1513) prepares the drive slots for hosting a TS1120 Tape Drive. This enables you to install or move 3592 drives without any additional hardware changes.

A fully configured IBM TS3500 Tape Library with one L23 frame and 15 D23 frames supports up to 192 drives. An L23 base frame and 15 D23 expansion frames with a minimal drive configuration provides a maximum capacity of 6260 storage slots with a total capacity of 1878 TB without compression using the IBM TotalStorage 3592 Tape Drive.

The base frame (model Lxx) is always on the left and as many as 15 additional expansion frames (Dxx) can be added to the right side. During the installation of additional D23 frames, the x-rail of the L frame where the accessor resides is extended, so that the accessor can move through the new installed frame.

If a D23 is being added to an installed L32 or D32 frame, feature FC1610 is required, since the D23 is a shorter frame. This feature includes a short rear side cover for the Model D32/L32 frame and the Model D23/D53 front and rear side covers.

If attaching a D23 frame to an L53 frame, the First Expansion Frame Attachment Feature (FC9002) for the L53 must be specified. Subsequent expansion requires the Additional Expansion Frame Attachment feature (FC9003).

Additional 16-slot I/O stations for 3592 media should be ordered via feature FC1659 if attaching a D23 frame to a L53.

## IBM TS3500 Tape Library storage only frames S24 and S54

IBM System Storage TS3500 storage-only frame includes the Model S24™ Frame and the Model S54 Frame. The TS3500 Tape Library Model S24 and S54 frames are *high density* (HD) storage-only expansion frames compatible with existing TS3500 Tape Libraries and frames.

The Advanced Library Management System (ALMS) is required for support of Sxx frames.

The TS3500 Tape Library Model S24 expansion frame is designed for 3592 data cartridges. You can add up to 15 Model S24 expansion frames to the TS3500 Model L22 or L23 base frame to increase 3592 cartridge storage. Each Model S24 frame supports up to 1,000 IBM 3592 cartridge slots.

The TS3500 Tape Library Model S54 expansion frame is designed for LTO data cartridges. You can add up to 15 Model S54 expansion frames to the TS3500 Tape Library Model L32, L52, or L53 base frame to increase LTO cartridge storage. Each Model S54 frame supports up to 1320 LTO cartridge slots.

Currently, up to 6887 slots are supported per single TS3500 library. Therefore, the limit of 15 active expansion frames is reduced as listed in Table A-1. IBM plans to provide support for greater than 6887 cartridges in a future release as has been previewed.[1]

*Table A-1 TS3500 active frames*

| Number of active S24 frames | Number of active S54 frames | Limit of total active expansion frames |
|---|---|---|
| 1 | 0 | 13 (reduce by 2) |
| 0 | 1 | 13 (reduce by 2) |
| 2 | 0 | 12 (reduce by 3) |
| 0 | 2 | 11 (reduce by 4) |
| 3 | 0 | 10 (reduce by 5) |
| 0 | 3 | 9 (reduce by 6) |
| 4 | 0 | 9 (reduce by 6) |

[1] Previews provide insight into IBM plans and direction. Specific availability dates, ordering information, and terms and conditions will be provided when the product functionality is announced.

| Number of active S24 frames | Number of active S54 frames | Limit of total active expansion frames |
|---|---|---|
| 0 | 4 | 7 (reduce by 8) |
| 5 | 0 | 7 (reduce by 8) |
| 0 | 5 | 5 (reduce by 10) |
| 6 | 0 | 6 (reduce by 9) |
| 0 | 6 | Not supported |
| 7 | 0 | Not supported |

### *High density technology*

The depth of a cartridge location in a high density slot is known as the tier. The cartridge immediately accessible in the HD slot is a tier 1 cartridge. Behind that is tier 2 and so on. The maximum tier in an LTO HD slot is tier 5. The maximum tier in a 3592 HD slot is tier 4 because the 3592 cartridge is slightly longer than the LTO cartridge. The single-deep slots on the door-side of HD frames and in non-HD frames are referred to as tier 0 slots.

Figure A-12 shows a graphical exterior view of an S24 frame. An S54 frame has a similar exterior view. The difference is that S54 has a tier 5 slot inside.

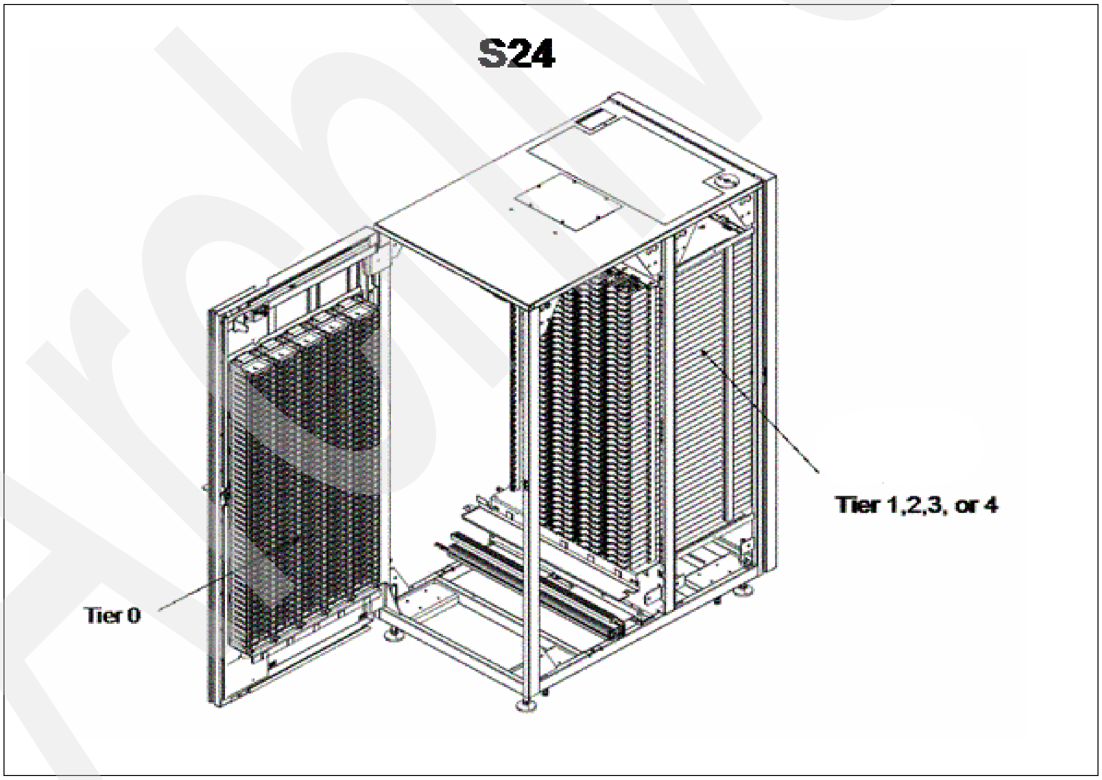



*Figure A-12 S24 frame*

Figure A-13 shows a side view of the HD frame.

The S24 frame supports up to five tiers (tier 0 to tier 4) with up to 200 IBM 3592 cartridge slots for each tier. The S54 frame supports up to six tiers (tier 0 to tier 5) with up to 220 IBM LTO cartridge slots for each tier.

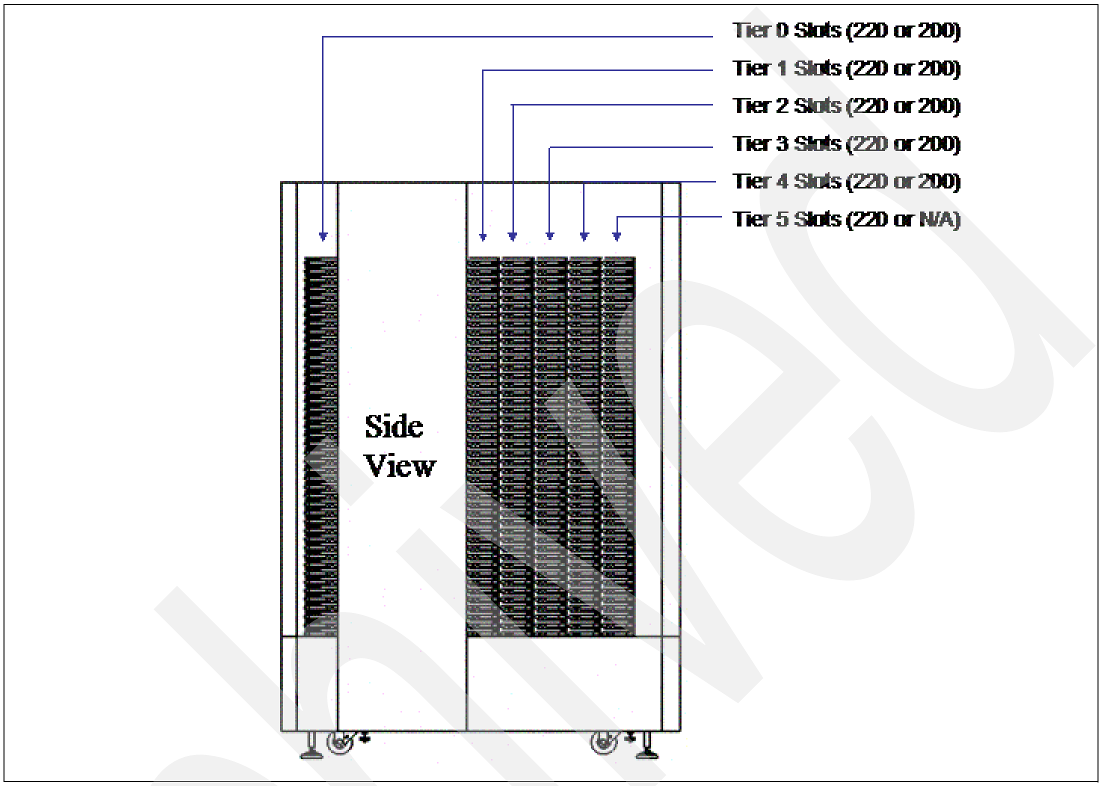



*Figure A-13 Sxx frame side view*

### LED lighting

New internal LED lighting (as shown in Figure A-14) is added to the HD frame because the window at the top of the frame is removed.

Figure A-14 internal LED lighting

### Library configurations supported by HD frames

When installing HD frames in a TS3500, these configuration rules apply:

- HD frames are supported in mixed media, LTO media-only, and 3592 media-only libraries without high-availability (HA) frames.
- HD frames are supported as active frames in HA LTO-only or 3592-only libraries.
- HD frames are supported as service bay B in HA LTO-only or 3592-only libraries.
- HD frames are *not* supported as active frames in a HA mixed-media library.
- HD frames are *not* supported as service bay B in a HA mixed-media library.

### Capacity on demand for HD frame

HD frames support HD capacity on demand (CoD) and have the ability to add slot capacity nondisruptively to Sx4 frames. FC1645 provides on demand activation of an additional 400 slots of capacity (tiers 3 and 4) for Model S24, and FC1646 provides on demand activation of an additional 660 slots of capacity (tiers 3, 4, and 5) for Model S54.

### HD frame basic concept

In HD frames, the cartridge accessor performs a *shuffle* operation in order to access the cartridges stored in tier 2 and beyond. A shuffle is the process of moving cartridges in lower tiers into the gripper or other available slots in order to access cartridges in higher tiers (tier 2 or greater). In order to reduce the occurrence of shuffle operations and to take advantage of repeated accesses of certain cartridges, the role of cartridge cache is assigned to all single-deep (tier 0) slots in an HD library. In order to maintain efficient shuffle operations, the library performs a load balancing of the tiers, which stores cartridges across all HD slots in the library string. In other words, all HD slots are filled to a minimum tier level until that tier is full across the library. This reduces the need to access cartridges in higher tiers.

Cartridges are located in the frames where the appropriate drives that can process them also are located. The TS3500 Tape Library without HD frame operates in *fixed home cell mode*, which means that the cartridges are returned to their home cells. The TS3500 Tape Library with HD frame operates in *floating home cell mode*.

## IBM 3584 High Availability Unit HA1

The IBM 3584 High Availability Frame Model HA1 can be added to the IBM TS3500 Tape Library Base Frame Models. In conjunction with a service bay feature on the TS3500 Tape Library Model D23 or L23, the Model HA1 provides for the installation and operation of a second library accessor that is designed to operate simultaneously with the first accessor and service mount requests in the IBM TS3500 Tape Library. It is designed to non-disruptively fail over to a redundant accessor when any component of either accessor fails, which helps maintain availability and reliability. This design also includes the ability to add one or more Model D53 or D23 frames to an IBM TS3500 Tape Library that has an attached Model HA1 with minimal disruption.

Dual active accessor support is provided in a mixed media library. This includes any combination of 3592 and LTO media types. For example, a single library can have 3592, LTO1, LTO2, LTO3, and LTO4 media installed and configured. The ALMS (see “ALMS” on page 478) is required for support of dual accessors and two or more media types.

When dual accessors are installed and an attached host issues a command for cartridge movement, the library automatically determines which accessor can perform the mount in the most timely manner. If the library’s primary accessor fails, the second accessor assumes control and eliminates system outage or the requirement for operator intervention.

A dual accessor library will have two garage areas called service bays (see Figure A-15 on page 475). Service Bay A (the 3584 High Availability Frame Model HA1) is to the left of and adjacent to the L-frame, when facing the front door. Service Bay B (a modified TS3500 Tape Library Model D23 or D53) is to the right of the last active frame in the library.

The TS3500 Tape Library Model HA1 itself provides only a frame, which serves as Service Bay A for the original accessor for the TS3500 Tape Library Model Lxx. The second accessor is provided by ordering the Service Bay B Configuration and Dual Accessor feature (FC1440) on a TS3500 Tape Library Expansion Frame Model D23 or D53. When this feature is ordered on a Model D23 or D53, that expansion frame will be reserved and function as a Service Bay B for the second accessor.

This feature should initially be installed on a new Model D23 or D53 frame that is added to the IBM TS3500 Tape Library when ordering the Model HA1. If your library already contains the service bays and you decide to add one or more D23 or D53 expansion frames, Service Bay B will be converted to an expansion frame, the new frame or frames will be added to the right, and the last frame on the right will be converted to Service Bay B. The downtime for this process is designed to be less than hour.

The service bays will be regular library frames but they will not have drives, power supplies, or node cards. Storage slots within the service bays will only be used to test service actions. Figure A-15 demonstrates how the Service Bays surround the other library frames.

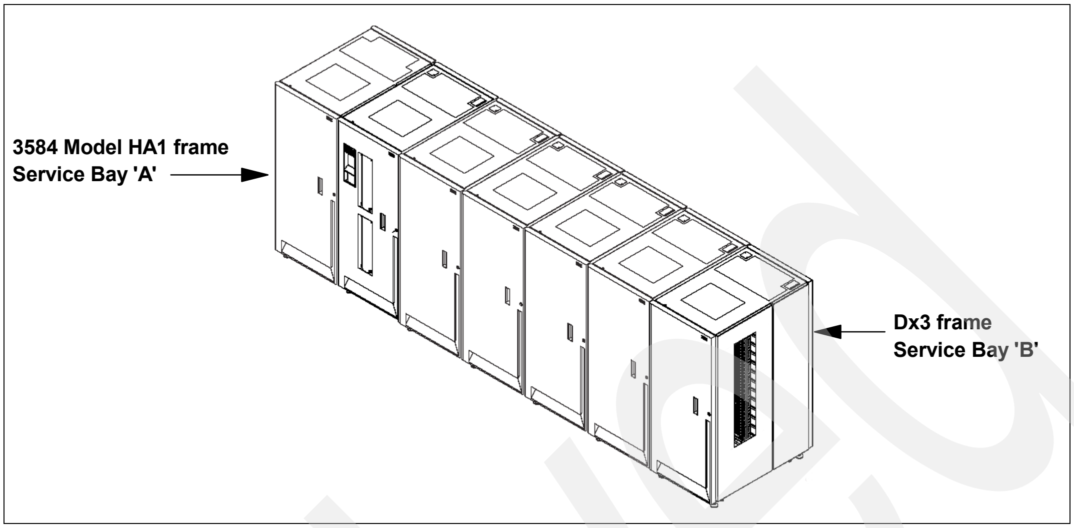



*Figure A-15 Location of service bays in the IBM TS3500 Tape Library*

In summary, to implement nondisruptive accessor failover, these components are required:

- A 3584 Model HA1 frame to act as Service Bay A
- High Availability Library feature (FC9040) for the Lxx frame.
- Advanced Library Management System feature (FC1690)
- A D53 or D23 frame to operate as Service Bay B for the second accessor
- Additional expansion frame Attachment (FC9003)
- Service Bay B Configuration with Accessor (FC1440)

## Control path failover

Alternate path support, currently available for AIX, Linux, Solaris, HP-UX, and Windows hosts, configures multiple physical control paths to the same logical library within the device driver and provides automatic failover to an alternate control path when a permanent error occurs on one path. This is transparent to the running application.

For example, consider a simple multi-path architecture connection consisting of two HBAs in a host that are connected to a library with two or more drives. Two drives have the control ports enabled. The two HBAs are connected to the first and second control port drives, respectively. This simple configuration provides two physical control paths to the library for redundancy if one path from an HBA to the library fails. When the server boots, each HBA detects a control port to the library, and two medium changer devices (smc0 and smc1) are configured. Each logical device is a physical path to the same library; however, an application can open and use only one logical device at a time, either smc0 or smc1.

Without the device driver alternate pathing support, if an application opens smc0 and a permanent path error occurs (because of an HBA, cable, switch, or drive control port failure), the current command to the library fails. It is possible to initiate manual failover by changing the device path to the alternate path (smc1), but this is a manual operation and the last failing command has to be resent.

When the alternate pathing support is enabled on both smc0 and smc1, the device driver configures them internally as a single device with multiple paths. The application can still open and use only one logical device at a time (either smc0 or smc1). If an application opens smc0 and a permanent path error occurs, the current operation continues on the alternate path without interrupting the application.

Activation of control path failover is done by entering a license key at the library Operator Panel. Control path failover is provided by an optional FC1680 for Lx2 frame models and requires the use of the IBM Atape device driver. For Lx3 models, control path failover and data path failover are available with the optional Path Failover feature (FC1682).

## Data path failover

Data path failover and load balancing exclusively support native Fibre Channel LTO and IBM 3592 tape drives in the IBM TS3500 Tape Library using the IBM device driver. Data path failover is now supported for AIX, Linux, HP-UX, Solaris, and Windows hosts. Load balancing is supported for AIX, Linux, HP-UX and Solaris. Refer to the *IBM Tape Device Drivers Installation and User's Guide*, GC27-2130.

Data path failover provides a failover mechanism in the IBM device driver, so that you can configure multiple redundant paths in a SAN environment. If a path or component fails, the failover mechanism is designed to provide automatic error recovery to retry the current operation using an alternate, preconfigured path without stopping the current job in progress. This improves flexibility in SAN configuration, availability, and management. When accessing a tape drive device that has been configured with alternate pathing across multiple host ports, the IBM device driver automatically selects a path through the HBA that has the fewest open tape devices and assigns that path to the application.

This autonomic self-optimizing capability is called load balancing. The dynamic load balancing support is designed to optimize resources for devices that have physical connections to multiple HBAs in the same machine. The device driver is designed to dynamically track the usage on each HBA as applications open and close devices, and balance the number of applications using each HBA in the machine. This can help optimize HBA resources and improve overall performance. Further, data path failover provides autonomic self-healing capabilities similar to control path failover, with transparent failover to an alternate data path in the event of a failure in the primary host-side path.

Data path failover and load balancing for Linux and Solaris are provided by an optional feature (FC1681) for Lx2 models. Data path failover is included in the Path Failover feature (FC1682) for Lx3 models, which also includes control path failover.

Data path failover and load balancing support for AIX or for IBM 3592 tape drives do not require this feature.

## SNMP

Occasionally, the IBM TS3500 Tape Library might encounter a situation that should be reported, such as an open door that causes the library to stop. Because many servers can attach to the IBM TS3500 Tape Library by differing attachment methods, the library provides a standard TCP/IP protocol called Simple Network Management Protocol (SNMP) to send alerts about conditions (such as an opened door) over a TCP/IP LAN network to an SNMP monitoring server. These alerts are called *SNMP traps*. Using the information supplied in each SNMP trap, the monitoring server (together with customer-supplied software) can alert operations staff of possible problems or operator interventions that occur. Many monitoring servers (such as IBM Tivoli NetView) can be used to send e-mail or pager notifications when they receive an SNMP alert.

## SMI-S support

This section describes how the IBM TS3500 Tape Library uses the Storage Management Initiative - Specification (SMI-S) to communicate in a SAN environment.

To communicate with storage devices in a SAN, management software can use other software known as the Storage Management Initiative - Specification Agent for Tape. The SMI-S Agent for Tape is available for Intel-based SuSE LINUX Enterprise Server 9. The SMI-S Agent for Tape communicates by using the Web-Based Enterprise Management (WBEM) protocol, which allows management software to communicate with the IBM TS3500 Tape Library.

The SMI-S Agent for Tape is designed for compliance with the Storage Management Initiative - Specification. The SMI-S is a design specification of the Storage Management Initiative (SMI) that was launched by the Storage Networking Industry Association (SNIA). The SMI-S specifies a secure and reliable interface that allows storage management systems to identify, classify, monitor, and control physical and logical resources in a Storage Area Network (SAN). The interface is intended as a solution that integrates the various devices to be managed in a SAN and the tools used to manage them. The SMI-S was developed to address the problems that many vendors face in managing heterogeneous storage environments. It creates a Management Interface protocol for multivendor storage networking products. By enabling the integration of diverse multivendor storage networks, the initiative is able to expand the overall market for storage networking technology.

For detailed information about SMI-S, see the *IBM TotalStorage SMI-S Agent for Tape Installation Guide*, GC35-0512.

The SMI-S agent normally ran on a separate LINUX PC, but from library firmware level 7050 SMI-S, in a limited form, it is running on the MCP. The level of SMI-S is 1.1, and the following functions are supported within the Server Profile:

- Library code level: Use IBMTSSML3584_SoftwareIdentity VersionString.
- Library name: Use IBMTSSML3584_TapeLibrary ElementName.
- Administrator and Contact information: Use IBMTSSML3584_TapeLibrary PrimaryOwnerName and PrimaryOwnerContact.

There is no support for Service Location Protocol (SLP) and Secure Socket Layer (SSL) at the time writing this publication.

The external LINUX PC supports the following protocols:

- Server Profile SMI-I Version 2
- Storage Media Library Version 2
  - Limited Access Port 1.1
  - Chassis 1.1
  - FC Port 1.1
  - Software 1.1
  - Physical Package 1.1

In the future, the imbedded SMI-S will have the same functions as the external LINUX PC.

> **Note:** The imbedded SMI-S function requires a LX3 Frame and a library firmware level that supports SMI-S.

## ALMS

The Advanced Library Management System, an optional extension to the IBM patented multi-path architecture (FC1690), provides enhanced flexibility and capabilities for partitioning the IBM TS3500 Tape Library. ALMS virtualize the SCSI element addresses while maintaining the approach of the multi-path architecture and using SCSI3 Medium Changer commands. Without ALMS everything is based on the SCSI element address (location-centric) and partitioning is based on real cartridge slots and drive slots. With ALMS, there is no affinity between a real slot address and a SCSI Element address reported to the server and used by the server. Instead there is now an affinity with the VOLSER (volume serial numbers on the barcode label of the cartridge).

**Note:** ALMS is available only for the IBM TS3500 Tape Library and requires FC1690 for enablement.

## Virtual I/O

The IBM TS3500 Tape Library has I/O stations and I/O slots that enable you to import and export up to 32 cartridges at any given time. The I/O slots are also known as *import/export elements (IEEs)*. As a feature of ALMS, Virtual I/O (VIO) slots increase the quantity of available I/O slots by allowing storage slots to appear to the host as I/O slots. Storage slots that appear to the host as I/O slots are called *virtual import/export elements (VIEEs)*. The goal of virtual I/O slots is to reduce the dependencies between the system administrator and library operator so that each performs their import and export tasks without requiring the other to perform any actions. With virtual I/O slots, the library automatically moves cartridges from the I/O stations to physical storage slots and from physical storage slots to the I/O stations.

## Element number

Element numbers identify the physical location within the library. This information is required mostly for storage applications, such as IBM Tivoli Storage Manager, which translate the device to a name that the robotic system understands.

In the IBM TS3500 Tape Library, each SCSI storage element is assigned a SCSI element address. A SCSI storage element is a physical location capable of holding a tape cartridge (such as an I/O slot, drive, or storage slot). The element numbering is grouped in:

- Tape drive sequence
- I/O station sequence
- Cartridge slot sequence

**Note:** The numbering is contiguous for the cartridge slot sequence. However, the addition, removal, or movement of one or more tape drives affects the element numbering of the cartridge slots.

Table A-2 shows the element numbers for tape drives in each IBM TS3500 Tape Library frame up to six frames. For element numbers up to the maximum 16 frames, see the *IBM System Storage TS3500 Tape Library Operator Guide*, GA32-0560.

*Table A-2 IBM TS3500 Tape Library tape drive element numbers*

| Drive number | Frame 1 (Lx3) | Frame 2 (Dx3) | Frame 3 (Dx3) | Frame 4 (Dx3) | Frame 5 (Dx3) | Frame 6 (Dx3) |
|---|---|---|---|---|---|---|
| 1 | 257 | 269 | 281 | 293 | 305 | 317 |

| Drive number | Frame 1 (Lx3) | Frame 2 (Dx3) | Frame 3 (Dx3) | Frame 4 (Dx3) | Frame 5 (Dx3) | Frame 6 (Dx3) |
|---|---|---|---|---|---|---|
| 2 | 258 | 270 | 282 | 294 | 306 | 318 |
| 3 | 259 | 271 | 283 | 295 | 307 | 319 |
| 4 | 260 | 272 | 284 | 296 | 308 | 320 |
| 5 | 261 | 273 | 285 | 297 | 309 | 321 |
| 6 | 262 | 274 | 286 | 298 | 310 | 322 |
| 7 | 263 | 275 | 287 | 299 | 311 | 323 |
| 8 | 264 | 276 | 288 | 300 | 312 | 324 |
| 9 | 265 | 277 | 289 | 301 | 313 | 325 |
| 10 | 266 | 278 | 290 | 302 | 314 | 326 |
| 11 | 267 | 279 | 291 | 303 | 315 | 327 |
| 12 | 268 | 280 | 292 | 304 | 316 | 328 |

Each element in the IBM TS3500 Tape Library (the cartridge storage slots, I/O storage slots, and tape drives) has two addresses:

- Physical address
- SCSI element address

When initiating an operation such as moving a tape cartridge or performing manual cleaning, you can use the physical or logical address to specify a location in the library.

The physical address consists of frame, column, and row identifiers that define a unique physical location in the library. The address is represented as:

- Fx,Cyy,Rzz for a storage slot (where F equals the frame and x equals its number, C equals the column and 7520ax01_TLibs.fm equals its number, and R equals the row and zz equals its number).
- Fx,Rzz for a tape drive and I/O storage slot (where F equals the frame and x equals its number, and R equals the row and zz equals its number).

The SCSI element address consists of a bit and hex value that defines to the SCSI interface a logical location in the library. This logical address is represented as xxxx (X'yyy'), where xxxx is a bit value and yyy is a hex value. It is assigned and used by the host when the host processes SCSI commands. The SCSI element address is not unique to a storage slot, drive, or I/O slot; it varies, depending on the quantity of drives in the library. For example, the storage slot address F2,C03,R22 means:

- F2: frame 2 (first expansion frame)
- C03: column 3 (second column from left on drive side)
- R22: row 22 (22nd position down from the top of the column)

Each drive has a unique address to indicate its physical location. The drive address consists of two values: a frame number and a row number:

- Frame number: Represented as Fx, where F equals the frame and x equals its number. Regardless of whether any drives are installed, the frame number for the base frame is 1 and increments by one for each adjacent expansion frame.
- Row number: Represented as Rzz, where R equals the row and zz equals its number. The row number is 1 for the top drive position in the frame, and increments by one for each row beneath the top drive. Regardless of whether drives are installed, the row numbering is the same for every frame.

A drive address of F2,R10 means frame 2 (that is, the first expansion frame), row 10 (tenth drive position from the top of the column).

> **Note:** ALMS will virtualize a SCSI element address. Therefore, there is no relationship between physical location and SCSI element address if using ALMS.

# Other IBM System Storage Tape Models

Here we will describe the two models of IBM Open System Tape that belongs to the IBM System Storage Enterprise Tape Family. They are the IBM TS1100 Tape Drive Family and IBM TS3400 Tape Library.

## IBM System Storage TS1100 Family

The IBM System Storage TS1100 Tape Drive family offers a design that is focused on high capacity, performance, and high reliability for storing mission-critical data. Introduced in October 2003, the 3592-J1A Tape Drive had 300 GB of native capacity in a half-inch format tape cartridge. It was also a foundation for future generations of this new tape drive family based on the concept of media reuse. This design helps protect the client's investment in tape cartridges.

In October 2005, the second generation of the 3592 drive, IBM System Storage TS1120 Tape Drive Model E05, was introduced. IBM 3592-E05 has the same physical measurements as the 3592-J1A Tape Drive but the capacity increased 1.6 times from 300 GB to 500 GB native capacity on one cartridge. It has a 4 GB Fibre Channel attachment and a native data rate of up to 100 MB/s.

Now the achieved characteristics of the two generations of 3592 tape drives become increased again by IBM System Storage TS1130 Model E06 Tape Drive, the third generation of the 3592 family, which provides the unprecedented capacity of 1 TB of uncompressed data.

The TS1120 Tape Drive is the follow-on to the IBM 3592 Tape Drive Model J1A and the highly successful 3590 Enterprise Tape Drive. The TS1120 Tape Drive can be installed in the IBM System Storage TS3500, the IBM TotalStorage 3494 Tape Library, the IBM System Storage TS3400 and in a StorageTek™ 9310 Powderhorn™.

The tape drive uses IBM 3592 Cartridges, which are available in limited capacity (100 GB) for fast access to data, standard capacity (500GB) or extended capacity (700 GB). All three cartridges are available in re-writable or Write Once Read Many (WORM) format.

The TS1120 Tape Drive is supported in a wide range of environments, including selected IBM System i, System p, xSeries, IBM mainframe Linux, Sun, and Hewlett Packard servers, as well as Intel-compatible servers running Linux, Microsoft Windows 2000, or Windows Server® 2003. A tape controller is required for attachment to ESCON® or FICON® channels on IBM mainframe servers. Sharing drives optimizes drive utilization and helps reduce infrastructure requirements.

The TS1120 tape drive supports a native data transfer rate of up to 104 MB/s. In open system environments where data typically compresses at 2:1, the TS1120 tape drive can transfer data up to 200 MB/s. In a mainframe environment where data typically compresses at 3:1, a single tape drive can transfer data up to 260 MB/s. This high transfer rate help reduce backup and recovery times.

Figure A-16 shows the IBM System Storage TS1120 Tape Drive.

*Figure A-16 IBM System Storage TS1120 Tape Drive*

For more information about IBM TS1120 Tape Drive, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

IBM System Storage TS1130 Tape Drive (also referred to as the 3592 Model E06 and EU6) is the third tape drive generation of the IBM 3592 tape family. This generation provides higher capacity and performance compared to the predecessor 3592 Model E05. The TS1130 records in two recording formats supporting both encryption and non-encryption. Enterprise format 3 (EFMT3) is used to represent the non-encrypted recording format and enterprise encrypted format 3 (EEFMT3) to denote the encrypted recording format. With this recording formats, the non-compressed capacity of the extended length MEDIA9 and MEDIA10 cartridges is increased from 700 GB to 1 TB. The 3592 Model E06 is downward read compatible (n-2) to the 3592 Model J1A format (EFMT1) and is downward write compatible (n-1) to the 3592 Model E05 formats (EFMT2/EEFMT2). All current media types are supported.

Host interfaces to z Series and open platforms are maintained. The System Storage TS1130 tape drive is supported by IBM 3592 Model J70 Tape Controller, the System Storage TS1120 Tape Controller Model C06, and the TS7700 Virtual Engine using 4 Gb dual-port fiber cards. It allows for the integration into the IBM TotalStorage 3494 library, TS3500 library, TS3400 library, stand-alone rack mount, and Sun/STK Silo. There is no support for the 3494 Model B10/B20 Virtual Tape Server. Figure A-17 shows the front view of IBM TS1130 Tape Drive.

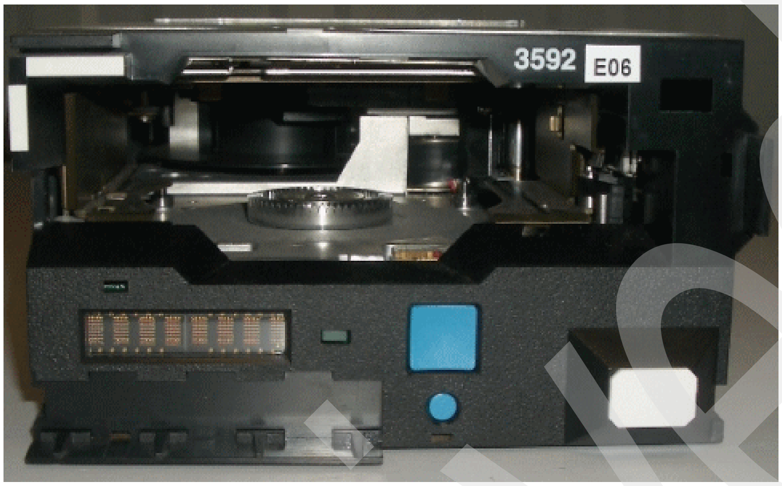



*Figure A-17   IBM System Storage TS1130 Tape Drive*

The TS1130 tape drive maintains the same features and technology enhancements introduced with the 3592 Model J1A and extended by the TS1120. In addition, the TS1130 offers several enhancements over the predecessor models. For detailed information refer to the *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

## IBM System Storage TS3400 Tape Library

The IBM System Storage TS3400 Tape Library (Machine type 3577, Model 5LU) is designed to offer high performance drive technology and automation for the open system environment. The IBM System Storage TS3400 Tape Library is a five units (5U) external desktop or rack mountable tape library that incorporates one or two IBM System Storage TS1120 Tape Drives Model E05.

The IBM System Storage TS1120 Tape Drive has a native capacity of 700 GB, when using the IBM Extended Data Cartridge (JB) or 500 GB when using the IBM Data cartridge (JA). The only attachment to the host is a 4 GB/s switch fabric Fibre Channel connection. The tape drives must be ordered separately with the final order.

The IBM System Storage TS3400 Tape Library supports the IBM System Storage TS1120 Tape Drive built-in encryption capabilities. The encryption methods are Application-Managed-Encryption, System-Managed-Encryption (SME), and Library-Managed Encryption (LME).

The previous IBM System Storage 3592 J1A Tape Drive is not supported in the IBM System Storage TS3400 Tape Library.

Designed for tape automation, the IBM System Storage TS3400 Tape Library can be attached to BM System p, IBM System i, IBM System x, Microsoft Windows, HP-UX, Sun Solaris, UNIX, Linux, and PC servers.

The IBM System Storage TS3400 Tape Library has two removable cartridge magazines providing 18 data cartridges slots including a 3 slot I/O station. The total native storage capacity is 12.6 TB when using the 700 GB data cartridges.

The IBM System Storage TS3400 Tape Library incorporates the IBM Multi-Path Architecture with one or two logical libraries. The TS1120 has two FC ports (dual ported) to make a connection to the host. The TS1120 provides a sustained native data transfer rate of 100MB/s.

Standard features for the IBM System StorageTS3400 Tape Library: Control path and data path fail over, barcode reader, dual power supplies, remote management and the possibility to use the IBM System Storage TS3400 Tape Library in sequential or random access mode.

Figure A-18 shows the front view of the IBM TS3400 System Storage Tape Library.

*Figure A-18 Front view of the IBM TS3400 System Storage Tape Library.*

For more information about IBM TS3400 Tape Library, see *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

# IBM 3592 Cartridges and Media overview

Users are faced with the need to cost-effectively store more digital information than ever before, often to meet growing regulatory and legal requirements. The 3592 tape drives are designed to help meet these needs with IBM System Storage Tape Cartridge 3592. The 3592-J1A, 3592-E05, and 3592-E06 use the 3592 tape cartridge, which offers various capacity options depending on what drive and recording format you use or what cartridge model you order (data, WORM, or economy).

These capabilities expand the range of client data workloads that can be addressed with the 3592 tape drives. The economy cartridge can help lower the cartridge cost for users with smaller capacity needs and provide faster access to data. The WORM cartridges provide non-erasable, non-rewritable storage media. Users with regulatory or legal requirements to store electronic records for long periods of time might be able to use the 3592 tape drives to provide cost-effective storage.

The 3592 cartridges have a form factor similar to the 3590 tape cartridge. They are supported in IBM System Storage Tape Library 3494, IBM System Storage TS3500 Tape Library, and StorageTek Automated Cartridge System (ACS) automation environments.

The 3592 cartridge contains 5-inch tape media with a new dual-coat, advanced-particle media and has improved areal density capabilities that differ from the tape media in any previously shipped cartridge. The 3592 cartridge is designed to have the strength and durability of an enterprise cartridge. Enhanced assembly strengthens the cartridge at critical locations and helps make the 3592 cartridge less susceptible to damage, for example, if you drop it.

The tape is pulled from the cartridge by means of a leader pin rather than a leader block as in the 3590, and a sliding door covers the area formerly occupied by the leader block in a 3590 cartridge. A locking mechanism prevents the media from unwinding when the cartridge is not located within a drive. A special mechanical design provision prevents the 3592 cartridge types from being loaded into 3590 or 3490 drives. If inadvertently loaded into a 3590, the cartridge present sensor does not change state and the drive does not attempt to load.

The 3592-E05 and the 3592-E06 use six media cartridge types:

- JA
- JJ
- JW
- JR
- JB
- JX

The 3592-J1A uses four media cartridge types:

- JA
- JJ
- JW
- JR

All six cartridge types contain the same dual-coat, advanced-particle media. Capacity on these media types depends on whether the cartridge is used by Model 3592-J1A, 3592-E05, or 3592-E06.

Table A-3 shows the media types and the capacity options that are available with 3592 tape drives.

*Table A-3 IBM TotalStorage Enterprise 3592 media types*

| Media type and description | Media type | Length | Native capacity 3592-J1A (E1 format) | Native capacity 3592-E05 emulating J1A (E1 format) | Native capacity 3592-E05 (E2 format) | Native capacity 3592-E06 (E3 format) | Native capacity 3592-E06 writing in format E2) |
|---|---|---|---|---|---|---|---|
| MEDIA5 DATA | JA | 609 m | 300 GB | 300 GB | 500 GB | 640 GB | 500 GB |
| MEDIA6 ECONOMY | JJ | 246 m | 60 GB | 60 GB | 100 GB | 128 GB | 100 GB |
| MEDIA7 WORM | JW | 609 m | 300 GB | 300 GB | 500 GB | 640 | 500 GB |
| MEDIA8 ECONOMY WORM | JR | 246 m | 60 GB | 60 GB | 100 GB | 128 GB | 100 GB |
| MEDIA9 EXTENDED DATA | JB | 820 m | N/A | N/A | 700 GB | 1 TB | 700 GB |

| Media type and description | Media type | Length | Native capacity 3592-J1A (E1 format) | Native capacity 3592-E05 emulating J1A (E1 format) | Native capacity 3592-E05 (E2 format) | Native capacity 3592-E06 (E3 format) | Native capacity 3592-E06 writing in format E2) |
|---|---|---|---|---|---|---|---|
| MEDIA10 EXTENDED WORM | JX | 820 m | N/A | N/A | 700 GB | 1 TB | 700 GB |

Capacity and performance characteristics are summarized in Table A-4.

*Table A-4 Capacity and performance summary*

| Media | E06 format capacity data rate (min–max) | E05 format capacity data rate (min–max) | J1A format capacity data rate (min–max) |
|---|---|---|---|
| JB/JX | 1 TB<br>40 MB/s–160 MB/s | 700 GB<br>40 MB/s–150 MB/s | N/A |
| JA/JW | 640 GB<br>40 MB/s–140 MB/s | 500 GB<br>40 MB/s–140 MB/s | 300 GB (read only)<br>30 MB/s–70 MB/s |
| JJ/JR | 128 GB<br>40 MB/s–140 MB/s | 100 GB<br>40 MB/s–140 MB/s | 60 GB<br>30 MB/s–70 MB/s |

The combinations of media types and specific tape drives have the characteristics listed in Table A-5. Improvements in the access performance (that is, time to first data, block locate time from load point, or random locate times, and the drive characteristics) are summarized in Table A-5.

*Table A-5 Access performance specifications and drive characteristics*

| Parameter | 3592-E06 EFMT3 or EEFMT3 | 3592-E05 EFMT2 or EEFMT2 | 3592-J1A EFMT1 |
|---|---|---|---|
| Tape speed: Locate/rewind | 12.4 m/s | 10 m/s | 8 m/s |
| Drive load/ready time | 12 s | 13 s | 19 s |
| Block locate time from load point average | 27 s for JA/JW<br>11 s for 20% scaled JA/JW<br>11 s for JJ/JR<br>36 s for JB/JX<br>15 s for 20% scaled JB | 33 s for JA/JW<br>11 s for 20% scaled JA/JW<br>11 s for JJ/JR<br>45 s for JB/JX<br>15 s for 20% scaled JB | 39 s for JA<br>11 s for 20% scaled JA |
| Time to first data average (load/ready + locate) | 39 s for JA/JW<br>24 s for 20% scaled JA/JW<br>24 s for JJ/JR<br>48 s for JB/JX<br>28 s for 20% scaled JB | 46 s for JA/JW<br>24 s for 20% scaled JA/JW<br>24 s for JJ/JR<br>58 s for JB/JX<br>28 s for 20% scaled JB | 39 s for JA<br>11 s for 20% scaled JA |
| Random block locate time | 20s for JA/JW<br>9 s for 20% scaled JA<br><br>27 s for JB/JX<br>12 s for 20% scaled JB | 23s for JA/JW<br>10 s for 20% scaled JA<br><br>31 s for JB/JX<br>12 s for 20% scaled JB | 27 s for JA<br>9 s for 20% scaled JA |
| Unload time | 23 s for JA/JW/JR/JJ/JB/JX | 23 s for JA/JW/JR/JJ/JB/JX | 21 s for JA |

| Parameter | 3592-E06<br>EFMT3 or EEFMT3 | 3592-E05<br>EFMT2 or EEFMT2 | 3592-J1A<br>EFMT1 |
|---|---|---|---|
| Rewind max. | 66 s for JA/JW<br>18 s for 20% scaled JA<br>18 s for JJ/JR<br>90 s for JB/JX<br>24 s for 20% scaled JB | 66 s for JA/JW<br>18 s for 20% scaled JA<br>18 s for JJ/JR<br>90 s for JB/JX<br>24 s for 20% scaled JB | 77 s for JA<br>18 s for 20% scaled JA |
| Read/write speed max. | 4.3 m/s | 3.2 m/s | 2.52 m/s |
| Number of tracks | 1152 | 896 | 512 |
| Number of passes (from BOT to EOT) | 72 | 56 | 64 |
| Linear density | 321 kbpi | 282 kbpi | 282 kbpi |
| Servo regions | 5 | 5 | 5 |
| Data tracks recorded simultaneously | 16 | 16 | 8 |
| Buffer size | 1 GB | 512 MB | 128 MB |

For more information about IBM 3592 Cartridges and Media see *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

# Tape encryption overview

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

The IBM System Storage TS1120 (3592-E05) and TS1040 (LTO4) Tape Drives are capable of encrypting data as it is written to tape. The TS1120 tape drive supports any kind of IBM TotalStorage Enterprise Tape Cartridge, including WORM cartridges and the TS1040 tape drive supports IBM LTO4 Data Cartridges for data encryption. Encryption is performed at full line speed in the tape drive after compression. (Compression is more efficiently done before encryption). The encryption process takes less then one percent of the performance impact on the read/write throughput.

For the TS1120 Tape Drive, no Feature Code has to be installed on those tape libraries that support the TS1120 Tape Drives (TS3400 and the TS3500 Tape Library). For the TS1040, a billable Feature Code must be installed, Feature Code 5900 (Transparent LTO Encryption) and Feature Code 9900. However, when the Application-Managed Encryption method is available without charge, supported Tape Libraries for the TS1040 Tape Drive are: TS3100, TS3200, and TS3310.

Encryption adds a strong measurement 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:** TS1120s produced before September 8, 2006 do not have the capability to encrypt data on the Data Cartridge. However, there is a chargeable upgrade available (FC5592) to upgrade the TS1120. This encryption capability includes drive hardware as well as microcode additions and changes.

Encryption keys are used to encrypt data when it is being written to, and decrypt data when it is being read from, a data cartridge. The IBM Encryption Key Manager (EKM) is the component that assists the TS1120 and the TS1040 in generating, protecting, storing, and maintaining encryption keys. EKM R2 must be used when TS1040s are installed in a tape library.

The EKM is installed on a separate server in the network and is communicating through TCP/IP with the tape library or tape drive. The EKM operates on z/OS, i5/OS, AIX, Linux, HP-UX, SUN Solaris, and Windows. EKM is capable of serving numerous IBM encrypting tape drives, regardless of where those tape drives reside.

EKM is part of the IBM Java environment and uses the IBM Java Security components for its cryptographic capabilities. EKM has three main components that controls the encryption. These components are:

- Java security keystore:

  The keystore is defined as part of the Java Cryptography Extension (JCE) and is an element of the Java Security components, which are, in turn, part of the Java runtime environment™. A keystore holds the certificates and keys (or pointers to the certificates and keys) used by EKM to perform cryptographic operations. EKM supports several types of Java keystores offering different operational characteristics to meet your requirements.

- Configuration file:

  The EKM configuration file lets you tailor the behavior of EKM to meet your requirements.

- Tape drive table:

  The tape drive table is used by EKM to keep track of the tape devices it supports. The tape drive table is a non-editable, binary file whose location is specified in the configuration file. See Figure A-19.

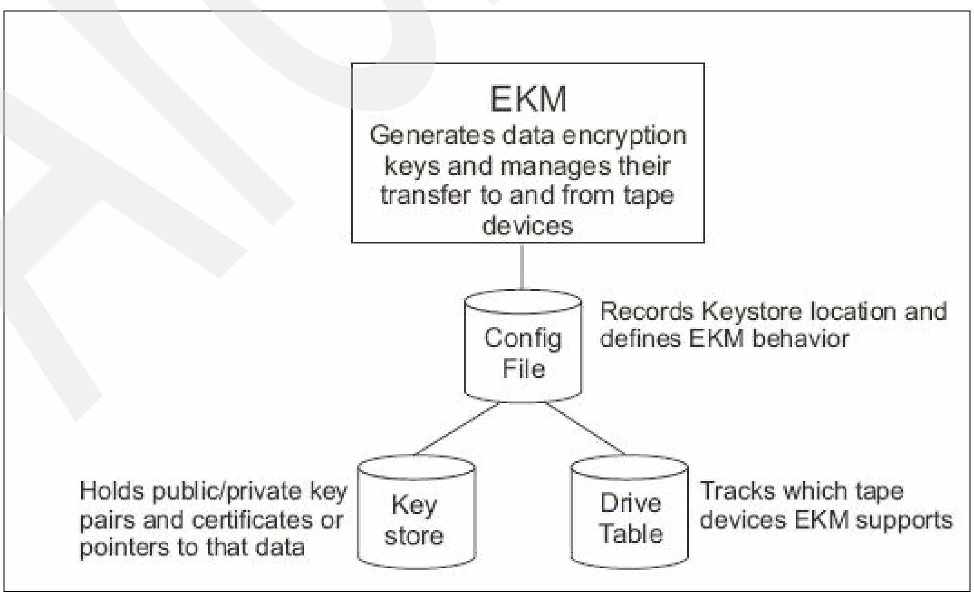



*Figure A-19 Three main components of EKM*

**Important:** Due to the critical nature of keys in your keystore, we highly recommend that you back up your keystore on a regular basis so that you can recover it as required and be able to read the data cartridges that were encrypted using the certificate with that drive or library. Do **not** encrypt your backups!

EKM acts as a process waiting for a key generation of a key retrieval request that a tape drive or library sends over a TCP/IP communication path between the EKM and the tape library or tape drive. When a tape drive writes encrypted data, it first requests an encryption key from the EKM. Upon receipt of the request, EKM generates an Advanced Encryption Standard (AES) key and sends it to the tape drive. The AES uses a 256 bit encryption as stated in the Institute of Electrical and Electronics Engineers (IEEE P1619.1).

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. TS1120 and TS1040 Tape Drive encryption uses 256-bit AES algorithm keys to encrypt data.

## Encryption methods

Symmetric and asymmetric key encryption are the two most important encryption methods. The encryption method for the TS1120 and the TS1040 Tape Drive are slightly different. In the following sections we explain those differences.

### Symmetric key encryption

Encryption of data using a symmetric key and algorithm is sometimes called private key encryption or secret key, which is not to be confused with the private key in an asymmetric key system. In a symmetric key system, the cipher key that is used for encrypting data is closely related to the cipher key used for decryption.

The encryption and decryption ciphers can be related by a simple transform on the key, or the encryption key and the decryption key can be identical. In the IBM Tape Encryption solution, the same encryption key is used for both encryption of data and decryption of data, this key is protected by an asymmetric key algorithm and never available in the clear.

Symmetric key encryption is several orders of magnitude faster than asymmetric key encryption; in addition, the comparable key sizes for symmetric key as opposed to asymmetric key are an order of magnitude different. A 128-bit secret key is considered safe, while Rivest-Shamir-Adleman (RSA) suggests a 1024-bit key length. The IBM Tape Encryption solution utilizes an Advanced Encryption Standard (AES) algorithm with a key length of 256 bits. The AES algorithm is based off the Rijndael algorithm. AES is an accepted standard that supports a subset of the key sizes and block sizes that the Rijndael algorithms supports.

Secret key algorithms can be architected to support encryption one bit at a time, or by specified blocks of bits. The AES standard supports 128-bit block sizes and key sizes of 128, 192, and 256. The IBM Tape Encryption solution uses an AES-256 bit key. Other well known symmetric key examples include Twofish, Blowfish, Serpent, Cast5, DES, TDES, and IDEA.

Figure A-20 shows the process of symmetric data flow.

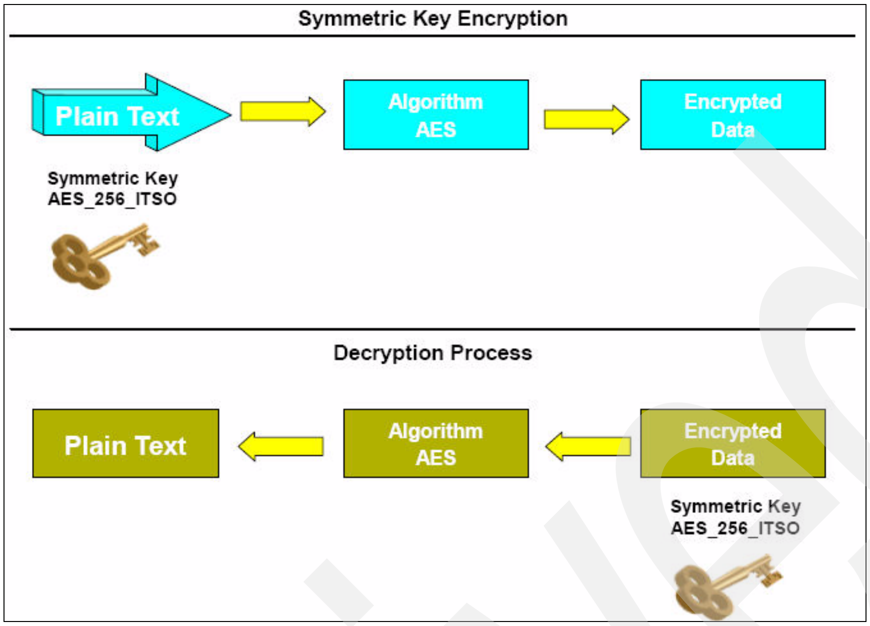



*Figure A-20 Symmetric key encryption data flow*

## Asymmetric key encryption

Another important method of encryption that is widely used today is referred to as public/private key encryption or asymmetric encryption. Using this encryption methodology, ciphers are generated in pairs. The first key is used to encrypt the data, and the second key is used to decrypt the data.

This technique was pioneered in the 1970s and represented a significant breakthrough in cryptography. Rivest-Shamir-Adleman (RSA) algorithm is the most widely used public key technique. The power of this approach is a public key, which is used to encrypt the data. This public key can be widely shared, and anyone who wishes to send secure data to an organization can use its public key. The receiving organization then uses its private key to decrypt the data; this makes public/private key very useful for sharing information between organizations. This methodology is widely used on the Internet today to secure transactions, including SSL.

Asymmetric key encryption is much slower and more computationally intensive than symmetric key encryption. The advantage of asymmetric key encryption is the ability to share secret data without sharing the same encryption key. Figure A-21 shows an encryption and decryption data path when using public key encryption algorithms. In the diagram, the plain text is enciphered using the public key and an RSA encryption algorithm, which yields the encrypted data. Starting with the enciphered text, a private key is used, with the RSA algorithm to decrypt the data back to plain text.

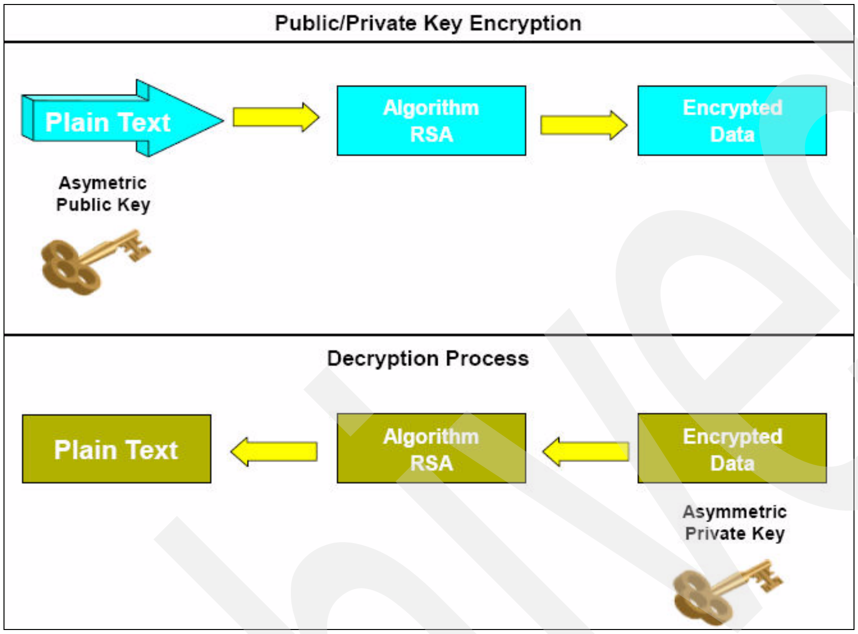



*Figure A-21 Asymmetric key encryption data flow*

## Managing encryption

There are three methods of encryption management to choose from. This methods differ in where you choose to locate your EKM application. Your operating environment determines which is the best for you, with the result that key management and the encryption policy engine can be located in any one of the following environmental layers.

### *Application-managed tape encryption*

This method is best where operating environments run an application already capable of generating and managing encryption policies and keys, such as Tivoli Storage Manager. Policies specifying when encryption is to be used are defined through the application interface. The policies and keys pass through the data path between the application layer and the TS1120 and TS1040 Tape Drives. Encryption is the result of interaction between the application and the encryption-enabled tape drive, and is transparent to the system and library layers. Since the application manages the encryption keys, volumes written and encrypted using the application method can only be read using the Application-Managed Encryption method.

### *System-managed tape encryption*

This method is best for Open Systems operating environments where no application capable of key management runs. Encryption policies specifying when to use encryption are set up through each instance of IBM device driver. Key generation and management is performed by the Encryption Key Manager (EKM), a Java application running on the host or externally on another host. Policy controls and keys pass through the data path between the system layer and the TS1120 and TS1040 Tape Drives. Encryption is transparent to the applications.

System-Managed Tape Encryption and Library-Managed Tape Encryption are transparent to one another. In other words, a tape encrypted using System-Managed Encryption can be decrypted using Library-Managed Encryption, and vice versa, provided they both have access to the same EKM keystore and both use AIX and the AIX Atape driver. Otherwise, this might not be feasible.

#### *Library-managed tape encryption*

This method is support on the following IBM Tape libraries:

- TS3100 with TS1040 Tape Drive
- TS3200 with TS1040 Tape Drive
- TS3400 with TS1120 Tape Drive
- TS3500 with TS1040 and TS1120 Tape Drives. Both tape drives can be installed in the TS3500 but they cannot be intermixed within the same logical library.

Key generation and management is performed by EKM, a Java application running on a library-attached host. The keys pass through the library-to-drive interface, therefore encryption is transparent to the applications. Library-Managed Encryption, when used with certain applications such as Symantec NetBackup, includes support for an internal label option. When the internal label option is configured, the TS1120 and TS1040 tape drives automatically derives the encryption policy and key information from the metadata written on the tape volume by the application.

System-Managed Tape Encryption and Library-Managed Tape Encryption are transparent to one another. In other words, a tape encrypted using System-Managed Encryption can be decrypted using Library-Managed Encryption, and vice versa, provided they both have access to the same EKM keystore and both use AIX and the AIX Atape driver. Otherwise, this might not be feasible.

## TS1120 Tape Encryption

The TS1120 Tape Drive uses an AES encryption key that 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. TS1120 Tape Drive Encryption uses 256-bit AES algorithm keys to encrypt data.

Two types of encryption algorithms are used by EKM for encryption on the TS1120 Tape Drive:

- Symmetric 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 algorithms: Asymmetric 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, or public/private key pair is generated, the public key is typically used to encrypt, and the private key is typically used to decrypt. TS1120 Tape Drive encryption 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). See Figure A-22.

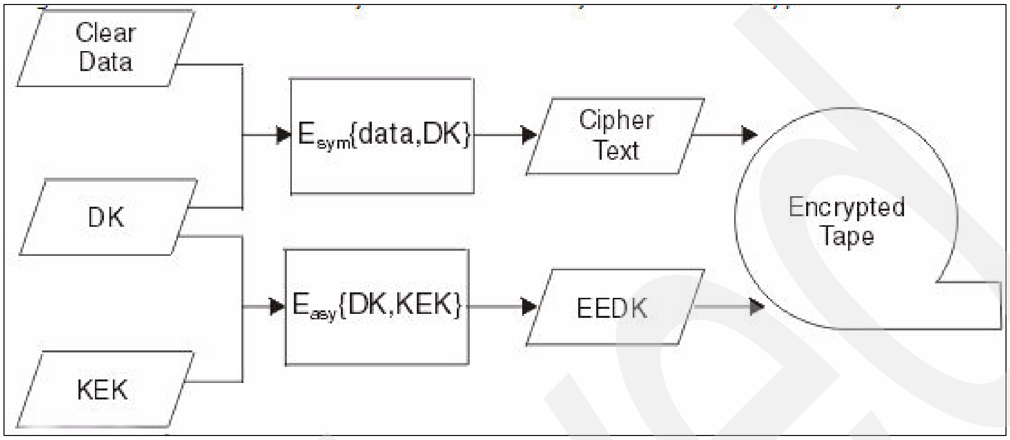



*Figure A-22 Tape Encryption process flow of the TS1120 Tape Drive*

When unencrypted data (clear text) is sent to the TS1120 Tape Drive for encryption, it is converted to ciphertext (encrypted data) through AES encryption, a symmetric (or secret) key type of encryption requiring a symmetric Data Key (DK), and is then written to tape. The 256-bit AES Data Key is also encrypted, or wrapped, using the public key from an asymmetric Key Encrypting Key (KEK) pair to create an Externally Encrypted Data Key (EEDK).

This EEDK is written to the cartridge memory and to three additional places on the 3592 Tape Cartridge. The tape cartridge now has both the encrypted data and the means to decrypt it for anyone who holds the private KEK. The DK can 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 would allow the DK to be unwrapped and the tape decrypted on a different TS1120 Tape Drive.

In the following two diagrams we are explaining the Tape Encryption and Decryption process in a more detailed way. We start first with the Encryption process.

Figure A-23 describes the flow of encrypted data to tape, and how keys are communicated to the tape drive and then stored on the data cartridge. In our example we assume that an EKM is running on one server and that the tape library and tape drives are connected to another server.

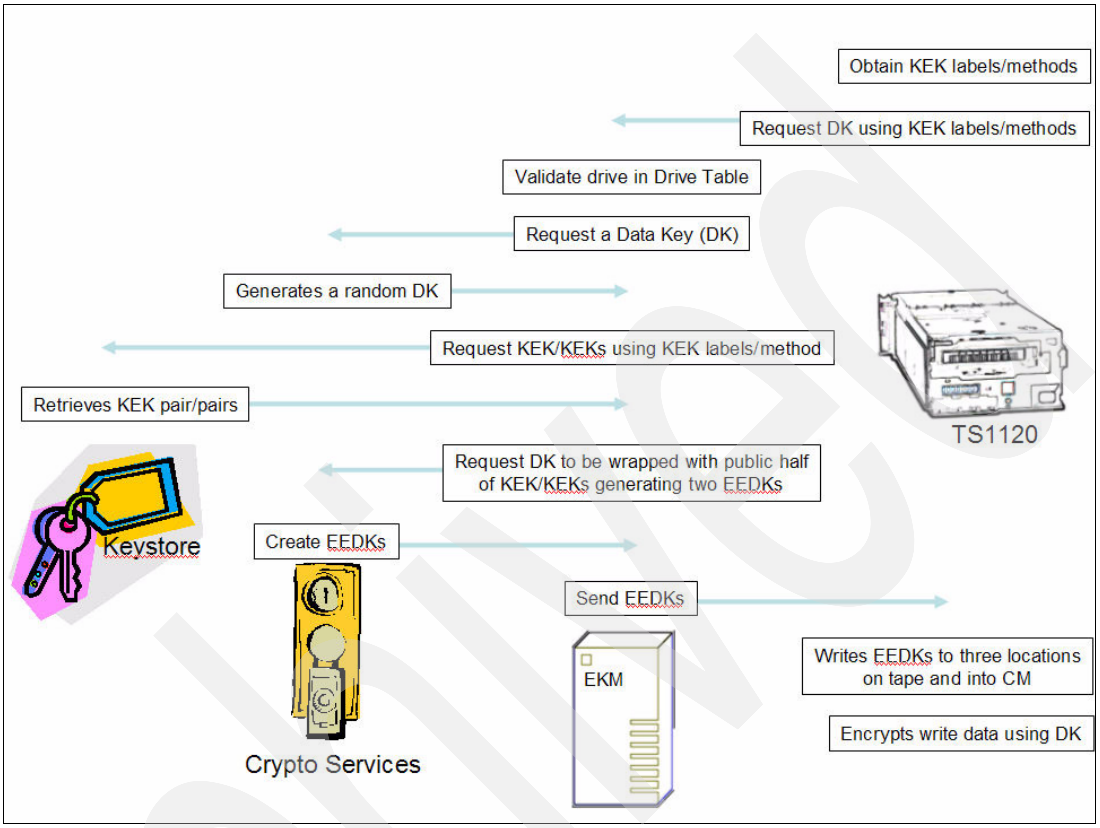



*Figure A-23 Encryption process TS1120*

We assume that a certificate (a way to bind public key information with an identity) from a Business Partner had been imported into this keystore. It has only a public key associated with it; the Business Partner has the corresponding private key.

Now, our abstract server sends a write request to the drive. Our drive is encryption-capable, and the host has requested encryption. As part of this initial write, the drive obtains two Key Encrypting Keys (KEKs) labels from the host or a proxy, which are aliases for two Rivest-Shamir-Adleman (RSA) algorithm KEKs. The drive requests that EKM send it a data key and to encrypt the DK using the public KEKs aliased by the two KEK labels.

The EKM validates that the drive is in its list of valid drives. After validation, the EKM obtains a random DK from cryptographic services. EKM then retrieves the public halves of the KEKs aliased by the two KEK labels. The EKM then requests that cryptographic services create two encrypted instances of the DK using the public halves of the KEKs, therefore, creating two Externally Encrypted Data Keys (EEDKs).

The EKM sends both EEDKs to the tape drive. The drive stores the EEDKs to several locations on the tape and in the cartridge memory. The EKM also sends the DK to the drive in a secure manner. The drive uses the separately secured DK to encrypt the data.

Figure A-24 shows the decryption data path. In this example, we decrypt data that was encrypted at another site. For the decryption process, the tape has two EEDKs stored in its cartridge memory. We call these EEDK1 and EEDK2.

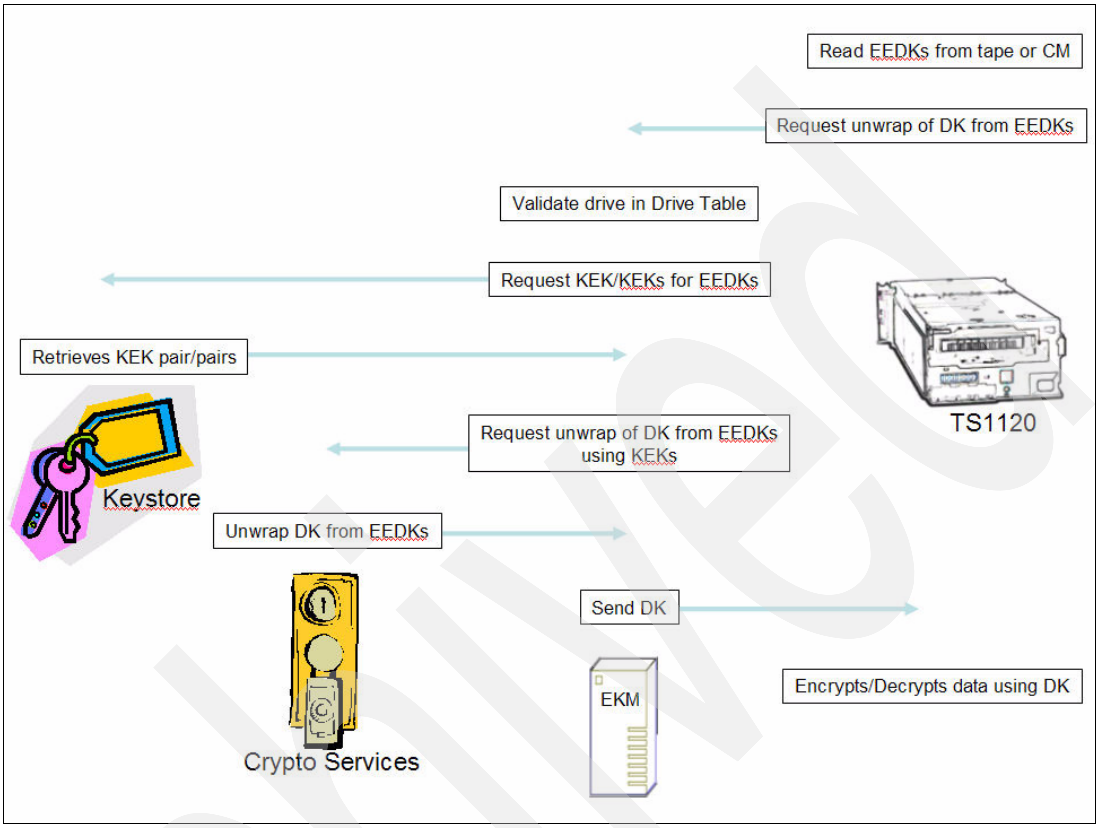



*Figure A-24 Decryption process TS1120*

An encrypted tape is mounted for a read or a write append. The two EEDKs are read from the tape. The drive asks the EKM to decrypt the DK from the EEDKs. The EKM validates that the drive is in its list of valid drives. After validation, the EKM requests the keystore to provide the private halves of each KEK used to create the EEDKs. The KEK label associated with EEDK1 cannot be found in the keystore, but the HASH of the public key for EEDK2 is found in the keystore.

The EKM asks cryptographic services to decrypt the DK from EEDK2 using the private half of the KEK associated with EEDK2. The EKM then sends the DK to the drive in a secure manner. The drive either decrypts the data for a read operation or uses the DK to encrypt data for a write-append.

## TS1040 Tape Encryption

The TS1040 Tape Encryption differs from the TS1120 Tape Encryption in a way that the TS1040 cannot store a wrapped form of the symmetric encryption key on the tape cartridge itself and must store the symmetric encryption key elsewhere and not in EEDK on tape like the TS1120. An associated Key Identifier maps to the Data Key in the external keystore instead of EEDK. A keystore can be hardware or software based and stores the certificates and encryption keys. An AES 256-bit encryption is used, like the TS1120, to encrypt/decrypt the data on the data cartridge.

Encrypted or non-encrypted records can coexist on the same medium. The tape drive must use a data key for each unique key identifier encountered during read operations.

### Write Request

The process for a Write Request to the TS1040 with encryption includes these steps:

1. The TS1040 tape drive receives a mount request for write with Beginning Of Tape (BOT) with encryption.
2. The TS1040 initiates a session with the EKM. The TS1040 communicates through the library using the TCP/IP protocol. The TS1040 request a data key and passes an optional key label.
3. The EKM authenticates the TS1040 in its Drive Table.
4. The EKM retrieves a pre-generated AES-256 Data Key from the TS1040.
5. The EKM sends a data key and key identifier to the TS1040 in a secure manner.
6. The TS1040 receives the key structures and embeds the key identifier in the data. It encrypts and writes the data to the tape.

### Read Request

When an encrypted cartridge is mounted in the TS1040 in response to a specific mounted request, the following steps are taken:

1. The TS1040 receives a mount request for read or append operation.
2. The TS1040 begins reading and finds the encrypted record. The key identifier is retrieved.
3. The TS1040 initiates a session with the EKM. The TS1040 communicates through the library using the TCP/IP protocol. The key identifier will be passed for decryption.
4. The EKM authenticates the TS1040 in the drive table.
5. The EKM retrieves the pre-generated data key referenced by the key identifier.
6. The EKM passes the data key to the TS1040 in a secure manner.
7. The TS1040 reads the data from or write appends data to the data cartridge.

# Hardware and operating system platforms

This section gives information about operating system support, SCSI, and FC adapter vendors, and some applications that support the IBM Open System Tape.

## Hardware server platforms

The IBM Open System Tape products are supported on the following operating systems and servers:

- IBM System i
- IBM System p with AIX and Linux
- IBM System x and other Intel-based systems (Windows 2000 and 2003)
- Sun SPARC with Solaris
- Hewlett-Packard with HP-UX
- Intel Linux (Red Hat and SLES)
- IBM System z and Linux
- Tru64 (IBM TS3500 Tape Library only)
- Other Open Systems using SCSI attachment or Fibre Channel attachment

Note that not all platforms and attachment methods are supported for all models. For current details about operating systems and attachment support for each LTO model, see the following Web site:

http://www-01.ibm.com/systems/support/storage/config/ssic/index.jsp

**Note:** Always check the Web site for the most current, detailed, and accurate information.

## ISV storage management software

Although operating systems provide utilities, such as **dd**, **tar**, and **cpio**, to perform basic read/write operations for tape drives, in most cases a storage management software package is used. These packages are designed to provide sophisticated capabilities that manage tape drives and libraries. They are available from companies known as Independent Software Vendors (ISVs).

IBM publishes information about ISV storage management applications that are certified with LTO devices and on which operating system platforms. This is available at the Web site:

http://www-03.ibm.com/systems/storage/tape/library.html#interoperability

The ISV matrix for TS7520 can be found at this Web site:

ftp://service.boulder.ibm.com/storage/tape/TS7520_isv_matrix.pdf

This time IBM does not provide the ISV matrix for TS7530 on the public site, but it will be posted soon. Also check with the ISV for detailed support information.

# Determining the number of drives on a SCSI bus

How do you determine how many SCSI drives to place on a host adapter? There are several factors to take into consideration, including:

- Tape drive speed capability
- Disk drive speed capability
- Application
  - Application requirements
  - Application characteristics
    - Read/write mix
    - Amount of data transferred
    - Streaming or stop/start
    - Data block size
- Adapter slot availability and capability
- Cost of more adapters

To ensure best performance, if possible, avoid daisy-chaining (connecting more than one drive to an adapter). If cost or slot availability considerations make daisy-chaining unavoidable, then connect no more than two drives per LVD adapter for LTO3.

When daisy-chaining with LTO3 drives, you must consider the data transfer rate of the drive and the capacity of the adapter. A single LTO3 SCSI drive, which is capable of transferring over 200 MB/s of compressible data, can saturate a SCSI-160 adapter. A SCSI-160 adapter can transfer 160 MB/s, but that does not include SCSI overhead. With overhead, the available bandwidth is approximately 140-150 MB/s. Two LTO3 drives cannot run at their native drive rate of 80 MB/s on a single adapter. If performance is not a primary consideration, it might be possible to daisy-chain two LTO3 drives on one adapter.

The type of application is also significant. If you are mainly doing smaller volume reads or writes, then more drives can be attached without saturating the adapter. A more typical use of tape is in high-volume backup, usually writing large blocks of data (for example, backing up large database files). In this scenario, a single drive per adapter will give the best performance.

# Host Bus Adapters and device drivers

In this section we cover the following topics:

- What are HBAs?
- Why are they necessary, and which one do you require?
- Are drivers required for HBAs?

**Note:** We recommend that you do not attach both disk and tape devices to the same HBA.

## What HBAs are

HBA stands for Host Bus Adapter. An HBA is an I/O adapter (or card) that sits between the host computer's bus and the SCSI or Fibre Channel fabric and manages the transfer of information between the two channels. To minimize the impact on host processor performance, the HBA performs many low-level interface functions automatically or with minimal processor involvement.

## Device drivers

A device driver is a program that controls a device. Every device, whether it be a printer, disk drive, or keyboard, must have a driver program. Many drivers, such as the keyboard driver are included with the operating system. For other devices, you might have to load a new driver either from the operating system CD, or as provided by the manufacturer when you first install the device on your computer.

A driver acts like a translator between the device and programs that use the device. Each device has its own set of specialized commands that only its driver knows. In contrast, most programs access devices by using generic commands, that is, Read, Write, Put, and Get. The driver, therefore, accepts generic commands from a program and then translates them into specialized commands for the device.

Figure A-25 is an example of the data flow between an application program and an LTO tape device. Note the different pieces of code or microcode that are involved.

The HBA Device Driver is not always a separate piece of installable software; sometimes it is included as part of the standard operating system. This is true for many common SCSI adapters with Linux. You should check the documentation provided with the card to see if this applies. For Fibre Channel HBAs, driver software will almost always have to be installed.

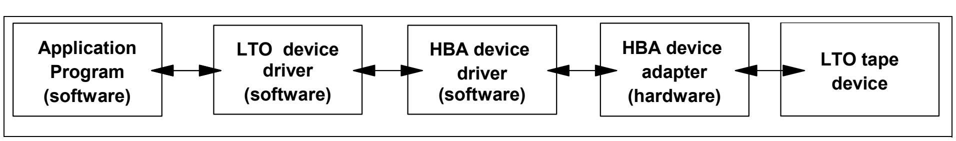



*Figure A-25 Device data flow*

### *Data flow*

The simplified list below reflects the components involved in the data path for moving data at a file level between disk storage devices and tape. Problem or performance analysis must be approached by determining which component of the data path impacts performance.

- Disk device
- SCSI Device Adapter
- Adapter device driver
- Disk device driver
- Logical Volume Manager
- File system
- Application program
- Atape Device Driver: Tape driver
- HBA Adapter Device Driver
- HBA (SCSI or FC-AL) Device Adapter
- Tape device

### *IBM device driver overview*

The IBM tape and medium changer device drivers are designed specifically to take advantage of the features provided by the IBM tape drives and medium changer devices. The goal is to give applications access to the functions required for basic tape functions (such as backup and restore) and medium changer operations (such as cartridge mount and dismount), as well as to the Advanced Functions required by full tape management systems. Whenever possible, the IBM tape driver will take advantage of the device features transparently to the application.

## LVD and SAS

The IBM LTO3 full-high tape drives have only one type of SCSI attachment interface: low voltage differential (LVD). The IBM LTO3 half-high and LTO4 tape drives have both LVD and SAS SCSI attachment interfaces.

LVD is available with Ultra160 SCSI at 160 MB/s and the speed capability of the bus will determine the number of LTO drives that can be attached on the same bus. But distance is also important. LVD can span 25 meters in a point-to-point configuration, while in a multidrop (daisy-chain) configuration it is limited to 12 meters.

Serial Attached SCSI (SAS) can communicate with Advanced Technology Attachment (ATA) devices. SAS has a point-to-point architecture and a bandwidth of 300 MB/s. Because of its point-to-point architecture, more devices can be handled in the same time on the bus with an maximum of 128 targets. Another advantage of SAS is that the connection cables between the HBA and the devices are much thinner and thus better scalable. SAS devices do not require external terminators. The I/O bus will be electronically terminated.

The total cable length from the device to the HBA is limited to 6 meters. Two different connecting interfaces are used for connecting the external devices: SSF-8088 and SSF-8470. SSF is the abbreviation for Small Form Factor Committee. All IBM SAS tape drives have a SSF-8088 interface. SAS cables are available in several lengths up to 5.5 m, and in any combination of the SSF-8470 and SSF-8088 connectors.

At the time of writing, IBM SAS Tape Drives are only supporting a point-to-point connection and there is no support to connect the SAS Tape Drive on an Expander Box. Two LTO tape drives are available with the SAS interface:

- IBM LTO3 Half High Tape Drive
- IBM LTO4 Full High Tape Drive

For additional information about the SAS interface, refer to *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

# SCSI HD68 and VHDCI cable connectors

There are three types of SCSI cables: HD68-HD68, HD68-VHDCI, and VHDCI-VHDCI. The HD68 connector is the normal 68-pin SCSI connector. The Very High Density Connector (VHDCI) is a mini SCSI connector that is about half the width of the HD68 connector. The server SCSI adapter can be either HD68 or VHDCI. For System p, System i, and HP servers, LVD SCSI adapters are always VHDCI, and HVD adapters are always HD68. But Sun and Netfinity/Intel servers have some adapters that are reversed.

The connector type for a given adapter can be found in either of two ways. You can look at the adapter and the plug will be either about 3 cm wide (VHDCI) or 6 cm wide (HD68). The other method is to look up the adapter characteristics to determine the plug type. One source of this information is the *IBM System Storage TS3500 Tape Library Operator Guide*, GA32-0560, available online at:

http://www-03.ibm.com/servers/storage/tape/resource-library.html#publications

Before June 12, 2001, all the LTO tape drives used HD68 connectors. The current IBM TS3500 hot swappable canister LTO drive uses the VHDCI connectors. Check to make sure you order the correct cable with the right-end plug to attach to your HBA.

Figure A-26 shows the VHDCI and HD-68 connectors.

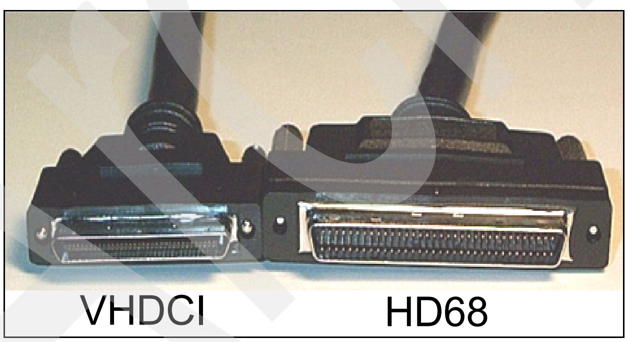



*Figure A-26 SCSI connectors*

# B

# IBM Integrated Removable Media Manager (IRMM) product overview

This appendix provides you with an overview of IRMM. In addition to the architecture, we discuss implementation considerations for using IRMM together with Tivoli Storage manager and different tape libraries, as well as the TS7530 Virtualization Engine.

## Overview

In addition to their high capacity and low price, for many companies the fact that removable media can be stored separately from read and write devices and thus withdrawn from direct access is particularly relevant. Viruses, worms, and other “creatures” are thus denied the possibility of propagating themselves uncontrollably, as they could remain on storage that is continuously available online.

Furthermore, with removable media, a very large quantity of data can be stored in a very small and possibly well-protected area at low storage costs. Write Once Read Multiple (WORM) properties, which are now available not only for optical media but also for magnetic tapes, additionally increase security. Furthermore, the requirement for storage capacity is increasing continuously. Progress in storage density and the capacity of cartridges can scarcely keep up with the ever-growing requirement, which means that the number of cassettes is also growing continuously.

The problems and requirements relating to the integration of removable media in the storage network can be divided into two areas:

1. The management of removable media
2. The sharing of the associated resources

The first area of concern is the management of removable media. In large environments, removable media management must be able to catalog hundreds of thousands of media, storing not only the media and their attributes, but also accesses to these media with corresponding data about errors, duration of use, and so on.

In contrast to hard disk storage, it is possible to store the media separately from drives, which means that the system must additionally know the location of a medium at all times. Since this location can be a manually-managed store or an automatic library in which the cassettes are automatically located, special solutions are required that take these requirements into account.

The second important field of application for a removable media management system in the storage network is the sharing of libraries, drives and media. This sharing between several applications connected to the storage network requires corresponding mechanisms for access control, access synchronization and access prioritization. These mechanisms control who may access which hardware when, so that potentially all applications can access all resources available in the storage network.

To fulfil these requirements, there is an increasing need for management layers for removable media in storage networks. These layers link existing applications to the hardware connected via the storage network. They control and synchronize all accesses and should remain as transparent as possible to the applications. As a central interface, this middleware should therefore be capable of managing all resources and also the sharing, i.e. the joint use of libraries, drives and cartridges by various applications.

IRMM addresses these needs for removable media management. It provides a robust middleware that shields the applications from the complex internal processes during management. It is also familiar with all components and their interactions and can therefore provide optimal control over the use of resources.

**Note:** IRMM is based on the IBM Enterprise removable Media Manager (eRMM). So in some figures you will see still references to eRMM.

## IRMM architecture

Figure B-1 presents the architecture of IRMM. Basically, IRMM provides a management middleware that shields the application layer from the details of the tape hardware. It receives commands from the applications, evaluates them and instructs the hardware to work accordingly.

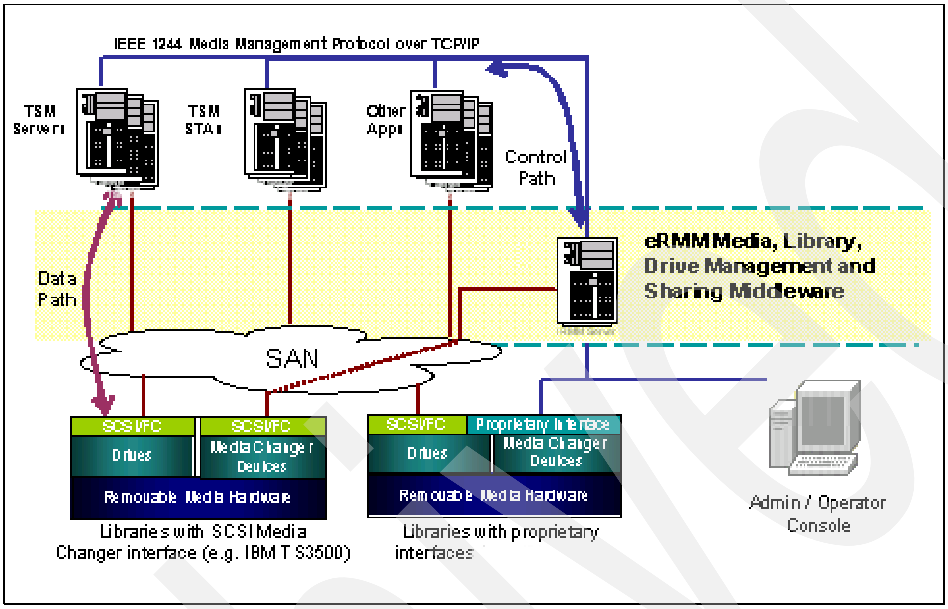



*Figure B-1 IRMM architecture*

Since the control path is separated from the data path such architecture is called to work *out-of-band*, and since it actually virtualizes the library media changer interfaces, IRMM is an out-of-band virtualization middleware. Respectively, IRMM follows similar concepts as the IBM SAN File System and the IBM SAN Volume Controller and therefore integrates nicely in the IBM System Storage Strategy.

## IRMM components

IRMM is composed of several core components:

- A Media Manager acts as a central repository for the metadata that describes the storage resources and policies and provides mechanisms to control and coordinate the allocation and use of media, libraries, and drives between multiple client applications. Currently the Media Manager is designed to work with a DB2 database.
- Library Managers manage library hardware on behalf of the Media Manager and depict the contents and capabilities of libraries to the Media Manager.
- Drive Managers manage storage device hardware on behalf of the Media Manager and depict the contents and capabilities of storage devices to the Media Manager. Drive Managers must be installed on every client that is supposed to work with IRMM. To prevent proliferation of Drive Managers only a so called *Host Drive Manager* needs to be installed on every client which actually presents a Drive Manager for every drive connected to this client to the Media Manager.

Library- and Drive Managers are connected via TCP/IP to the Media Manager and use a text based request/reply protocol for communication.

Beyond the core components, IRMM also provides:

- An External Library Manager (ELM) agent to cooperate with IBM Tivoli Storage Manager
- A command-line interface to be used in interactive or script-based systems

Figure B-2 shows the components of IRMM and their interactions.

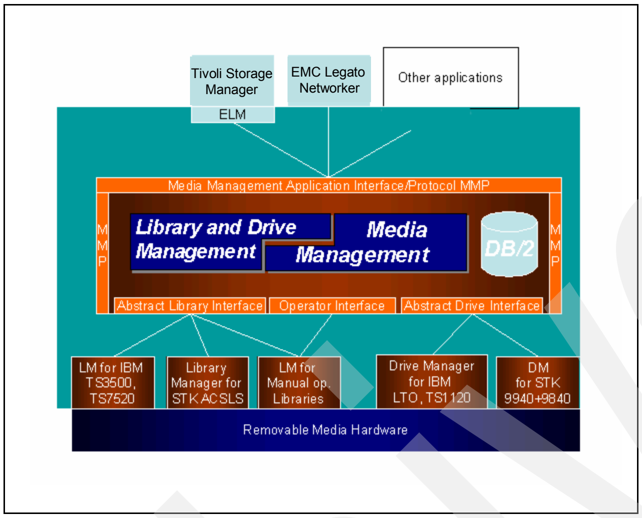



*Figure B-2 IRMM components*

IRMM is an implementation of the IEEE Standard 1244 for removable media management systems. This standard describes the architecture, the different components as well as the protocols these components use for communication.

# IBM Tivoli Storage Manager and IRMM

The IBM Tivoli Storage Manager provides an interface for external media management programs. These external media manager programs interact with Tivoli Storage Manager to manage removable media. While the Tivoli Storage Manager server tracks and manages client data, the media manager, operating entirely outside of the I/O data stream, and tracks physical volumes. The media manager also controls library drives, slots, and doors, therefore these programs are often referred to as External Library Manager (ELM). The advantage of the ELM is, that no tape devices needs to be configured on the Tivoli Storage Manager server. If you have a large number of tape drives, as you may have with a TS7530, tape drive handling with IRMM would be much easier.

In contrast to other interfaces like, for example, the SCSI Medium Changer interface, the ELM interface clearly separates the complexity of media management tasks from data management tasks of the Tivoli Storage Manager server. It also provides an abstraction / virtualization layer that hides the physical details of the hardware and provides logical library images to the Tivoli Storage Manager server. A library image actually can be mapped across multiple physical libraries.

This separation of concerns enables IRMM to:

- Select which drive is being used and thereby distribute workload among all drives and even all libraries an application has access to
- Queue mount requests in case no empty drive is available and to reschedule them when a drive becomes available again
- Implement extended media management functionality, like for example, keeping track of all cartridges to provide audit trails and usage patterns, recording drive or cartridge errors, provide a common scratch pool, etc.
- Provide an interface, based on an open IEEE standard, that allows customers to choose best-of-breed tape library hardware.

## Physical configuration

Figure B-3 presents a sample configuration of a Tivoli Storage Manager - IRMM deployment using IBM TS3500 Tape Libraries. These libraries have SCSI/FC-attached medium changers.

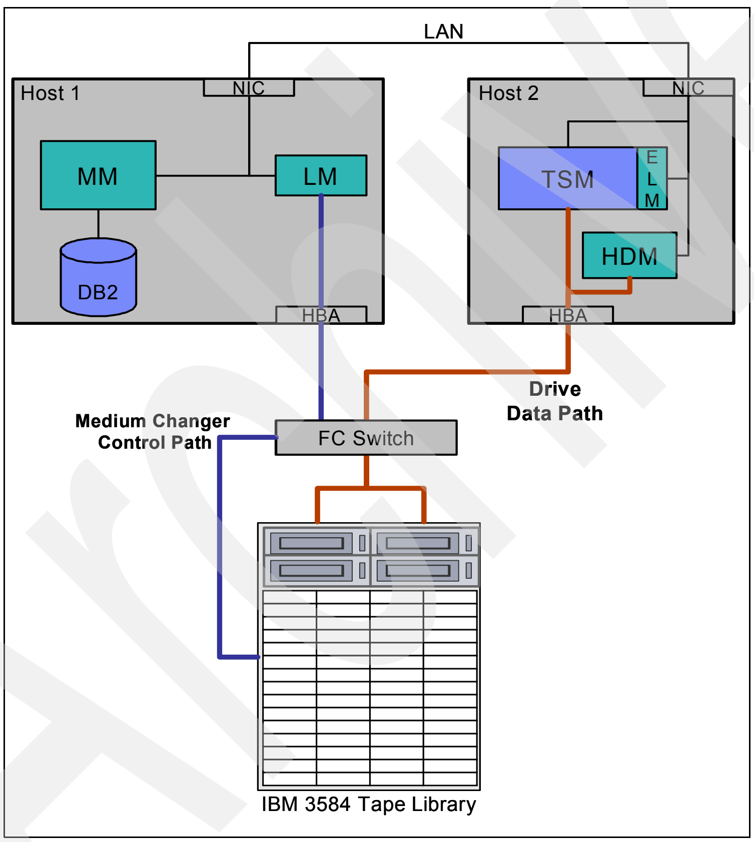



*Figure B-3 Physical Tivoli Storage Manager: IRMM configuration with IBM TS3500 libraries*

This setup dictates that the IRMM Library Manager has access to the storage area network to control the medium changers of the tape libraries.

Although Figure B-3 show a setup with a dedicated computer for the IRMM Media and Library Manager components, it is also possible to install these components together with a Tivoli Storage Manager Server on one host. The actual deployment should reflect at least the performance and high-availability requirements of the customer.

## Tivoli Storage Manager configuration

The following tasks are needed to define and set up an external Library Manager:

1. Define an external library:

   ```
   define library <libname> libtype=external
   ```

2. Define a path from the Tivoli Storage Manager server to the library:

   ```
   define path <servername> <libname> srctype=server desttype=library
   externalmanager=/opt/IBM/IRMM/client/tsm/elm
   ```

3. Define device class, for the library with a device type that matches the drives. For this example the device type is 3592:

   ```
   define devclass <devclassname> library=<libname> devtype=3592 mountretention=5
   mountlimit=20
   ```

   The MOUNTLIMIT parameter has to be set to the max. number of drives this server should be able to access in parallel.

   > **Note:** In the case where IRMM-managed libraries with different types of media should be made available, an external library with an appropriate device class must to be defined for every type of media.

4. Define a storage pool for this device class:

   ```
   define stgpool <stgpoolname> <devclassname> maxscratch=500
   ```

## Summary

Since no drives or drive paths have to be defined for every Tivoli Storage Manager Server and Tivoli Storage Manager Storage Agent (used in a LAN-free environment), a setup with IRMM enables tremendous savings for setup, configuration, and maintenance. In a setup with three Tivoli Storage Manager servers, 30 storage agents, and 30 drives, nearly 1,000 drive paths must be defined and maintained. IRMM does that automatically. Even if drive paths change because of connection problems or drive maintenance or failures, IRMM keeps track of the correct path from the Tivoli Storage Manager Server/STA to the drive. For more information see:

http://www-03.ibm.com/systems/z/os/linux/solutions/irmm/index.html

# C

# Feature codes

This appendix provides descriptions of the feature codes for IBM TS7500 Virtualization Engine hardware and software components. For planning and configuration guidance as well as usage considerations, refer to Chapter 3, “TS7530 components and features” on page 61, Chapter 4, “TS7520 architecture” on page 99, and Chapter 5, “Configuration and planning” on page 129.

# TS7530 Virtualization Engine Server (3954-CV7)

The feature codes (FC) described in this section are available for the TS7530 Virtualization Engine Server.

## FC1682 Path Failover

This optional feature provides automatic control path failover and data path failover for virtual tape drives in the TS7500. Control path failover is designed to provide automatic failover to a pre-configured redundant control path in the event of a loss of a host adapter or control path drive, without aborting the current job in progress. Data path failover is designed to provide a failover mechanism for configuring multiple redundant paths in a SAN environment. In the event of a path or component failure, the failover mechanism is designed to automatically provide error recovery to retry the current operation using an alternate, preconfigured path without aborting the current job in progress. This can provide flexibility in SAN configuration, availability, and management.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Corequisites** | None |
| **Installation** | Plant or field |

## FC3450: Dual 4 Gbps Fibre Channel Port Card

This feature provides a 4 Gb/s dual ported Fibre Channel adapter card for connecting the TS7500 solution server to the application hosts, tape libraries, or other servers in the TS7500 complex.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | Two |
| **Corequisites** | Sum of feature FC3450 plus feature FC3451 cannot exceed two |
| **Installation** | Plant or field |

## FC3451: Quad 1 Gbps Ethernet Port Card

This feature provides a 1 Gbps quad-ported Ethernet adapter card to support network replication or attachment to NDMP and iSCSI storage devices.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | Two |
| **Corequisites** | Sum of feature FC3450 plus feature FC3451 cannot exceed two. |
| **Installation** | Plant or field |

## FC3453: Quad Port 4 Gbps Fibre Channel Port Card

Each FC3453 feature provides a quad port Fibre Channel adapter for connecting the TS7530 Server to the disk cache subsystems, application hosts, and tape libraries.

| | |
|---|---|
| **Minimum required** | Two |
| **Maximum allowed** | Three |
| **Corequisite** | Sum of feature FC3453 plus feature FC3455 cannot exceed four |
| **Installation** | Plant or field |

## FC3454: Dual Core AMD Opteron Processor

Each FC3454 feature provides an additional AMD dual core Opteron processor card with 4 GB RAM for the TS7530 Server. Additional processors may enhance the performance of software, encryption, and other processor intensive functions.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | Three |
| **Installation** | Plant or field |

## FC3455: Data Compression Card

This feature provides an adapter card which performs hardware compression for the TS7530 Server.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | Two |
| **Corequisites** | Sum of FC3453 plus FC3455 cannot exceed four |
| **Installation** | Plant or field |

## FC6025: 25 Meter LC-LC Fibre Channel Cable

This feature provides a 25 meter (82.5 foot) 50.0/125 micrometer short wavelength multimode fiber-opticcable with LC Duplex connectors on both ends

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | Twelve |
| **Corequisites** | Mutually exclusive with feature FC9700 |
| **Installation** | Plant or field |

## FC7420: Failover/Failback Enable

This feature enables hardware connections between two TS7500 solution servers that are installed in the same 3952 Tape Frame to support the Failover/Failback operation. This feature must be ordered and installed on each of the servers in a 3952 Tape Frame for the function to be enabled. After the installation of this feature followed by failover license activation and configuration at the management console for both servers, the two servers form a failover pair.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | One. |
| **Corequisites** | The Failover/Failback feature is required on the TS7500 V3.1 software Both TS7500 solution servers in the failover pair must have the same installed quantities of all optional features, other than FC6025 and FC9700. |
| **Installation** | Plant or field. |

## FC7421: Network Replication

This feature enables the TS7500 to support the Network Replication function. If this Network Replication feature is installed in one server in a 3952 Tape Frame, and a second server is installed in that frame, the second TS7500 Virtualization Engine must also have this Network Replication feature installed.

**Minimum required** None.

**Maximum allowed** One.

**Corequisites** The Network Replication feature is required on the TS7500 V3.1 software.

**Installation** Plant or field.

## FC7422: Network Encryption

This feature enables the TS7500 to support the Network Encryption function. If this Network Encryption feature is installed in one server in a 3952 Tape Frame, and a second server is installed in that frame, the second server must also have this Network Encryption feature installed

**Minimum required** None.

**Maximum allowed** One.

**Corequisites** The Network Encryption feature is required on the TS7500 V3.1 software.

**Installation** Plant or field.

## FC7423: Network Compression

This feature enables the TS7500 to support the Network Compression function. If this Network Compression feature is installed in one server in a 3952 Tape Frame, and a second server is installed in that frame, the second server must also have this Network Compression feature installed

**Minimum required** None

**Maximum allowed** One

**Corequisites** The Network Compression feature is required on the TS7500 V3.1 software

**Installation** Plant or field

## FC7425: Hosted Backup

This feature enables the TS7500 Server to support the virtual pass-through of data between a backup client application running on the TS7500 Server and the Virtual Tape Library.

**Minimum required** None.

**Maximum allowed** One.

**Prerequisite** At least one FC3454 processor card is required.
Mutually exclusive with FC7420 Failover and Failback functionality.
The Hosted Backup feature is required on the TS7500 V3.1 software.

**Installation** Plant or field.

## FC7426: NDMP Enablement

This feature enables the TS7500 to support NDMP. If this NDMP feature is installed in one server in a 3952 Tape Frame, and a second server is installed in that frame, the second server must also have the NDMP feature installed.

**Minimum required** None.

**Maximum allowed** One.

**Prerequisite** Mutually exclusive with FC7420 Failover and Failback functionality. The NDMP feature is required on the TS7500 V3.1 software.

**Installation** Plant or field.

## FC7427: Secure Tape

This feature enables the TS7500 to support the encryption function for data written to physical tape cartridges by the TS7500. If this encryption feature is installed in one server in a 3952 Tape Frame, and a second server is installed in that frame, the second TS7500 server must also have the encryption feature installed.

**Minimum required** None.
**Maximum allowed** One.
**Corequisite** The Secure Tape feature is required on the TS7500 V3.1 software.
**Installation** Plant or field.

## FC7428: iSCSI Enablement

This feature enables the TS7500 Server to support iSCSI. If this iSCSI feature is installed in one TS7500 Server in a 3952 Tape Frame, and a second TS7500 Server is installed in that frame, the second TS7500 Server must also have the iSCSI feature installed.

**Minimum required** None.
**Maximum allowed** One.
**Corequisite** The iSCSI feature is required on the TS7500 V3.1 software.
**Installation** Plant or field.

## FC7429: Local Replication

This feature enables the TS7500 Server to support the Local Replication function.

**Minimum required** None.

**Maximum allowed** One.

**Corequisite** The Local Replication feature is required on the TS7500 V3.1 software.

**Installation** Plant or field.

## FC9305: Four Node Indicator

This feature indicates that this TS7500 Server will be installed in a four-node configuration, as supported by the required TS7500 Enterprise Edition software V3R1.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Prerequisites** | Feature must be included with each TS7530 Server in the primary base frame in a 4-node system |
| **Installation** | Plant or field |

## FC9307: Enterprise Edition VE Preload - AAS (5697-P19)

This feature instructs IBM manufacturing to preload the TS7500 Enterprise Edition V3R1 software (5697-P19) on the TS7530 Server.

| | |
|---|---|
| **Minimum required** | One |
| **Maximum allowed** | One |
| **Installation** | Plant install |

## FC9326: Plant Install in F05

This specify code allows the factory installation of a TS7500 Server into a new 3952 Tape Frame coming from the plant.

| | |
|---|---|
| Minimum required | None. |
| **Maximum allowed** | One. |
| **Prerequisite** | One of FC9326 or FC9327 is required. |
| **Installation** | Plant install. |

## FC9327 -Field Merge in F05

This specify code allows the field merge of a TS7500 Server into a customer installed 3952 Tape Frame.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | One. |
| **Prerequisite** | One of FC9326 or FC9327 is required. |
| **Installation** | Plant or field. |

## FC9700: No Factory Cables

This feature should be specified if you do not want the factory to ship any cable features with the new machine

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Corequisite** | Mutually exclusive with FC6025 25-meter 4 Gbps Fiber Cable |
| **Installation** | Plant or field |

# TS7520 Virtualization Engine Server (3954-CV6)

The feature codes described in this section are available for the TS7520 Virtualization Engine Server.

**Note:** Effective June 30, 2008, IBM has started the withdrawal of the TS7520 Virtualization Engine 3954-CV6 and select features. Check with your local product management team for availability of the product and features

## FC1682: Path Failover

Path Failover provides automatic control and data path failover to a pre-configured redundant path without aborting the current job in progress. It also provides failover for multiple redundant paths in a SAN environment by automatically providing error recovery to retry the current operation using an alternate, preconfigured paths without aborting the current job in progress. This can provide flexibility in SAN configuration, availability, and management.

If this Path Failover feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this Path Failover feature installed.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | One |
| **Corequisites** | None |
| **Installation** | Plant or field |

## FC3450: Dual 4 Gbps Fibre Channel Port Card

This feature provides a dual port 4 Gbps Fibre Channel card that provides all Fibre Channel connectivity required.

| | |
|---|---|
| **Minimum** | One. |
| **Maximum** | Six. |
| **Corequisites** | Minimum of one required if installing CV6 with FC9303, otherwise, a minimum of two required. The sum of FC3450 plus FC3451 cannot exceed six. |
| **Installation** | Plant or field. |

## FC3451: Quad 1 Gbps Ethernet Port Card

This feature provides a four port 1 Gbps Ethernet port card that provides all iSCSI connectivity required.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | Four |
| **Corequisites** | Sum of FC3450 plus FC3451 cannot exceed six |
| **Installation** | Plant or field |

## FC3452: INTEL XEON PROCESSOR 7020 (withdrawn)

This feature provides an additional dual-core processor to improve performance and accelerate compression.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | Three |
| **Corequisites** | None |
| **Installation** | Plant or field |

## FC3460: Memory Upgrade

This feature provides an additional two gigabytes of memory to improve high-availability (HA) performance. One of this feature is required to support 64,000 virtual cartridges in a HA configuration. No additional functions require this feature.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | Seven |
| **Corequisites** | None |
| **Installation** | Plant or field |

## FC6025: 25-meter LC-LC Fibre Channel Cable

This feature provides a 25 meter (82.5 foot) 50.0/125 micrometer short wavelength multimode fiber-optic cable with LC Duplex connectors on both ends. Customer supplied cables may be used.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | Eight |
| **Corequisites** | Mutually exclusive with FC9700 |
| **Installation** | Plant or field |

A Fibre Channel cable is required for attaching a TS7520 to host server Fibre Channel adapters or other storage area Fibre Channel components.

The cable can be customer supplied, or ordered with the TS7520 Virtualization Engine in the lengths shown. The attaching Fibre Channel cable must be a 50.0/125 micrometer short wavelength fiber-optic cable for distances up to 500 meters.

## FC7420: Failover/Failback Enable

This feature enables hardware connections between two TS7520 Virtualization Engines that are installed in the same 3952 Tape Frame to support the Failover/Failback or HA operation. This feature must be ordered and installed on each of the TS7520 Virtualization Engines in a 3952 Tape Frame for the function to be enabled. With this feature installed, and the failover license-activated and configured at the management console for both TS7520 Virtualization Engines, then the two TS7520 Virtualization Engines have formed a failover (HA) pair.

| | |
|---|---|
| **Minimum** | None. |
| **Maximum** | One. |
| **Corequisites** | The Failover/Failback feature is required on the TS7500 V3.1 software. Both TS7520 Virtualization Engines in the failover pair must have the same installed quantities as all optional features. |
| **Installation** | Plant or field. |

## FC7421: Network Replication

This feature enables the TS7520 Virtualization Engine to support the Network Replication function. If this Network Replication feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this Network Replication feature installed.

**Minimum** None.

**Maximum** One.

**Corequisites** The Network Replication feature is required on the TS7500 V3.1 software.

**Installation** Plant or field.

## FC7422: Network Encryption

This feature enables the TS7520 Virtualization Engine to support the Network Encryption function. If this Network Encryption feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this Network Encryption feature installed.

**Minimum** None.

**Maximum** One.

**Prerequisite** Network Replication FC7421.

**Corequisites** The Network Encryption feature is required on the TS7500 V3.1 software.

**Installation** Plant or field.

## FC7423: Network Compression

This feature enables the TS7520 Virtualization Engine to support the Network Compression function. If this Network Compression feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this Network Compression feature installed.

**Minimum** None.

**Maximum** One.

**Prerequisite** Network Replication feature (FC7421).

**Corequisites** The Network Compression feature is required on the TS7500 V3.1 software.

**Installation** Plant or field.

## FC7424: 3494 Support (withdrawn)

This feature provides 3494 support for virtual devices. This feature is only required when paired with the Limited Edition Version of the TS7500 V2R1 software (5697-N66). This feature is included as part of the base code in the Enterprise Edition.

**Minimum** None
**Maximum** One
**Corequisites** Available with TS7500 V2R1 Limited Edition software FC0005
**Installation** Plant or field

## FC7425: Hosted Backup

The Hosted Backup option makes virtual tape libraries and drives available to local system by allowing backup applications to be installed directly on to the TS7520, eliminating the need for a dedicated backup server. If this Hosted Backup feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this Hosted Backup feature installed.

**Minimum** None.
**Maximum** One.
**Corequisites** The Hosted Backup feature is required on the TS7500 V3.1 software.
**Installation** Plant or field.

## FC7426: NDMP

The NDMP backup support option allows backup applications and NAS devices to perform backup and restore using the NDMP version 4 protocol over an IP network. With this enabled, the TS7520 acts as an NDMP server, centralizing management while eliminating locally attached tape devices from each NAS device. When a backup occurs, data is moved from a NAS device directly to the virtual library. If this Hosted Backup feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this Hosted Backup feature installed.

**Minimum** None.

**Maximum** One.

**Corequisites** The NDMP feature is required on the TS7500 V3.1 software.

**Prerequisites** The Hosted Backup FC9425 is required, as well as the TS7500 V3.1 software feature.

**Installation** Plant or field.

## FC7427: Secure Tape

With this feature, the TS7520 uses the Advanced Encryption Standard (AES) algorithm published by the National Institute of Standards and Technology, an agency of the US government. With this option, you can create one or more keys that can be used to encrypt the data when it is exported to physical tape and decrypt when it is imported back to virtual tapes. The data on the tape cannot be read or be decrypted without using the appropriate key.

If this Secure Tape feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this Secure Tape feature installed.

**Minimum** None.
**Maximum** One.
**Corequisites** The Secure Tape feature is required on the TS7500 V3.1 software.
**Installation** Plant or field.

## FC7428: iSCSI Enable

This option allows SCSI commands to be used over an IP network and allows hosts to connect the Ethernet instead of requiring Fibre Channel. The supported host platforms or Windows and Linux. If this iSCSI Enable feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this iSCSI Enable feature installed.

| | |
|---|---|
| **Minimum** | None. |
| **Maximum** | One. |
| **Corequisites** | The iSCSI Enable feature is required on the TS7500 V3.1 software. |
| **Installation** | Plant or field. |

## FC7429: Local Replication

This involves making a copy of a complete virtual volume in the same TS7520 server. This acts exactly the same as network replication except the target and source servers are the same. If this Local Replication feature is installed in one TS7520 Virtualization Engine in a 3952 Tape Frame configured as an HA or failover pair, the second TS7520 Virtualization Engine installed in that frame must also have this Local Replication feature installed.

| | |
|---|---|
| **Minimum** | None. |
| **Maximum** | One. |
| **Corequisites** | The Local Replication feature is required on the TS7500 V3.1 software. |
| **Installation** | Plant or field. |

## FC7430: Enhanced Tape Caching

This feature provides the functionality of the TS7520 to act as a cache to the physical tape library, providing transparent access to data within the TS7520 Virtualization Engine cache and an attached physical library.

This feature is included as part of the base code in the Enterprise Edition.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Corequisites** | Available only with TS7500 V2R1 Limited Edition software FC0007 |
| **Installation** | Plant or field |

## FC9302: Enterprise Edition VE Preload (withdrawn)

This feature provides the required TS7500 V2R1 Enterprise Edition Software (5697-N65) that will be preloaded by IBM on the TS7520 Virtualization Engine. It must be included with each TS7520 Virtualization Engine ordered.

| | |
|---|---|
| **Minimum** | None. However, the sum of FC9302 and FC9303 must be one. |
| **Maximum** | One. |
| **Prerequisites** | None. |
| **Installation** | Plant only. |

## FC9303: Limited Edition VE Preload (withdrawn)

This feature provides the required TS7500 V2R1 Limited Edition Software (5697-N66) that will be preloaded by IBM on the TS7520 Virtualization Engine. It must be included with each TS7520 Virtualization Engine ordered.

| | |
|---|---|
| **Minimum** | None. However, the sum of FC9302 and FC9303 must be one. |
| **Maximum** | One. |
| **Prerequisites** | None. |
| **Installation** | Plant only. |

## FC9305: Four Node Indicator

This feature indicates that this CV6 will be installed in a four-node configuration, as supported by the required TS7500 V2R1 Enterprise Edition Software (5697-N65). It must be included with each TS7520 Virtualization Engine ordered on the primary base frame in a four-node system.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | One |
| **Prerequisites** | FC7317 on the 3952 Tape Frame Model F05 |
| **Installation** | Plant only |

## FC9326: Plant Install 3954 Model CV6 (withdrawn)

This specify code allows the factory installation of a TS7520 Virtualization Engine into a new 3952 Tape Frame coming from the plant. This feature must appear on the TS7520 Virtualization Engine order, and the Plant Install a 3954 Model CV6 feature (FC5728) must appear on the 3952 Tape Frame order.

| | |
|---|---|
| **Minimum** | None. However, the sum of FC9326 or FC9327 must be one. |
| **Maximum** | One. The maximum sum of FC9326 plus FC9327 is one. |
| **Prerequisites** | None. |
| **Installation** | Plant only. |

## FC9327: Field Merge 3954 Model CV6 (withdrawn)

This specify code allows the field merge of a TS7520 Virtualization Engine into a customer installed 3952 Tape Frame. This feature must be ordered on the TS7520 Virtualization Engine and the Field Install a 3954 Model CV6 feature (FC5729) must be ordered on the 3952 Tape Frame.

| | |
|---|---|
| **Minimum** | None. However, the sum of FC9326 or FC9327 must be one. |
| **Maximum** | One. The maximum sum of FC9326 plus FC9327 is one. |
| **Prerequisites** | None. |
| **Installation** | Plant only. |

### FC9380: Discontinuance Support

This feature is specified as part of the upgrade path from TS7520 to TS7530. This feature must be ordered on every TS7520 Server (3954 Model CV6) that is being replaced with a TS7530 Server (3954 Model CV7). It provides any required Fibre Channel HBAs to allow the TS7520 Server to meet the minimum eight FC port requirement of the replacement process.

| | |
|---|---|
| **Minimum** | None. |
| **Maximum** | One. |
| **Prerequisites** | FC3451 cannot be greater than two. |
| **Installation** | Supported on an MES order only. |

### FC9700: No Factory Cables (withdrawn)

This feature should be specified if you do not want the factory to ship any Fibre Channel cable feature (FC6025) with the new machine. These Fibre Channel cables are for attachment to host servers.

| | |
|---|---|
| **Maximum** | One |
| **Corequisites** | Mutually exclusive with FC6025 |
| **Installation** | Plant only |

## TS7500 Virtualization Engine Cache Controller (3955-SV6)

The feature codes listed in this section are available for the TS7500 Virtualization Engine Cache Controller SV6.

### FC9328: Plant Install 3955 Model SV6

This code allows the factory installation of a TS7500 Model SV6 Cache Controller into a new IBM 3952 Tape Frame coming from the plant. This feature must appear on the 3955 Model SV6 order, and the Plant Install a 3955 Model SV6 feature (FC5736) must appear on the 3952 Model F05 order.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | One. |
| **Corequisite** | FC5738 is required on the 3952-F05. |
| **Installation** | Plant only. |

### FC9329: Field Install 3955 Model SV6

This specify code allows the field installation of a TS7520 Cache Controller into a 3952 Tape Frame.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | One. |
| **Corequisite** | FC5739 is required on the 3952-F05. |
| **Installation** | Plant only. |

## FC9401: Configure for RAID 6

This feature instructs IBM manufacturing pre-format this TS7500 disk cache unit with RAID 6.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | One. |
| **Corequisite** | RAID6 is supported only on 1 TB drives. FC7113 is required. |
| **Installation** | Plant only. |

## FC9700: No Factory Cables

This feature should be specified if you do not want the factory to ship any Fibre Channel cable features (FC6013) with the new machine.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Corequisite** | Mutually exclusive with FC6013 |
| **Installation** | Plant only |

## FC6013: 13 Meter LC-LC Fibre Channel Cable

This feature provides a 13 meter (43 foot) 50.0/125 micrometer short wavelength multimode fiber-optic cable with LC Duplex connectors on both ends. Customer supplied cables may be used.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | Two |
| **Corequisite** | Mutually exclusive with FC9700 |
| **Installation** | Plant or field |

## FC7111: 8 TB SATA Storage

This feature is required to specify that this product will be fully loaded with 500 GB 7200 rpm Serial ATA HDDs providing 8 TB unformatted disk storage capacity.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Prerequisite** | Mutually exclusive with FC7112 and FC7113 |
| **Installation** | Plant only |

## FC7112: 12 TB SATA Storage

This feature is required to specify that this unit will be fully loaded with 750 GB 7200 rpm Serial ATA HDDs providing 12 TB unformated disk storage capacity.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Prerequisite** | Mutually exclusive with FC7111 and FC7113 |
| **Installation** | Plant only |

### FC7113: 16 TB SATA Storage Drawer

This feature specifies that this unit will be fully loaded with 1 TB 7200 rpm Serial ATA HDDs providing 16 TB unformated disk storage capacity.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Prerequisite** | Mutually exclusive with FC7111 and FC7112 |
| **Installation** | Plant only |

### FC7401: Enable 1st 3955 Model SX6 in 3952 Expansion Frame (withdrawn)

This feature is required for the TS7500 Model SV6 Cache Controller to enable the first TS7500 Model SX6 Cache Module attached to this TS7500 Model SV6 Cache Controller in its storage string. The first TS7500 Model SX6 Cache Module in a storage string will be the first or second TS7500 Model SX6 Cache Module installed in an expansion unit 3952 Tape Frame. If two or more TS7500 Model SX6 Cache Modules are installed in an expansion unit then this feature must be on each TS7500 Model SV6 Cache Controller.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | One. |
| **Corequisite** | If two or more TS7500 Cache Modules are installed in an expansion unit, then this feature must be on each TS7500 Cache Controller. |
| **Installation** | Plant or field. |

### FC7402: Enable 4th 3955 Model SX6 in 3952 Expansion Frame (withdrawn)

This feature is required for the TS7500 Model SV6 Cache Controller to enable the fourth TS7500 Model SX6 Cache Module attached to this TS7500 Model SV6 Cache Controller in its storage string. The fourth IBM Virtualization Engine TS7500 Model SX6 Cache Module in a storage string will be the seventh or eighth TS7500 Model SX6 Cache Module installed in an expansion unit 3952 Tape Frame. If eight or more TS7500 Model SX6 Cache Modules are installed in an expansion unit then this feature must be on each TS7500 Model SV6 Cache Controller.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | One. |
| **Corequisite** | If eight or more TS7500 Cache Modules are installed in an expansion unit then this feature must be on each TS7500 Cache Controller. |
| **Installation** | Plant or field. |

## IBM TS7500 Virtualization Engine Cache Module (3955-SX6)

The feature codes listed in this section are available for IBM TS7500 Virtualization Engine Cache Module.

## FC7111: 8 TB SATA Storage

This feature is required to specify that this product will be fully loaded with 500 GB 7200 rpm Serial ATA HDDs providing 8 TB unformatted disk storage capacity.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| Prerequisite | Mutually exclusive with FC7112 and FC7113 |
| **Installation** | Plant only |

> **Note:** The Feature 8 TB SATA Storage has been withdrawn from marketing effective August 30, 2008.

## FC7112: 12 TB SATA Storage

This feature is required to specify that this unit will be fully loaded with 750 GB 7200 rpm Serial ATA HDDs providing 12 TB unformated disk storage capacity.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Prerequisite** | Mutually exclusive with FC7111 and FC7113 |
| **Installation** | Plant only |

## FC7113: 16TB SATA Storage Drawer

This feature specifies that this unit will be fully loaded with sixteen 1 TB 7200 rpm Serial ATA HDDs providing 16 TB unformated disk storage capacity.

| | |
|---|---|
| **Minimum required** | None |
| **Maximum allowed** | One |
| **Prerequisite** | Mutually exclusive with FC7111 and FC7112 |
| **Installation** | Plant only |

## FC9330: Plant Install 3955 Model SX6

This code allows the factory installation of a TS7500 Model SX6 Cache Module into a new 3952 Tape Frame coming from the plant. This feature must appear on the 3955 Model SX6 order, and the Plant Install a 3955 Model SX6 feature (FC57xx) must appear on the 3952 Model F05 order.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | One |
| **Prerequisites** | None |
| **Installation** | Plant only |

## FC9331: Field Merge 3955 Model SX6

This code allows the field merge of a TS7500 Model SX6 Cache Module into a customer-installed 3952 Frame Model F05. This feature must be ordered on the 3955 Model SX6 and the Field Install a 3955 Model SX6 feature (FC5748) must be ordered on the 3952 Model F05. Two IBM Virtualization Engine Cache Controllers must be installed in a 3952 Tape Frame before a 3955 Model SX6 can be installed.

**Minimum** None.
**Maximum** One. The maximum of FC9328 plus FC9329 is one.
**Prerequisites** None.
**Installation** Plant only.

# IBM 3952 Tape Frame (3952-F05)

The feature codes listed in this section are available for the IBM 3952 Tape Frame.

## FC1903 Dual AC Power

This feature provides one additional Power Distribution Unit to allow connection to independent branch power circuits. If this feature is ordered, two power cords will be provided.

**Minimum** Zero
**Maximum** One
**Installation** Plant or field

## FC1906: Ethernet Switch Kit

This feature includes one 16-port Ethernet switch and is recommended for each 3954 Model CV7 (up to a maximum of two). IT also includes Ethernet cables to connect CV7s in the base frame to the integrated switch, and to connect the Ethernet switch to the Fibre Channel switches in the base frame. It is required for FC7317 and optional for FC7319.

**Minimum** None.

**Maximum** Two.

**Corequisites** If FC7317 is present indicating a TS7500 Base frame, two FC1906s are required.

**Installation** Plant or field.

## FC1907: Fibre Channel Switch Kit (withdrawn)

This feature includes two 32-port Fibre Channel switches with 16 ports enabled. It is only valid for Model F05 in TS7500 configuration with FC7317. FC1907 is required when FC7320s or FC7318 is ordered. FC1903 and FC1906 are required.

**Minimum** None.

**Maximum** One.

**Corequisites** If FC7317 is present indicating a TS7500 Base frame, two of FC1906 are required.

**Installation** Plant or field.

## FC1908: Eight Port Switch Expansion

Enables an additional eight ports for each of the Fibre Channel switches added with feature number 1907. Allowed two times to enable the complete 32 ports on both switches. These features are required for large configurations including more than three (for the first) and seven (for the second) expansion frames.

| | |
|---|---|
| **Minimum** | None. One for configurations with three expansion frames, two for configurations with seven expansion frames. |
| **Maximum** | Two. |
| **Corequisites** | Requires the Fibre Channel Switch Kit feature (FC1907). |
| **Installation** | Plant or field. |

**Note:** The Feature 1908 - 8 port Switch expansion is scheduled for withdrawal on December 30, 2008.

## FC1910: Fibre Channel Switch Kit

This feature provides two 32 port FC switches with 16 ports enabled to interconnect the TS7500 Servers and the TS7500 Cache Controllers in the TS7500 configuration.

| | |
|---|---|
| **Minimum** | None. |
| **Maximum** | One. |
| **Corequisites** | Mutually exclusive with 1907.<br>FC1907 or FC1910 is required on the TS7500 Base Unit (3952-F05 with FC7317) when any other 3952-F05 with FC7318 or FC7320 is attached. |
| **Installation** | Plant or field. |

## FC1911: Enable Addl. 8 FC Switch Ports

This feature enables eight more FC switch ports in the switch provided by feature FC1910.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | Two |
| **Corequisites** | Requires Fibre Channel Switch kit FC1910 |
| **Installation** | Plant or field |

## FC4741: Remove 3955-SV6 from Model F05 Tape Frame

This feature provides the instructions to remove a TS7500 Cache Module from an installed 3952 Tape Frame. All attached SX6 Cache Modules must be re moved prior to SV6 removal. This feature is only valid on IBM TS7500 Expansion Frames.

| | |
|---|---|
| **Minimum** | None. |
| **Maximum** | Two; one per FC5738 and FC5739 if present. |
| **Corequisites** | One of FC5738 must be removed when this feature is added. All FC5748 and FC5749 must be removed. Only valid when FC7318 is present on IBM TS7500 Expansion frames. |
| **Installation** | Field only. |

## FC4746: Remove 3955-SX6 from Model F05 Tape Frame

This feature provides the instructions to remove a TS7500 Cache Module from an installed 3952 Tape Frame. This feature is only valid on IBM TS7500 Expansion Frames.

**Minimum** None.

**Maximum** Ten; one per FC5748 and FC5749 if present.

**Corequisites** One of FC5748 or FC5749 must be removed when this feature is added. Only valid when FC7318 is present on IBM TS7500 Expansion frames.

**Installation** Field only.

## FC4747: Remove 3954-CV6

This feature provides the instructions to remove a TS7520 Server from an installed 3952 Tape Frame.

**Minimum required** One.

**Maximum allowed** Two.

**Corequisite** One FC5732 is required for every FC4747 ordered.
One FC5728 or FC5729 must be removed from the Model F05 for every FC4747 ordered.

**Installation** Field only.

## FC5728: Plant Install a 3954 Model CV6 (withdrawn)

This feature allows the factory installation of a TS7520 Virtualization Engine a new 3952 Tape Frame coming from the plant. This feature must appear on the 3952 Tape Frame order, and the Plant Install a 3954 Model CV6 feature (FC9326) must appear on the TS7520 Virtualization Engine order.

**Minimum** None. However, one if FC7317 or FC7319 is present, two if FC7320 is present.

**Maximum** Two. The maximum of FC5728 plus FC5729 is two.

**Installation** Plant only.

## FC5729: Field Install A 3954 Model CV6 (withdrawn)

This feature allows the field installation of a TS7520 Virtualization Engine into an existing 3952 Tape Frame in the field. This feature must appear on the 3952 Tape Frame order, and the Field Install a 3954 Model CV6 feature (FC9329) must appear on the TS7520 Virtualization Engine order.

**Minimum** None.

**Maximum** Two. The maximum of FC5728 plus FC5729 is two.

**Corequisites** If FC7317 or FC7320 is present, the sum of FC5728 plus FC5729 must equal two.

**Installation** Field only.

## FC5731: Plant Install 3954 CV7

This feature allows the factory installation of a TS7530 Server in a new 3952 Tape Frame coming from the plant.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | Two. |
| **Corequisites** | The sum of FC5731 plus FC5732 must not exceed two.<br>FC7317 or FC7320 is required.<br>Mutually exclusive with FC5728 and FC5729. |
| **Installation** | Plant only. |

## FC5732: Field Install 3954-CV7

This feature allows the field installation of a TS7530 Server into an installed 3952 Tape Frame.

| | |
|---|---|
| **Minimum required** | None. |
| **Maximum allowed** | Two. |
| **Corequisites** | The sum of FC5731 plus FC5732 must not exceed two.<br>FC7317 or FC7320 is required.<br>Mutually exclusive with FC5728 and FC5729. |
| **Installation** | Plant only. |

## FC5738: Plant Install A 3955 Model SV6

This feature allows the factory installation of a TS7500 Cache Controller into a new 3952 Tape Frame coming from the plant. This feature must appear on the 3952 Tape Frame order, and the Plant Install a 3955 Model SV6 feature (FC9328) must appear on the TS7500 Cache Controller order.

| | |
|---|---|
| **Minimum** | None. |
| **Maximum** | Two. However, the sum of FC5738 and FC5739 cannot exceed two. |
| **Corequisites** | If the TS7500 Base Unit feature (FC7317) is ordered, then the quantity of FC5738 must be two. |
| **Installation** | Plant only. |

## FC5739: Field Install A 3955 Model SV6

This feature allows the field installation of a TS7500 Cache Controller into an existing 3952 Tape Frame in the field. This feature must appear on the 3952 Tape Frame order, and the Field Install a 3955 Model SV6 feature (FC9329) must appear on the TS7500 Cache Controller order.

| | |
|---|---|
| **Minimum** | None. |
| **Maximum** | Two. However, the sum of FC5738 and FC5739 cannot exceed two. |
| **Installation** | Field only. |

## FC5748: Plant Install A 3955 Model SX6

This feature allows the factory installation of a TS7500 Cache Module into a new 3952 Tape Frame coming from the plant. This feature must appear on the 3952 Tape Frame order, and the Plant Install a 3955 Model SX6 feature (FC9324) must appear on the TS7500 Cache Module order.

**Minimum** None.

**Maximum** If the TS7500 Base Unit feature (FC7317) or Secondary Base Unit feature (FC7320) is ordered, the maximum of FC5748 plus FC5749 is six. If the TS7500 Expansion Unit feature (FC7318) is ordered, the maximum of FC5748 plus FC5749 is ten.

**Corequisites** None.

**Installation** Plant only.

## FC5749: Field Install A 3955 Model SX6

This feature allows the field installation of a TS7500 Cache Module into a customer installed 3952 Tape Frame. This feature must be ordered on the 3952 Tape Frame and the Field Merge a 3955 Model SX6 feature (FC9331) must appear on the TS7500 Cache Module order.

**Minimum** None.

**Maximum** If the TS7500 Base Unit feature (FC7317) or Secondary Base Unit feature (FC7320) is ordered, the maximum of FC5748 plus FC5749 is six; if the TS7500 Expansion Unit feature (FC7318) is ordered, the maximum of FC5748 plus FC5749 is ten.

**Corequisites** None.

**Installation** Field only.

## FC7317: TS7500 Base Unit

This feature identifies this 3952 Tape Frame as the base unit for the TS7500 Virtualization Engine.

**Minimum** None.

**Maximum** One.

**Corequisites** Requires a quantity of one of the Plant Install a 3954 Model CV7 feature (FC5728), a quantity of two of the Plant Install a 3955 Model SV6 feature (FC5738), the Dual AC Power feature (FC1903), and two of the Ethernet Switch Kit feature (FC1906).

**Compatibility conflicts** The feature is mutually exclusive with the TS7500 Expansion Unit feature (FC7318). This feature is mutually exclusive with the TS7500 Base Unit feature (FC7317) and Expansion Unit feature (FC7318). The sum of FC7317, FC7318, and FC7320 must be one.

**Installation** Plant only.

## FC7318: TS7500 Expansion Unit

This feature identifies this 3952 Tape Frame as an expansion unit for the TS7500 Virtualization Engine. The components in an expansion unit must be attached to components of a base unit. Therefore, a separate 3952 Tape Frame with the TS7500 Base Unit feature

(FC7317) must already be installed for this to be attached to, or a new 3952 Tape Frame base unit must be ordered at the same time as this expansion unit. When the first expansion unit is ordered, a Fibre Channel Switch Kit feature (FC1907) must be ordered against the TS7500 Base Frame.

**Minimum** None.

**Maximum** One.

**Prerequisite** A separate 3952 Tape Frame with the TS7500 series Base Unit feature (FC7317) is required. When the first expansion unit for a TS7500 solution is ordered, a Fibre Channel Switch Kit feature (FC1907) must be ordered against the TS7500 Base Frame, and a separate 3952 Tape Frame with FC7317 selected.

**Compatibility conflicts** The feature is mutually exclusive with the TS7500 Expansion Unit feature (FC7318). This feature is mutually exclusive with the TS7500 Base Unit feature (FC7317) and Expansion Unit feature (FC7318). The sum of FC7317, FC7318, and FC7320 must be one.

**Installation** Plant only.

## FC7319: TS7520 Limited Edition Unit (withdrawn)

This feature identifies this frame as a Limited Edition base unit frame which contains one TS7520 Virtualization Engine, one TS7520 Cache Controller, and up to two TS7520 Cache Modules.

**Minimum** None.

**Maximum** One.

**Corequisites** Requires a quantity one of the Plant Install a 3954 Model CV6 feature (FC5728), a quantity of one of the Plant Install a 3955 Model SV6 feature (FC5738), and the Dual ac Power feature (FC1903).

**Compatibility conflicts** The feature is mutually exclusive with the TS7500 Expansion Unit feature (FC7318). This feature is mutually exclusive with the TS7500 Base Unit feature (FC7317) and Expansion Unit feature (FC7318). The sum of FC7317, FC7318, and FC7320 must be one

**Installation** Plant only.

## FC7320: TS7500 Secondary Base Unit

This feature identifies this 3952 Tape Frame as the secondary base unit for the TS7500 Virtualization Engine.

**Minimum** None.

**Maximum** One.

**Corequisites** Requires a quantity of two of the Plant Install a 3954 Model CV7 feature (FC5731), and a quantity of two of the Plant Install a 3955 Model SV6 feature (FC5738).

**Compatibility conflicts** The feature is mutually exclusive with the TS7500 Expansion Unit feature (FC7318). This feature is mutually exclusive with the TS7500 Base Unit feature (FC7317) and Expansion Unit feature (FC7318). The sum of FC7317, FC7318 and FC7320 must be one.

**Installation** Plant only.

## FC9954 NEMA L6-30 Power Cord

This feature provides a NEMA L6-30 non-watertight 4.3-meter (14-foot) power cord, 200-208, 240 Vac, 24 Amps, used in U.S., Canada, Latin America, and Japan.

| | |
|---|---|
| **Minimum** | One of 9954, 9955, 9956, 9957, or 9958 |
| **Maximum** | One |
| **Prerequisites** | None |
| **Installation** | Plant or field |

## FC9955 RS 3750 DP Power Cord

This feature provides a Russellstoll 3750DP Watertight 4.3-meter (14-foot) power cord, 200-208, 240 Vac, 24 Amps, used in U.S, Chicago, Canada, LA, and Japan.

| | |
|---|---|
| **Minimum** | One of 9954, 9955, 9956, 9957, or 9958 |
| **Maximum** | One |
| **Prerequisites** | None |
| **Installation** | Plant or field |

## FC9956 IEC 309 Power Cord

This feature provides a IEC 309, p+n+g, 32A, 4.3-meter (14-foot) power cord, 230 Vac, 24 Amps, used in EMEA.

| | |
|---|---|
| **Minimum** | One of 9954, 9955, 9956, 9957, or 9958 |
| **Maximum** | One |
| **Prerequisites** | None |
| **Installation** | Plant or field |

## FC9957 PDL 4.3 Power Cord

This feature provides a PDL 4.3-meter (14-foot) power cord, 230-240 Vac, 23 Amps, used in Australia and New Zealand.

| | |
|---|---|
| **Minimum** | One of 9954, 9955, 9956, 9957, or 9958 |
| **Maximum** | One |
| **Prerequisites** | None |
| **Installation** | Plant or field |

## FC9958 Korean 4.3m Power Cord

This feature provides a NEMA L6-30 non-watertight 4.3-meter (14-foot) power cord, 200-208, 240 Vac, 24 Amps, with a Korean plug, used in North and South Korea.

| | |
|---|---|
| **Minimum** | One of 9954, 9955, 9956, 9957, or 9958 |
| **Maximum** | One |
| **Prerequisites** | None |
| **Installation** | Plant or field |

### FC9959 Unterminated Power Cord

This feature provides an unterminated, non-watertight 4.3-meter (14-foot) power cord, 200-208, 240 Vac, 24 Amps power cord with IRAM and BSMI agency certifications. This is the recommended cord for Argentina and Taiwan.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | One |
| **Prerequisites** | None |
| **Installation** | Plant or field |

### FC9966 China Unterminated Power Cord

This feature provides an unterminated, non-watertight 4.3-meter (14-foot) power cord, 200-208, 240 Vac, 24 Amps power cord with CCC agency certification. This is the recommended power cord for China.

| | |
|---|---|
| **Minimum** | None |
| **Maximum** | One |
| **Prerequisites** | None |
| **Installation** | Plant or field |

## IBM Virtualization Engine TS7500 Software Version 3 Release 1

This section summarizes the feature codes and maintenance applicable to TS7500 Software V3R1.

### Program numbers

The program number for the TS7500 Software Version 3 Release 1 and the program numbers for software maintenance are:

| | |
|---|---|
| **5697-P19** | IBM Virtualization Engine TS7500 Enterprise Edition Software V3.1.0 |
| **5697-N69** | TS7500 Enterprise Edition reg./ren 1 year |
| **5697-N70** | TS7500 Enterprise Edition after license 1 year |
| **5697-N71** | TS7500 Enterprise Edition reg. 3 year |
| **5697-N72** | TS7500 Enterprise Edition ren. 3 year |
| **5697-N73** | TS7500 Enterprise Edition after license 3 year |

### Software feature codes

Software feature codes are required to match the hardware feature codes for Advanced Functions and, for the TS7500 Enterprise Edition (5697-P19), to match the installed TS7500 capacity.

> **Note:** The Virtualization Engine TS7500 software for Enterprise Edition and TS7500 software for the limited edition have been withdrawn.
>
> Upgrades to move from IBM Virtualization Engine TS7500 Enterprise Edition V2R1 to TS7500 Enterprise Edition V3R1 are available at no charge.
>
> There is no replacement software available for the TS7500 Limited Edition V2R1.

## Advanced function features

The following hardware features of the TS7500 Model Virtualization Engine must have corresponding features ordered on the IBM Virtualization Engine TS7500 V3.1 software program (5697-P19). The feature codes for the TS7500 Enterprise Edition and for upgrades of an existing TS7510 Virtualization Engine are summarized in Table C-1.

*Table C-1 Software Feature Codes for TS7500*

| Description | 3954-CV6[a] 3954-CV7 features | 5697-P19 feature code US | 5697-P19 feature code AP, Canada | 5697-P19 feature code EMEA |
|---|---|---|---|---|
| Failover/Failback | 7420 | 0012 | E8LF | UBP0C1 |
| Network Replication | 7421 | 0001 | E8KQ | UBPKC1 |
| Network Encryption | 7422 | 0002 | E8KR | UBP6C1 |
| Network Compression | 7423 | 0004 | E8KU | UBP5C1 |
| Hosted Backup | 7425 | 0017 | E8LL | UBP1C1 |
| NDMP | 7426 | 0013 | E8LG | UBP4C1 |
| Secure Tape | 7427 | 0015 | E8LJ | UBP7C1 |
| iSCSI Enable | 7428 | 0017 | E8LM | UBP2C1 |
| Local Replication | 7429 | 0016 | E8LK | UBP3C1 |
| Path Failover | 1682 | 0014 | E8LH | UBPJC1 |

a. The above hardware features may also be ordered for TS7520 Model CV6 Virtualization Engine via a MES. However, during implementation of the licenses the customer will have to upgrade the software to V3R1 (no-charge upgrade).

## Capacity features

Table C-2 lists the features that must be ordered for the TS7500 Enterprise Edition V3R1 based on the capacity installed in the TS7500.

*Table C-2 Capacity features for TS7500*

| Description | 5697-N65 feature code US | 5697-N65 feature code AP, Canada | 5697-N65 feature code EMEA |
|---|---|---|---|
| Per Terabyte (1–12) | 0005 | E8KV | UBPZC1 |
| Per Terabyte (13–32) | 0006 | E8KW | UBP8C1 |
| Per Terabyte (33–64) | 0007 | E8LA | UBP9C1 |
| Per Terabyte (65–100) | 0008 | E8LB | UBRAC1 |
| Per Terabyte (101–250) | 0009 | E8LC | UBRBC1 |
| Per Terabyte (250+) | 0010 | E8LD | UBRCC1 |
| Per 250 Terabytes (250+) | 0011 | E8LE | BBRCF2 |

To match the maximum capacity of 884 TB, the following features are required in the US:

| | |
|---|---|
| **FC0005 x 12** | For the first 12 TB |
| **FC0006 x 20** | For the next 20 TB |
| **FC0007 x 32** | For the next 32 TB |
| **FC0008 x 36** | For the next 36 TB |
| **FC0009 x 150** | For the next 150 TB |
| **FC0011 x 2** | For the next 500 TB |
| **FC0010 x 134** | For the last 134 TB |

D

# Installation and implementation checklists

In this appendix we provide checklists and worksheets that will help you during planning and installation of the TS7530 Virtualization Engine.



# Customer installation responsibilities

The customer responsibilities for a TS7530 installation are:

- Physical planning

  Detailed planning information is available in the *IBM Virtualization Engine for Tape TS7500 Introduction and Planning Guide,* GC27-2067.

- Network planning

  There are three network configuration options to configure the TS7500 networks. Choose the best one for your needs.

  Detailed planning information is available in the *IBM Virtualization Engine for Tape TS7500 User's Guide,* GC27-2179.

- Electrical power

  220V power is required for each frame (single power or dual power).

- Management console

  A management console is used for configuration, management, and service support for the TS7530 solution. This console is required by the TS7530 solution and is either supplied by the customer or optionally ordered from IBM. If a management console is ordered, it is placed as a separate order from the TS7530 solution.

- Appropriate cables

  – Fibre Channel cables are required to attach the TS7530 Virtualization Engine Model CV6 to various server adapters.

  – Ethernet cables are required to attach the TS7530 Virtualization Engine Model CV6 to various server adapters when using the iSCSI protocol.

- Physical tape libraries, tape drives, tape media
- Client host platforms
- Configuration of subnet IP addresses, switches, zoning, and so on
- Installation of the TS7530 VE Console application from CD
- Checking the latest S/W and F/W levels for CVT7 and Cache Controller

  The latest one is required for the stable system. Check the revision history.

- System administration setup and configuration of virtual tape libraries, devices, and tapes
- System administration setup and mapping of client hosts to devices
- System administration setup and configuration of SNMP Alerts® and em-ail alerts

  For a Call Home fuction, prepare an e-mail address. If your system meets the critical status, the system sends some information to you and IBM support through the Call Home function.

See Chapter 5, "Configuration and planning" on page 129, and Chapter 6, "Initial setup" on page 181, for more information related to these tasks.

The following worksheets are intended to help you gather information required for installation and setup of the TS7530 Virtualization Engine.

# Worksheet for failover (HA) configurations

Use the worksheet in Table D-1 for a 2-node to 4-node configuration with failover.

*Table D-1 Installation Worksheet for 2-4 node and failover*

| Node | HA1 | HA2 | HA3 | HA4 |
|---|---|---|---|---|
| Hostname | | | | |
| Domain Name | | | | |
| DNS 1 (up to 3) | | | | |
| DNS 2 | | | | |
| DNS 3 | | | | |
| gateway | | | | |
| RSA | | | | |
| eth0 (Static) | | | | |
| eth0 subnet mask | | | | |
| eth0 HB (Heartbeat[a]) | | | | |
| eth0 HB subnet mask | | | | |
| eth1 | | | | |
| eth1 subnet mask | | | | |
| eth1 HB | | | | |
| eth1 HB subnet mask | | | | |
| **Optional** | | | | |
| Gateway server (Call Home[b]) | Yes or No<br>If you want to use a Call Home function, prepare a gateway machine. | | | |
| eth2 | | | | |
| eth3 | | | | |
| eth4 | | | | |
| eth5 | | | | |
| | **Fibre Channel Switch 1** | | **Fibre Channel Switch 2** | |
| hostname | | | | |
| address | | | | |
| subnet mask | | | | |

a. Heartbeat is on a non-routable subnet. Eth0 and eth1 cannot be on the same subnet. Examples of non-routable subnets are the 192 and the 10 net.

b. Call Home is a unique customer support utility that proactively identifies potential system or component failures and automatically notifies IBM using the IBM Electronic Service Agent program.
Detailed planning information is available in the *IBM Virtualization Engine for Tape TS7500 Call Home Function Installation and Setup Guide*, GC27-2169.
Note that the Call Home function is not supported on TS7510 hardware.

Table D-2 and Table D-3 provide two examples of non-routable subnets.

*Table D-2 Example #1 of non-routable subnets*

| **eth0 HB** | **192.168.10.1** | **192.168.10.2** |
|---|---|---|
| eth1 HB | 192.168.11.1 | 192.168.11.2 |
| subnet mask | 255.255.255.0 | 255.255.255.0 |

*Table D-3 Example #2 of non-routable subnets*

| **eth0 HB** | **10.10.10.1** | **10.10.10.2** |
|---|---|---|
| eth1 HB | 10.10.11.2 | 10.10.11.2 |
| subnet mask | 255.255.255.0 | 255.255.255.0 |

# Worksheet for a Limited Edition or standalone configuration

You can use the worksheet provided in Table D-4 for configuration of limited Edition or standalone configurations.

*Table D-4 Limited Edition (LE) or Standalone (SA)*

| **Node** | **LE or SA 1** | **SA 2** | **SA3** | **SA4** |
|---|---|---|---|---|
| hostname | | | | |
| Domain Name | | | | |
| Domain Name | | | | |
| DNS 1 (up to 3) | | | | |
| DNS 2 | | | | |
| DNS 3 | | | | |
| gateway | | | | |
| RSA | | | | |
| eth0 (static) | | | | |
| eth0 subnet mask | | | | |
| eth1 (static) | | | | |
| eth1 subnet mask | | | | |
| **Optional** | | | | |
| Gateway server (Call Home[a]) | Yes or No<br>If you want to use a Call Home function, prepare a gateway machine. | | | |
| eth2 | | | | |
| eth3 | | | | |
| eth4 | | | | |
| eth5 | | | | |
| | **Fibre Channel Switch 1** | | **Fibre Channel Switch 2** | |
| hostname | | | | |
| IP | | | | |
| subnet mask | | | | |

a. Call Home is a unique customer support utility that proactively identifies potential system or component failures and automatically notifies IBM using the IBM Electronic Service Agent program.
Detailed planning information is available in the *IBM Virtualization Engine for Tape TS7500 Call Home Function Installation and Setup Guide*, GC27-2169.
Note that the Call Home function is not supported on TS7510 hardware.

## LUN assignment worksheet for expansion racks

After discovering the new LUNs following the directions located in the Operations section of this manual, you will have a number of LUNs that will not have been enlisted. This worksheet is designed to assist you in mapping these LUNs appropriately.

LUNs marked with 31 are special LUNs and are not assigned to a particular host and should be ignored for this procedure.

For load balancing purposes it may be prudent to assign every other LUN in a round robin fashion to every other TS7530 node. This is the configuration of the base frame for this very reason.

*Table D-5 LUN Assignment Worksheet for expansion racks*

| Expansion frame | SCSI ID of LUN | Size | TS7530 node assignment |
|---|---|---|---|
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# Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this IBM Redbooks pubication.

## IBM Redbooks publications

For information about ordering these publications, see “How to get Redbooks publications” on page 541. Note that some of the documents referenced here may be available in softcopy only.


- *IBM System Storage Solutions Handbook*, SG24-5250
- *IBM System Storage Tape Encryption Solutions*, SG24-7320
- *Implementing IBM Tape in i5/OS*, SG24-7440
- *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946
- *IBM TS3500 Tape Library with System z Attachment A Practical Guide to Enterprise Tape Drives and TS3500 Tape Automation*, SG24-6789


## Other publications

These publications are also relevant as further information sources:


- *IBM Virtualization Engine for Tape TS7500 User’s Guide Version 3, Release 1*, GC27-2179
- *IBM Virtualization Engine for Tape TS7500 Version 2 Release 2 - User’s Guide,* GC26-2068
- *IBM Tape Device Drivers - Installation and User’s Guide,* GC27-2130
- *IBM Virtualization Engine TS7520 Introduction and Planning Guide*, GC27-2067
- *IBM Encryption Key Manager component for the Java platform: Introduction, Planning, and User's Guide*, GA76-0418
- *IBM System Storage TS3500 Tape Library Operator Guide*, GA32-0560
- *IBM System Storage TS3500 Tape Library Introduction and Planning Guide*, GA32-0559
- *IBM TotalStorage SMI-S Agent for Tape Installation Guide*, GC35-0512




 

## Online resources

These Web sites are also relevant as further information sources:

- Advance Library Management System (ALMS) White Paper

  http://www-03.ibm.com/systems/storage/tape/pdf/whitepapers/advanced_library_management_system.pdf
- Serial ATA Web site

  http://www.serialata.org
- IBM Tape Storage Web site

  http://www.ibm.com/servers/storage/tape
- IBM Tape Library Web site

  http://www.ibm.com/systems/storage/tape/library.html
- TS7520 Interoperability matrix

  http://www-03.ibm.com/servers/storage/tape/resource-library.html#interoperability
- TS7520 support matrix

  http://www-01.ibm.com/systems/support/storage/config/ssic/index.jsp
- TS7520 supported host bus adapters and SAN components

  http://www-03.ibm.com/servers/storage/support/config/hba/index.wss
- TS7520 ISV matrix

  http://www-03.ibm.com/systems/storage/tape/pdf/compatibility/ts7520_isv_matrix.pdf
- LTO ISV matrix

  http://www.ibm.com/servers/storage/tape/lto/lto_isv.htm
- IBM tape storage publications

  http://www-03.ibm.com/servers/storage/tape/resource-library.html#publications
- Download of the latest *IBM Tape Device Drivers Installation and User's Guide*

  http://ftp.software.ibm.com/storage/devdrvr/Doc
- Linear Tape-Open organization home page

  http://www.lto.org
- IBM Linear Tape-Open home page

  http://www.ibm.com/storage/lto
- Symantec NetBackup

  http://www.symantec.com/index.jsp
  http://www.symantec.com/enterprise/support/index.jsp
  http://seer.entsupport.symantec.com/docs/279261.htm
  http://www.symantec.com/enterprise/products/overview.jsp?pcid=1018&pvid=2_1
  http://ftp.support.veritas.com/pub/support/products/NetBackup_Enterprise_Server/278064.pd
  http://seer.entsupport.symantec.com/docs/287504.htm

- EMC NetWorker

  http://software.emc.com/
  http://software.emc.com/products/product_family/networker_family.htm
  http://web1.legato.com/cgi-bin/catalog?sf=Releases
  http://powerlink.emc.com/

- Download the sg-utils package

  http://www.torque.net/sg/

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**ibm.com**/services

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