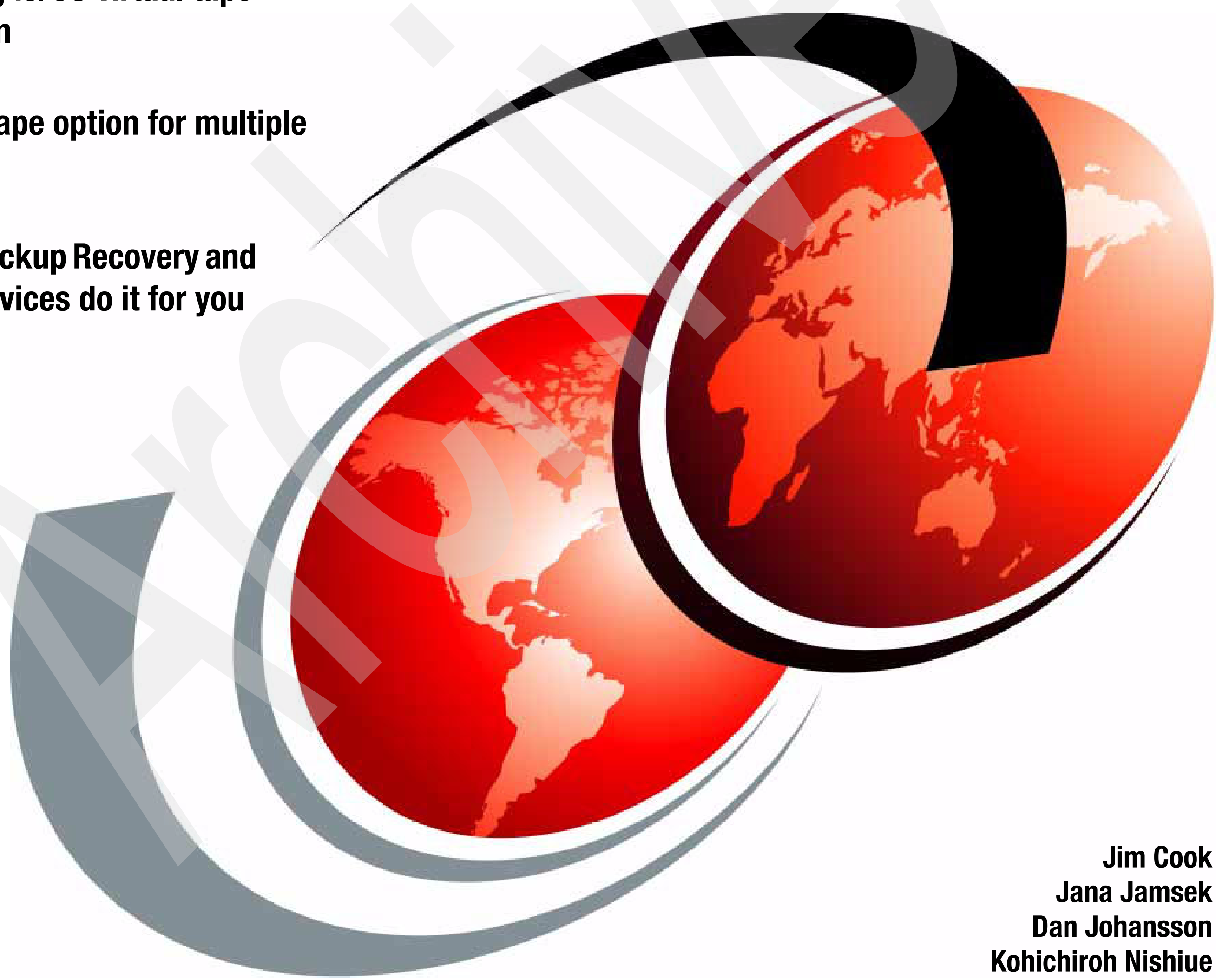
# IBM Virtualization Engine TS7510 Getting Started with i5/OS and Backup Recovery and Media Services

**Expanding i5/OS virtual tape integration**

**A virtual tape option for multiple partitions**

**Letting Backup Recovery and Media Services do it for you**





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# IBM Virtualization Engine TS7510: Getting Started with i5/OS and Backup Recovery and Media Services

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



**First Edition (March 2007)**

This edition applies to i5/OS V5R2 and later, 5722-SS1, and the IBM Virtualization Engine TS7510 and TS7510 V1R1 or later software.

# Contents

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# Preface

This IBM® Redbook provides a getting started level of information about supporting the IBM Virtualization Engine™ TS7510 under i5/OS®, primarily using the Backup Recovery and Media Services (BRMS), 5722-BR1, management product. BRMS is the primary backup and recovery management product for i5/OS.

This book cannot make you an expert in i5/OS backup and recovery or in the use of BRMS. It also cannot make you an expert in full usage and management of the IBM Virtualization Engine TS7510 capabilities. More complete coverage of the TS7510 is included in the IBM Redbook *IBM Virtualization Engine TS7510: Tape Virtualization for Open Systems Servers*, SG24-7189.

However, this book does provide sufficient information and examples to get you up and running with the IBM Virtualization Engine TS7510 attached to an i5/OS partition or system using BRMS. This book also helps you to understand where the IBM Virtualization Engine TS7510 can fit into your complete set of backup and recovery processes where multiple systems or servers, or logical partitions have to save data to a common repository. The TS7510 helps you to minimize your backup window, facilitates data sharing among the multiple systems, and helps you to minimize your total cost of ownership (TCO) in the backup and recovery area.

Key topics include:

- Description of the IBM Virtualization Engine TS7510 hardware and software capabilities
- Planning information to use the TS7510
- Basic installation and setup information, along with hardware and software requirements
- Extensive examples using BRMS to save to and restore from the TS7510
- Overview information about available TS7510 monitoring, measurement, and problem determination capabilities
- Basic i5/OS-oriented performance test results to help you estimate your “backup window” requirements

## The team that wrote this IBM Redbook

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*Implementing FC Disk and Tape with iSeries*, SG24-6220; *iSeries and IBM TotalStorage: A Guide to Implementing External Disk on eServer i5*, SG24-7120; and *Multipath for IBM eServer iSeries*, REDP-0777.

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# Why virtual tape on the System i family?

This chapter provides an overview of the positioning of the IBM Virtualization Engine TS7510 as a tape backup and recovery "device" and the technology history of "real tape" technology. It introduces the use of virtual tapes (tape interfaces but data actually stored on disk technology). This includes basic positioning of the following tape-based backup options from an i5/OS viewpoint:

- Save and restore with a real physical tape
- Save and restore with V5R4 i5/OS-based virtual tape support
- Save and restore using the IBM Virtualization Engine TS7510

## 1.1 Initial positioning of the TS7510 for backup and recovery

The TS7510 Virtualization Engine combines hardware and software into an integrated solution designed to provide tape virtualization for open systems servers running multiple different operating systems, all connected to the TS7510 over Fibre Channel physical connections.

The following list summarizes the key benefits of integrating the TS7510 into your backup and recovery processes, all at a moderate cost. The TS7510 is:

- Designed to allow multiple backup/restore jobs to run simultaneously on a single TS7510 for high performance and infrastructure simplification
- Designed to allow each backup server to allocate its own virtual library
- Designed to allow for a substantial number of mount points for very high performance, allowing for a substantial number of virtual cartridges to support capacity on demand growth
- Designed to allow for remote disaster recovery site copies, including electronic vaulting, with high security features using encryption
- Designed to assist server failover and failback for high-availability requirements

The TS7510 looks like a tape library with several tape devices to the system backup software. As such, virtual tape libraries provide the advantages of tape library products without most of the management headaches such as trying to manage the use of library devices by multiple systems during the same time period.

In some environments, the TS7510 could be the only *backup and recovery device* used by several systems. In other environments, the TS7510 can be integrated as an important device in a backup and recovery process that might use multiple devices.

In the following sections, we first review real tape technology history leading up to virtual tape technology capabilities. Then we end this chapter listing the advantages of using real tape devices, i5/OS V5R4 virtual tape support, and the TS7510 virtual tape support with i5/OS.

## 1.2 Short history of tape technologies

Tape devices (drives) and their supported media provide data interchange and backup and recovery functions. What started out as a rather casual use has turned into a *demand* for higher reliability, and, in general, the following price/performance pairings:

- Highest speed (throughput) and highest single media capacity, with acceptance of high cost to achieve the highest speeds
- Lower cost tape hardware with moderately high speeds and capacity per single media

Over time these two *objectives* have lead to marketplace acceptance or *adjustment to* compatibility differences among the media used by the devices to achieve these objectives.

Various speed capacities, write and read algorithms, and media format capacities have evolved over time. Individual, separately managed tape devices now can be packaged with additional automatic tape media loaders and also within tape libraries where one or more tape devices are enclosed in an associated *frame* that also contains a library of physical media and *arms* to move the media. Based upon commands from a control panel or from operating system software, the appropriate media can be automatically mounted, read from or written to, or unmounted.

As stated, the general driving force behind all these technolgies is higher speeds, higher data density (capacity) per tape media, automated mounting and unmounting of tape media, and increased reliability. Tape data encryption and decryption capabilities are becoming more available.

As the tape technologies have been introduced into the marketplace, many have evolved into follow-on *generations*, which can be viewed as enhancements to the original technology that might, for example, make a previous generation high cost product a relatively lower cost product now; thus enabling a use of the technology and hardware by a wider set of customers. Of course, just as in the auto industry, reliability has to be factored into acceptance of technology advancements.

One generation evolution example that we mention here is with Linear Tape-Open (LTO) technology. LTO is considered an open-format tape storage technology, because it has been developed by several companies: Hewlett-Packard (HP), International Business Machines (IBM), and Quantum. The term *open format* means that users have access to multiple sources of storage media products that will be compatible.

There are highest capacity and highest speed implementations and relatively lower cost, capacity, and speed implementations of this technology.

A high-capacity implementation of LTO technology is known as the *LTO Ultrium format*, or simply LTO Ultrium. Many vendors provide various LTO products, with generation 3 (LTO Ultrium 3, or LTO-3) being the most commonly available highest speed implementation at this time.

Note that LTO Ultrium generation 4 has been officially announced during January 2007. With the availability of generation 4 specifications, HP, IBM, and Quantum have again expanded a well-received open format tape technology for users in the midrange tape category. Products based on the LTO-4 format generation are expected to be available during 2007.

At the same time that there is continued innovation at the higher speed end of tape technology, there is also innovation at the lower or entry level tape technologies. In the industry, the technologies most often discussed media formats for this environment include Quarter Inch Cartridge (QIC), VXA Packet, and DSS.

Many System i customers are familiar with the QIC technology devices as, until the last few years, this was the only entry level tape device and media offered with System i configurations. VXA tape drives, now offered on System i configurations, have more advanced technology and are in more common use among many operating systems than QIC.

Digital Data Storage (DDS) is a tape data storage format developed by HP and Sony to adapt the Digital Audio Tape (DAT) audio technology for data storage. Tape data storage requires much higher data integrity than is available with DAT. Even though DSS is the technically correct term for the data format stored on the tape media, the term DAT is now most commonly applied to the data storage device and often used interchangeably with DDS.

DDS is currently at generation level 5.

Note that DDS tape drives will reject DAT audio tape media. At the time of writing this book, i5/OS did not support a DSS technology tape device.

A key problem area with real tape devices, which is worth noting here as we progress to the topic of virtual tape, is the physical action commonly referred to by the term *backhitch*. With the increased speeds of the newer technology tape devices, the operating system software, depending on the operating environment, could have periods when it did not present a data block to the device “fast enough” on write operations. When this happened, the high speed tape device was forced to stop and go back, and when new data was available, go forward writing again. This process is described by backhitch. Depending on the frequency of occurrence, this could significantly detract from maximum throughput capacities of the device.

While technology advancements continue to be made for real tape hardware, including addressing the backhitch occurrence, the emergence of *virtual tape* capabilities have also been introduced into the marketplace by several vendors, including IBM. The term virtual tape applies, because the operating system software thinks it is talking to a real tape device, typically in the context of a tape library configuration. However, the hardware is actually a computer with its own unique *operating system* and disk devices (or other storage medium) that stores the *tape data*.

As originally conceived, this kind of storage device was intended to manage less-frequently needed data but offer the simplicity of attachment by looking like known tape devices. Virtual tape is a good choice to be part of a hierarchical storage management (HSM) system in which data is moved as it falls through various usage thresholds towards least often used data being stored on less costly forms of storage media.

In the context of this IBM Redbook, virtual tape can also be used as part of a storage area network (SAN) where at least moderate speeds, significant storage capacity, and shared use among several partitions or separate systems is the expectation. All of this can be managed by a single virtual tape server for a number of networked systems, partitions, or both.

Things to keep in mind for virtual tape technology include:

- As virtual tape hardware throughput rates improve over time, there is no performance degradation due to a tape backhitch occurrence during write operations.
- With backed up data stored only on hardware that includes disk drives, the data is not really protected as it would be if it were on a real physical media that can easily be transported to a different physical location as part of a disaster recovery protection plan.

Currently, you can consider there to be three environments where real and virtual tape technology products are targeted, primarily based upon the amount of storage capacity afforded by the products:

- Enterprise tape systems
- Midrange tape systems
- Entry tape systems

A more complete treatment of the available real and virtual tape technologies and orderable hardware components within these environments is beyond the scope of this IBM Redbook. The IBM Internet Web page for tape storage products provides a good source of information in this area. It includes descriptions of available IBM products in these environments and a “Computer tape systems” option to help you in your choice of tape technologies.

We list the IBM site and some other links to various tape technology Web sites here:

- IBM Internet tape storage products Web site:

  `http://www.ibm.com/storage/tape`

  For information about DDS/DAT support, search using “DDS”.
- Industry LTO technology Web site:

  `http://www.lto-technology.com`

- HP storage products Web site:

  `http://www.hp.com/products`

  Click the **Storage** link.
- VXA Alliance group:

  `http://www.vxa.com`
- Exabyte Web site documentation:

  `http://www.exabyte.com`

i5/OS V5R4 virtual tape support, at least for data stored within an i5/OS partition's Integrated File System, offers a second virtual tape solution. Because the scope of this book is to get the TS7510 up and running with i5/OS and licensed program Backup Recovery and Media Services (BRMS), 5722-BR1, a thorough treatise of when to use real tape and two virtual tape solutions under i5/OS cannot be covered. However, in this book, we do discuss a general set of basic advantages and disadvantages for using real hardware tape, *hardware virtual tape* (the TS7510), and *software virtual tape* (i5/OS virtual tape support) and show some performance comparisons.

We also provide an appendix that reports performance test throughput rates using a selected set of i5/OS save and restore configurations over a real high speed tape, i5/OS virtual tape configurations, and a TS7510 virtual tape (Appendix A, "Sizing and performance examples" on page 281). You have to understand the test configurations and how they apply to your environment to determine what is the best usage of these capabilities for you.

For more information about i5/OS virtual tape support, see the IBM Redbook *i5/OS V5R4 Virtual Tape: A Guide to Planning and Implementation*, SG24-7164.

You should not expect any one of these *tape options* to be the single backup and recovery *tape solution* choice for most customers.

It depends.

The following sections in this chapter provide the general advantages and disadvantages of using the kinds of tape support available to i5/OS users:

- Real high speed tape devices
- i5/OS virtual tape support
- TS7510 virtual tape support

The succeeding chapters are focused on getting the TS7510 up and running under i5/OS and BRMS.

## 1.3 Saving and restoring with a real tape

Saving and restoring with a real tape device has advantages when:

- You need a real, physical tape volume. Saving to a real tape means that you have a physical volume that can be physically secured and duplicated according to the requirements unique to each customer environment.
- You have to minimize the cost of tape hardware technology and the amount of data to be saved and the time it takes to save the data has a wide *time window* to get the backup done without impacting application throughput.

- Alternatively, a high speed tape device can perform the backup within the time constraints of the business, the price/performance costs of the tape technology are acceptable, and the system workload management and hardware configuration are sufficient to:
  - Minimize application downtime.
  - Deliver the save data “fast enough” to maintain close to the rated speed of the high speed tape device. Typically, this involves backing up single larger files (millions of records). Saving multiple small to intermediate sized objects often prohibits the saving application and operating system from delivering the data to the tape device “fast enough” to maintain rated speed.

  In other words, the tape hardware technology can actually be used by the runtime environment.

The disadvantages of using real tapes come into play when any or some of the following events occur:

- Multiple saves (or restores) have to be done *at the same time*. This can occur in at least the following environments in any medium complex operating environment:
  - Multiple partitions within the same system have to save (or restore) data at the same time
  - Multiple systems of similar or dissimilar hardware configurations and operating systems within the same computer complex have to save (or restore) data at the same time

  Now the expense of multiple system adapters and high speed tape devices has to be considered.

  An alternative that several i5/OS customers use is to schedule the *saves times* for each partition for a specific time period or sequence. That way, using, for example, dynamic logical partition (LPAR) capabilities, an authorized user can complete the save function for one partition, assign the tape hardware adapter to the next partition, and perform the save for that partition.
- Many small and medium sized objects have to be saved at the same time, including from form multiple jobs or threads. Typically, this causes object to object processing overhead that impacts the ability to deliver the data to be saved “fast enough” to achieve the necessary data rates.
- Your system availability has been and could continue to be significantly compromised if tape errors occur during critical times of operation.

If a scheduled use of the same tape hardware by multiple partition or systems does not meet all your backup and recovery needs, the need for multiple tape devices and associated system hardware starts to become a larger cost and management impact. There are times when you have to consider *disk to disk* backups along with use of real tape technologies to meet your overall backup and recovery objectives.

> **Important:** As we discuss the virtual tape disk to disk capabilities throughout the remainder of this book, keep in mind that somewhere in your backup and recovery process, you probably require important data stored on a real tape volume for maximum recovery capability.

## 1.4 i5/OS internal virtual tape overview

Under i5/OS, the capability to save and restore using a disk to disk based object called a *save file* has been available under i5/OS (OS/400) for many years. It has the following advantages:

- Speeding up a save function
- Providing an object that can later be manually saved to backup media
- Providing an object that can later be transmitted (for example, using FTP) to another i5/OS partition

This “base i5/OS disk to disk save and restore capability” addresses the faster than real tape save and restore requirements. It also introduces the need to manage your disk space consumption and track any movement of data stored on the system to a real tape device.

This is required to:

- Conserve total disk space consumption
- Protect against system or disk hardware errors that make your saved data unavailable at critical times

Save files have many advantages, but do have some limitations that are not inherent when you choose another disk to disk backup and recovery option, such as saving to i5/OS internal virtual tapes and, as documented in this book, saving to an external virtual tape device.

i5/OS V5R4 introduced virtual tape support that essentially uses the physical tape interfaces to save and restore data to i5/OS managed disks that look like real tape devices. This virtual tape support internally emulates tape media stored in image catalog volumes.

You can select any supported tape media, but you have to ensure that the virtual media block size selected matches the capabilities of the physical tape media and device to be used for the duplication.

As you would expect, this i5/OS virtual tape has the big advantage of fast copying disk to disk with no physical human mounting and unmounting, while save and restore functions can use “similar to tape” interfaces. And, of course, there are no physical tape device errors or media errors to worry about during a critical save window.

Saving to real tape can be done at a less critical time.

### Advantages and disadvantages of using internal i5/OS virtual tape

As summarized from the IBM Redbook *i5/OS V5R4 Virtual Tape: A Guide to Planning and Implementation*, SG24-7164, the primary advantages of using i5/OS virtual tape include:

- There is no need for physical tape devices to be attached during backup or restore. If real tape devices are being used, conflicts over usage of the same device can occur if:
  - The tape device or media library is shared between systems or partitions
  - The tape device or media library is being used by another process or job at that time
  - The tape device or media library is unavailable or is unstable due to a hardware defect
  - Of course, selected virtual media still has to be duplicated to physical media, but any need to suspend application processing on certain objects during the actual save should be for a shorter duration. Duplication to a physical media or remote i5/OS system can be performed asynchronously to application usage of the real object.
- Virtual tape can be used to reduce backup time by running concurrent backups in situations where there are insufficient physical tape devices available to perform this task.

- The popular BRMS for iSeries, 5722-BR1, product provides powerful interfaces to i5/OS virtual tape support, through recognition of a virtual tape device type.
- You can FTP the image to other partitions or systems and add it as an entry to the image catalog on the target. There can be multiple reasons why you want the virtual tape image on another system or partition, including:
  - In the partition or system on which you are running a backup or restore, there is no hardware to support the media you use for backup. In such a situation, you can back up to virtual tape and then transfer the image to a partition or system to which a physical tape device is attached.
  - You want to restore data from an image on another partition or system and you do not use a switchable independent Auxiliary Storage Pool (iASP) to store the virtual tape images on. The image can be used in either switchable iASP or user auxiliary storage pool (ASP).

    For a user ASP and non-switchable iASP, the only benefit is that the user ASP or iASP are on other DASDs. For switchable iASP, the image can be used for backup and restore on multiple partitions or systems, without requiring the image to be transferred to another partition system. You can simply switch the iASP.
- It can reduce the save time, depending on the configuration and workload.
- There are no media errors with virtual tape. This feature especially eases the concern of a media error during an i5/OS Save-While-Active (SWA) function.
- Use of i5/OS virtual tape can reduce recovery time, especially in the case of applications in which it is common practice to restore files frequently. For example, for restoring mail files in IBM Domino®, you can restore the files directly from the virtual volumes.
- It allows you to have a local copy of data and an offsite duplicated copy of the data. Local copies can be retained on the system for a period of time for quick recall of the data.
- It allows the full range of capabilities to save more than one library of objects at one time in one i5/OS "save job." A save job per tape device is straightforward. Allowing one save job to save to multiple real tape devices at the same time requires careful setup of the save operations and tape configuration. Virtual tape makes this much easier using base i5/OS save commands and even easier using BRMS capabilities.
- In contrast to using the TS7510, you do not have to go through a major education effort to learn new hardware, new interfaces, and new management techniques.

The primary disadvantages of using internal i5/OS virtual tape support compared to using real tape devices are:

- Ensuring that you do not forget to make a real tape media copy of *must be protected* backup data.
- It is easy to continue to back up data and forget to manage the associated system disk storage being consumed. You have to manage internal disk storage consumption within the virtual tape medial catalog stored within the i5/OS Integrated File System. If not managed, "old data" and "new data" can lead to a frequent quick occurrence of the "`auxiliary storage threshold reached`" message. Then you must perform detailed analysis to determine what in the Integrated File System is taking up all the storage and what you can delete.

The primary disadvantages of using internal i5/OS virtual tape support compared to using external virtual tape support under the TS7510 include:

- Only i5/OS V5R4 support and management of only a single i5/OS partition's data. The TS7510 can back up and recover multiple physical systems and partitions and operating systems listed in Table 1-1 on page 9.
- i5/OS internal virtual tape support requires i5/OS V5R4, while the TS7510 is supported under releases V5R2, V5R3, and V5R4.
- The need to manage the increased utilization of an i5/OS partition's disk storage that contains the virtual tape data. The disk space consumed is on the TS7510.

**Notes:**

- The BRMS network feature provides a level of i5/OS management across multiple systems running i5/OS or multiple i5/OS partitions.
- Any i5/OS partition can host the virtual devices (including system and data disks) for:
  - An i5/OS partition running supported AIX® 5L™ (System i5 required) or Linux on Power release
  - A supported xSeries® system integration hardware adapter (Integrated xSeries Server (IXS), Integrated xSeries Adapter (IXA) or the newer internet Small Computer System Interface (iSCSI) adapter) running a supported Windows release and Linux distribution

  Hosted virtual I/O data is stored within that i5/OS partition's Integrated File System. By understanding this directory structure, you can use a single i5/OS partition to essentially back up and restore several AIX and Linux partitions running on the same System i configuration, as well as back up and restore several Windows operating systems or Linux distributions running the integrated xSeries software under that same i5/OS partition.

## 1.5 TS7510 external virtual tape overview

The industry has several hardware-based products with supporting software that provide “virtual tape” functions to several different operating systems. The IBM Virtualization Engine TS7510 is one of products from IBM in this area.

The TS7510 can back up and recover multiple physical systems and partitions running multiple operating systems, such as i5/OS, Windows, AIX, Linux, HP, and Sun™. See Table 1-1 for a summary of these possible host systems.

A more detailed table (Table 4-19 on page 63) shows these hardware and software platforms.

*Table 1-1 Supported TS7510 host systems*

| Platform | Minimum supported levels |
|---|---|
| i5/OS | V5R2 or later |
| RS6000 or<br>IBM eServer pSeries® | AIX 5L Version 5.1 or later<br>Red Hat Enterprise Linux 3 (RHEL 3), SUSE Linux Enterprise Server 8 (SLES 8), and SLES 9 |
| Wintel and xSeries | Microsoft® Windows 2000 (build 2195 or later), Windows 2003 (build 3790 or later), Linux RHEL 3.0, SLES 8 SP3, and SLES 9 |

| Platform | Minimum supported levels |
|---|---|
| IBM eServer pSeries or IBM eServer zSeries® for Linux | SLES 8 SP3 and SLES 9 |
| HP | HP-UX 11.0, 11.i (64 bit), 11.23i, and 11.23pi |
| Sun | Solaris™ 8 and 9 |

i5/OS supports hardware attachment of the TS7510 via Fibre Channel Tape Controller (Adapter) features: #2765, #5704, or #5761, i5/OS V5R2 and later. Support under i5/OS is available as a request for price quotation (RPQ). RPQ level support indicates limited availability of the support and there are currently some restrictions in that support under i5/OS.

For information about how to order this RPQ, refer to 4.1.3, “Ordering information” on page 51.

For a summary of restrictions under i5/OS, see 1.6, “TS7510 support restrictions under i5/OS”.

The IBM Virtualization Engine TS7510 represents to i5/OS one or more virtual tape libraries each with one or more virtual tape devices, as though they were a real physical tape library and attached tape device.

You define one or more virtual tape libraries and tape devices within each tape library through the Virtualization Engine for Tape Console interface, connected to the TS7510 itself. When defined and the physical Fibre Channel cables are correctly attached between the TS7510 and the corresponding i5/OS Fibre Channel adapter, the system detects the new configuration objects. The only way to verify that a media tape library definition under i5/OS is virtual rather than real is to compare the library device’s serial number under i5/OS (Work with Hardware Resources (WRKHDWRSC) command - Type(*STG)) with the serial number of the virtual library and devices that can be seen using the Virtualization Engine for Tape Console.

See the succeeding chapters for specific virtual tape libraries and tape devices that are supported and how to see what is defined to each i5/OS partition.

### Advantages and disadvantages of using external virtual tape TS7510

Because the virtual tape library and virtual tape devices are reported to i5/OS as real libraries and devices, all i5/OS and BRMS interfaces to tape library devices are supported.

Therefore, almost all of the advantages of the internal i5/OS virtual tape support and the use of tape libraries are available to the i5/OS user except those unique to the “saved tape image catalogue volumes” such as file transfer and switching iASPs to a second system.

The primary unique advantages of using the TS7510 virtual tape support include:

- Supported i5/OS releases include V5R2, V5R3, and V5R4.
- The virtual tape configuration is treated as a real tape library configuration objects, no special “image catalog” interfaces.
- The saved data requires no additional disk space to be managed by an administrator of the i5/OS partition.
- Saved and restored data can be from multiple i5/OS systems and partitions as well as different operating systems and hardware platforms.

- A single save, restore, and management of saved data interface for multiple operating systems.
- The TS7510 offers copy or replication functions, which provide additional protection of a virtual volume. These functions are set up and managed using the Virtualization Engine for Tape Console. We provide additional details on these functions in 2.7.5, “Network Replication” on page 28.

  Use of these TS7510 capabilities with i5/OS has some restrictions. See 1.6, “TS7510 support restrictions under i5/OS” on page 13.

The primary disadvantages include:

- You have to order and maintain a new hardware set of rules and learn a new interface to create virtual tape configurations and manage the TS7510’s disk storage.
- You have to understand when to use real tape support versus virtual tape support.
- At this time, you have limited ability to specify how saved data is spread across the physical disk devices within the TS7510.

You have to develop new expertise for managing the disk storage within the TS7510 and coordinate the tracking of TS7510 to real tape and real tape to the TS7510 for recovery purposes with any backup and recovery management product on the various operating systems that had the originally saved data.

> **Important:** In the industry, it is common to find statements advocating not to attach a real physical tape device to any hardware virtual tape configuration. This is primarily due to the recommendation to keep any operating system tape management and backup application in full control of the location of the cartridge and backup data. The TS7510 and most of the other virtual tape offerings have export and import capabilities as well as network replication capabilities that tape and backup management software is not aware of. Therefore, you have to specifically plan your recovery process to address using the duplicated data in any recovery process.
>
> Note that at the currently available hardware and software levels, there are usage restrictions in this area when using the TS7510 with i5/OS. See 1.6, “TS7510 support restrictions under i5/OS” on page 13, for more information.

The virtual tape system’s duplication functions can be put to effective use or not used. You will have to review the product documentation and the information in 1.6, “TS7510 support restrictions under i5/OS” on page 13, to determine best practices in your operating environment.

An example of what can happen when using the TS7510 duplication capabilities is that you can end up with more than one media with identical volume serial numbers. Without proper planning, this can cause problems to any tape management and backup recovery product, including Backup and Recovery Media Services for iSeries.

Additional i5/OS-based information in this area is provided in the following chapters:

- Chapter 2, “Description and terminology of the TS7510” on page 15
- Chapter 3, “Planning for i5/OS and the TS7510” on page 35
- Chapter 6, “i5/OS, BRMS, and TS7510 in action examples” on page 129

The information in these chapters can help ensure that you understand the need to keep management software such as BRMS “in synch” with any management of the data saved to the TS7510, within the TS7510, including:

- Standard saved files and tape volumes stored within the TS7510’s logical units (LUNs) - logical disks
- Movement of TS7510 volumes and files within its virtual vault
- Movement of saved volumes and files between the virtual vault and actual tape devices that i5/OS is unaware of (attached to the TS7510)

> **Note:** Whether you save and restore using the i5/OS internal virtual tape volumes or the TS7510 volume, you still have to consider having specific critical recovery data stored on a physical tape volume that can be secured in a safe place for disaster recovery purposes.
>
> Also, keep in mind that for large objects of data, both IBM 3592 and LTO3 are faster than the TS7510 in an environment where the system resources and operating system software can deliver the data “fast enough” to achieve the rated physical tape throughput. With critical restore scenarios, the system and software must also be ready to read the data as fast as possible from either a virtual tape environment or a real tape environment.
>
> Virtual tape may be your best choice for other save and restore scenarios, such as:
>
> - Many small objects
> - Many intermediate sized objects
> - Needing to write to multiple tape devices at the same time
>
> Note that a single TS7510 configuration has more bandwidth than a single 3592 or LTO3, allowing more aggregate throughput when multiple saves are occurring during the same time period to multiple virtual tapes.
>
> When considering use of the IBM Virtualization Engine TS7510 with one or more i5/OS partitions, read the remainder of this book and do careful assessment of your save and restore scenarios. You should also read at least the following IBM Redbooks:
>
> - *i5/OS V5R4 Virtual Tape: A Guide to Planning and Implementation*, SC24-7164
> - *IBM Virtualization Engine TS7510: Tape Virtualization for Open Systems Servers*, SG24-7189
>
> Apply the content to your own working environments.
>
> And, always test your save and restore processes, especially the recovery scenarios, before the restore is necessary for successful business operations.
>
> In Appendix A, “Sizing and performance examples” on page 281, given the time constraints of the residency to produce this book, we completed some performance tests that should help you determine performance expectations for using i5/OS internal virtual tape support or external virtual tape support using the TS7510. Keep in mind, however, the data and object attributes of our test cases may be significantly different from your environment.

## 1.6 TS7510 support restrictions under i5/OS

Typically, RPQ level support means that there are restrictions of some kind. We list the most significant functional considerations here:

- You use the TS7510's Virtualization Engine for Tape Console interface to define a virtual tape library and associated virtual tape devices. i5/OS performs standard auto device detection during startup and controller or device varyon processing. For recognized TS7510 configurations, the machine type, model, and density values do not match those of the emulated devices. The emulated devices support only their native density. For example, reported density might be *FMT3592P2, rather than *FMT3592A1 or *FMT3592A2. This is different from a real tape device. The reported density value or special i5/OS parameter values of *DEVTYPE or *CFGTYPE result in functions working properly.
- When using the Virtualization Engine for Tape Console interface during TS7510 setup, you might see a screen option titled "AS/400 mode." This option does no specific setup for i5/OS support.
- The device serial numbers generated by the TS7510 do not meet the requirements for i5/OS attachment. In a "dynamic SAN configuration environment," where cable attachments may be moved and multiple sets of virtual tape libraries and virtual devices configured on the TS7510, this can lead to i5/OS having multiple virtual tape library and virtual tape device objects configured, when only one set is desired.

  As a result, this might cause confusion when mapping the i5/OS tape device descriptions to the associated TS7510 virtual tape objects shown using the Virtualization Engine for Tape Console interface. This can impact identifying a device for normal use or for alternate installation.

  We describe this situation in this book in the following sections:

  – 5.5.1, "Recognition of a virtual tape library using i5/OS commands" on page 108
  – 5.5.3, "Recognition of a virtual tape library using iSeries Navigator" on page 113
- The TS7510 may have attached real tape devices. i5/OS has no knowledge of those tape devices or of any operations performed to those tape devices. Using the Virtualization Engine for Tape Console interface, data stored on the TS7510 may be *exported* to a media on one of those attached tape devices. i5/OS does not support accessing the data on that media.

  If you want i5/OS data saved to the TS7510 to be placed on a real tape media, you can use either the i5/OS Duplicate Tape (DUPTAP) command or the corresponding BRMS Duplicate Media using BRM (DUPMEDBRM) command.

2

# Description and terminology of the TS7510

This chapter introduces the IBM Virtualization Engine TS7510 capabilities, and its hardware and software components and associated terminology.

The succeeding chapters introduce the IBM System i and i5/OS view of the IBM Virtualization Engine TS7510 when it is attached to an i5/OS partition.

## 2.1 IBM Virtualization Engine TS7510 overview

There is an ever increasing requirement for fast save, fast restore, and backup of large consolidated systems and servers with a unified management for all these platforms. As the functions in this area expand, new backup approaches have emerged. Many of them employ backup and recovery between system disks and external media, such as via a tape device and also system disk to system disk. In high availability and disaster recovery needs, the backup copy of data is typically replicated to another disk configuration.

In the real world, although there is more emphasis on multiple systems or single large system environments to use *disk to disk*, there is still the need to back up and recover using real tape devices and media.

The IBM Virtualization Engine TS7510 fits well into these environments, emphasizing system disk to disks with a virtual tape interface to the client operating systems, while still allowing flexibility for use of tapes as part of the overall backup process.

The IBM Virtualization Engine TS7510 (sometimes also referred to as the TS7510 Virtualization Engine) was the first member of the IBM Virtualization Engine TS7000 Series of *virtual tape libraries*. The TS7510 Virtualization Engine combines hardware and software into an integrated solution designed to provide tape virtualization for open systems servers connecting over Fibre Channel (FC) physical connections.

The TS7510 Virtualization Engine combines IBM server and disk technology and is designed to virtualize or emulate tape libraries, tape drives, and tape media. Real tape resources can then be attached to the TS7510 Virtualization Engine to help address information lifecycle management and business continuance. In some environments, real tape devices can also be configured directly to a system for backup recovery purposes.

Through the implementation of a fully integrated tiered storage hierarchy of disk and tape, the benefits of both technologies can be leveraged to help enhance performance and provide the capacity required for today's tape processing requirements. Deploying the IBM Virtualization Engine TS7510 should help reduce batch processing time, total cost of ownership (TCO), and management overhead.

From an i5/OS viewpoint, we see the IBM Virtualization Engine TS7510 as a good choice for disk to disk backup and recovery operations with multiple systems or logical partitions present, with multiple operating systems present including i5/OS, AIX, Linux, and Windows operating systems.

The IBM Virtualization Engine TS7510 enables the system disk to external disks approach over a FC-based network. It contains disk drives and virtualization software that emulates and manages virtual tape libraries within the TS7510 itself.

A System i partition running i5/OS and other open systems connected to the TS7510 see these virtual tape libraries and tape devices as physical tape libraries and devices. Thus, their normal backup and recovery management software uses standard tape library interfaces.

Because backup operations to virtual tape library go to disk, we expect most save, restore, and tape management functions to be faster than with a physical tape library. However, having saved data on tape is more reliable than having them on disk. Therefore, we state one more time in this book, we strongly recommend that you copy critical recovery data from virtual tapes (residing on disk) to real tapes. We discuss this issue, where appropriate, throughout this book.

Another advantage of the TS7510 is that you can define multiple virtual tape libraries (up to 128), which drastically increases the flexibility for backing a up large number of systems or partitions using only one *physical device*.

In the following sections, we describe the parts of TS7510, placing the parts in a rack, and ways to connect a TS7510 to an i5/OS partition. In this chapter, we describe the primary physical *enclosures* that make up the TS7510 hardware configuration. In Chapter 5, “Installation and basic setup” on page 67, we provide more detailed diagrams of these enclosures and connections.

The TS7510 combines IBM server technology, disk technology, and tape technology, and is designed to virtualize or emulate tape libraries, tape drives, and tape media. The TS7510 has the following advantages:

- Helps to reduce backup window
- Helps to improve the entire restore process
- Facilitates data sharing
- Low total cost of ownership
- Throughput is superior in saving many small objects

Here are some of its highlights:

- Up to 128 virtual libraries per system (single system, single server, single logical partition)
  - Designed to allow each backup system to allocate its own virtual library
- Up to 1024 virtual drives per system
  - Designed to allow for a substantial number of mount points for very high performance
- Up to 8,192 virtual cartridges per system
  - Designed to allow for substantial number of virtual cartridges, allowing for capacity on demand growth
- Up to 1024 concurrent backups per system
  - Designed to allow multiple backup/restore jobs to run simultaneously on a single TS7510 for high performance and infrastructure simplification. The maximum number of concurrent backup/restore jobs is determined by the number of virtual tape devices defined and the system and the capability of the software performing the backup/restore to issue input/output (I/O) operations to all the defined virtual tape drives.
- 2:1 compression capability
  - Provides up to 92 terabytes (TB) cache physical capacity at 2:1 compression
- Support for major operating systems and hardware platforms
  - Supports your diverse information technology (IT) infrastructure
- 4 FC ports for host/tape attachment per CV5 8 FC ports if two CV5s are configured
  - High FC port count is designed to offer low independent software vendor (ISV) costs
- Optional IP remote replication function, with optional compression and encryption
  - Designed to allow for remote disaster recovery site copies. Designed to allow for electronic vaulting, with high security features using encryption
- Dual node server with failover/failback capacity
  - Designed to provide for automatic server failover and failback for high-availability requirements

- Dual core 3.0 GHz processors
  – High CPU speeds and dual processors address processor-intensive functions such as compression/encryption with minimal performance impact

Figure 2-1 shows a base frame in which the IBM Virtualization Engine TS7510 components reside. The following sections describe these components and most of the optional features.

*Figure 2-1 Single frame IBM Virtualization Engine TS7510*

> **Note:** The IBM Virtualization Engine TS7700 (also called the TS7700 Virtualization Engine) was announced in mid 2006. It is the newest member of the IBM Virtualization Engine TS7000 Series of virtual tape libraries. Having greater internal processor power, disk capacities, and advanced technologies, compared to the TS7510, it is intended as a mainframe virtual tape solution designed to optimize tape processing.
>
> The TS7510 is intended for smaller scale capacities and performance characteristics at a price level that is a more viable option (relative to the TS7700) within the backup and recovery options of many small and medium businesses (SMBs).

## 2.2 TS7510 Virtualization Engine: 3954 Model CV5

TS7510 Virtualization Engine (3954 Model CV5) is a member of the xSeries family of servers. The Peripheral Component Interconnect (PCI) slots 1 through 4, shown in Figure 2-2, contain the dual ported QLogic (QLA2342) Fibre Channel adapters with Lucent Connectors (LC). The 3954 Model CV5 is a modified xSeries 346, 8840-A5U, with the following features:

- 2 GB memory
- Two 3.0 GHz processors
- Two FC cards each with 2 ports (FC initiators) to connect to disks

  An FC initiator is the device that initiates input/output activity through an FC link at initial connection and at each subsequent communication. For example, an FC adapter in a host server is an FC initiator.

- Two FC cards, each with two ports, that can connect to host servers (as FC targets) or to physical tape drives in a tape library (as FC initiators)

  An FC target is the device that receives input/output activity through an FC link at initial connection and at each subsequent communication. For example, a storage device is an FC target.

- Dual AC Power units
- No disk drive (boots from 3955-SV5)
- DVD/CD, FDD
- Light Path Diagnostic panel
- 2 Gigabit Ethernet ports
- Remote Supervisor Adapter (RSA)
- RS485 Ports 1 and 2 unused in this configuration
- TS7510 Virtualization Engine runs Linux

The TS7510 Virtualization Engine 3954 Model CV5 is shown in Figure 2-2. A rear view of the 3954 Model CV5 installed in the IBM lab in Rochester is shown in Figure 2-3.

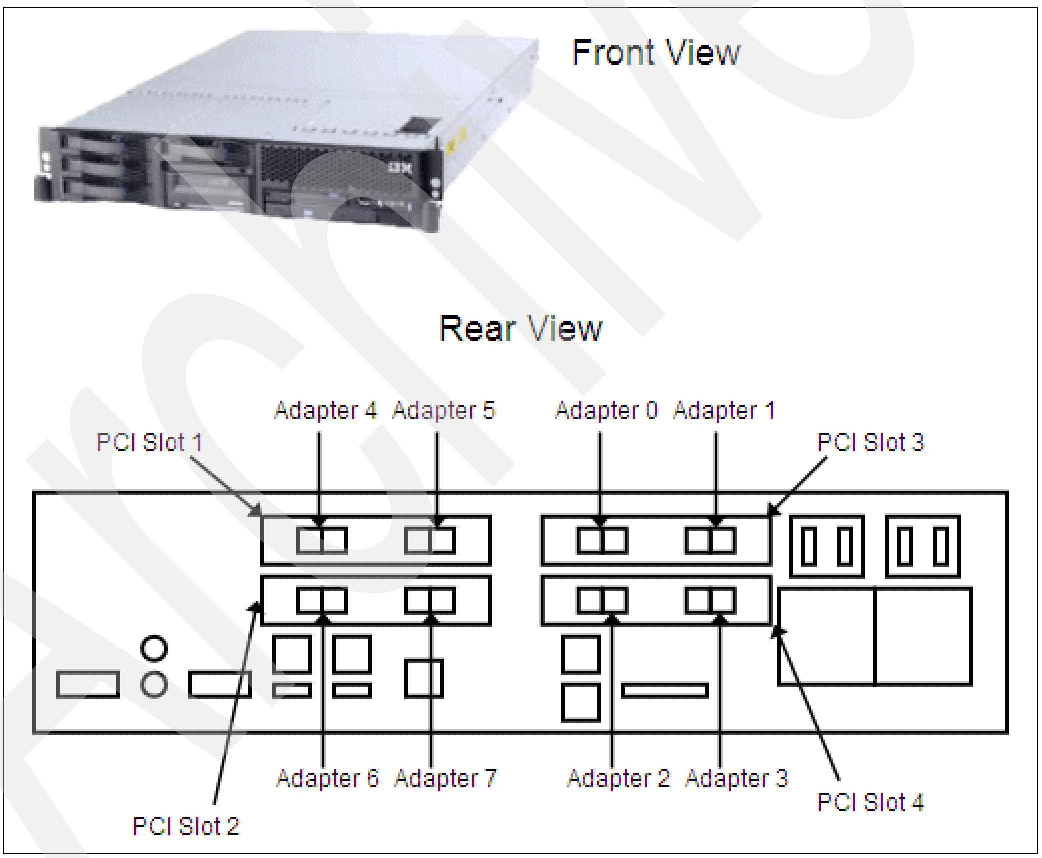



*Figure 2-2 Virtualization Engine CV5*

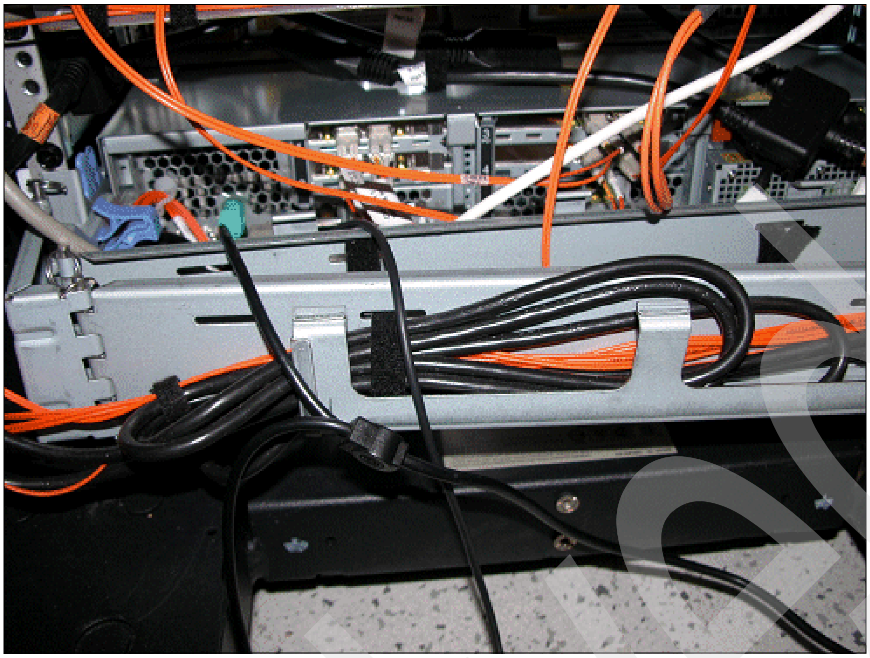


*Figure 2-3 3954 Model CV5: Rear view in the lab in Rochester*

We provide more details about attaching the cables in Chapter 5, "Installation and basic setup" on page 67.

> **Note:** In this book, we refer to the TS7510 Virtualization Engine, as either a *3954 Model CV5*, or just as a *CV5*.

For more information about Fibre Channel topology, refer to the IBM Redbook *IBM SAN Survival Guide*, SG24-6143.

Emulation of virtual tape libraries happens partially in the Linux software in the CV5 and partially in the microcode within the FC adapters that connect to host servers.

## 2.3 TS7510 Cache Controller: 3955 Model SV5

The 3955 Model SV5 is a modified IBM TotalStorage® DS4100 disk system. For the 3955 Model SV5, IBM has configured the dual controller model of the TotalStorage DS4100, providing 14 internal 250 GB Serial Advanced Technology Attachment (SATA) disk drives inside every controller. The 3955 Model SV5 can provide ample yet scalable storage for the IBM Virtualization Engine TS7510. There are four 2-gigabit Fibre Channel ports to attach to the 3954 Model CV5 on dual controllers. Two 3955 model SV5s are built into every IBM Virtualization Engine TS7510 configuration.

The 3955 Model SV5, shown in Figure 2-4, consists of the following components:

- IBM TotalStorage DS4100
- Fourteen 250 GB SATA disk drives, Redundant Array of Independent Disks 5 (RAID-5) protection on arrays of seven disk drives
- Dual array controllers
- Dual AC Power

- Fibre Channel host ports 1 and 2 connected to CV5
- Fibre Channel expansion ports connected to expansion unit SX5

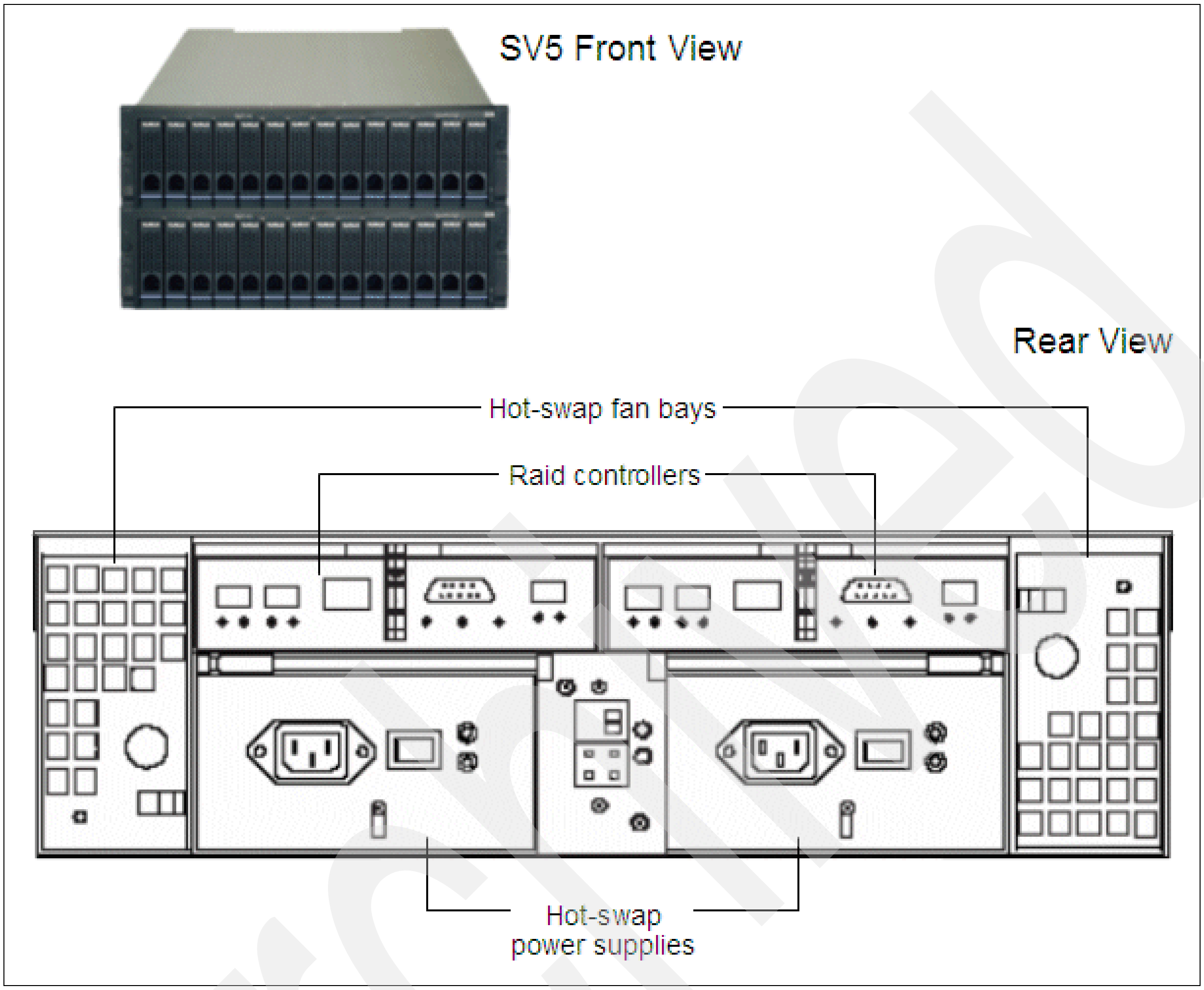



*Figure 2-4 3955 Model SV5*

A 3955 Model SV5 installed above 3954 Model CV5 in the IBM lab in Rochester is shown in Figure 2-5.

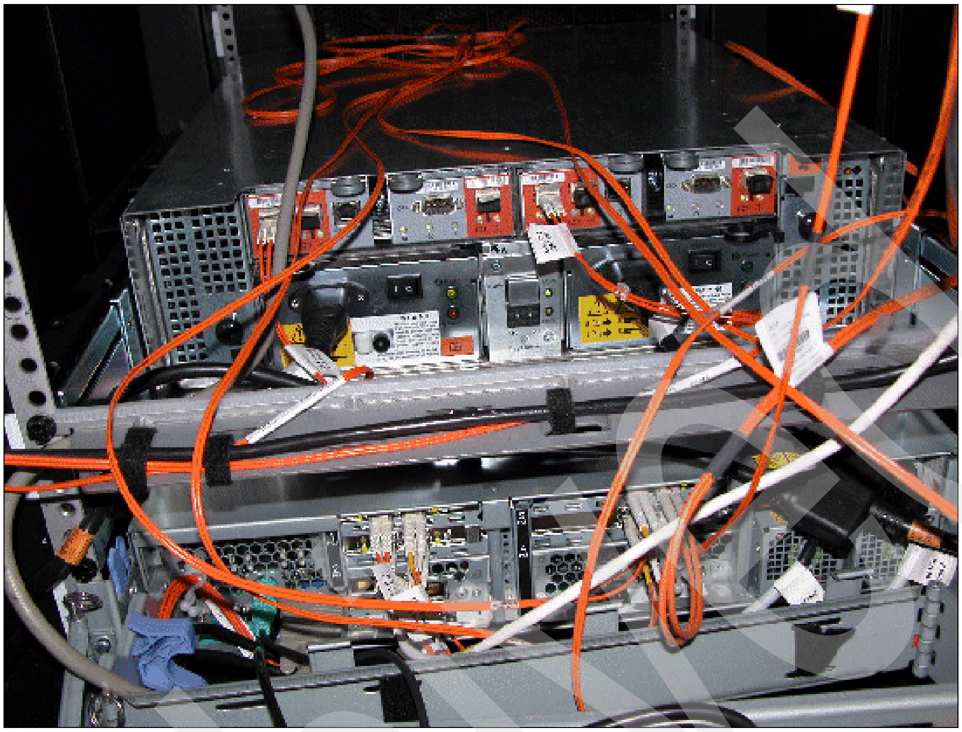


*Figure 2-5 3955 Model SV5 and 3954 Model CV5 in the lab in Rochester*

We provide more details about attaching the cables in Chapter 5, “Installation and basic setup” on page 67.

> **Note:** In this book, we refer to TS7510 Cache Controller as a *3955 Model SV5*, or just as an *SV5*.

For more information about TotalStorage disk system DS4100, refer to *Fibre Array Storage Technology A FAStT Introduction*, SG24-6246, and *Introducing IBM TotalStorage FAStT EXP100 with SATA Disks*, REDP-3794. Note that Disk system DS4100 was formerly known as FAStT100.

## 2.4 TS7510 Cache Module: 3955 Model SX5

The 3955 Model SX5 is the disk expansion drawer associated with the 3955 Model SV5. It is an IBM TotalStorage DS4000™ EXP100 Expansion unit.

The new 3955 Model SX5 is a rack-mountable enclosure configured with fourteen 250 GB SATA disk drive modules, offering up to 3.5 TB of raw capacity per enclosure. The IBM Virtualization Engine TS7510 configured capacity of each SX5 drawer is 3.0 TB usable. The 3955 Model SX5 consists of the following components:

- IBM TotalStorage DS4000
- Fourteen 250 GB SATA Hard Disk Drives (disk drives)
- Dual Enclosure Service Modules
- Dual AC Power

The SX5 connects to an existing SX5 or SV5 as shown in Figure 2-6.


*Figure 2-6 3955 Model SX5*

**Note:** In this book, we refer to the TS7510 Cache Module, as a *3955 Model SX5*, or just as an *SX5*.

## 2.5 Frames

The Tape Frame 3952 Model F05 is the 19-inch rack that contains components of the IBM Virtualization Engine TS7510, that is, CV5, SV5, and SX5. A single IBM Virtualization Engine TS7510 can consist of one or two 3952 model F05 frames.

One 3952 Model F05 comes with every configuration of IBM Virtualization Engine TS7510. It is referred to as the base unit. If a configuration of IBM Virtualization Engine TS7510 contains more than six 3955 Model SX5, a second 3952 model F05 is required. The second 3952 Model F05 is referred to as the *expansion unit*.

The 3952 Model F05 is shown in Figure 2-7. A Tape Frame 3952 Model F05 installed in the IBM lab in Rochester is shown in Figure 2-8.


Figure 2-7 3952 Model F05

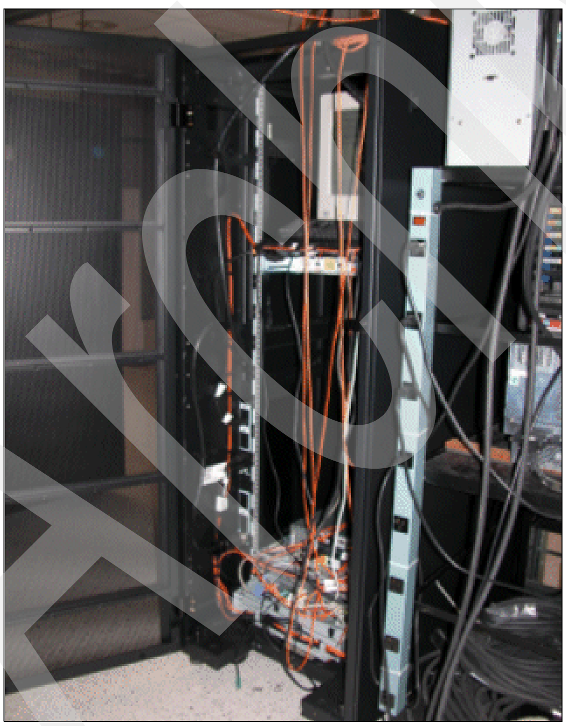


Figure 2-8 3952 Model F05 in the lab in Rochester

**Note:** In this book, we refer to a tape frame 3952 Model F05, as a *3952 Model F05*.

A logical representation of the CV5 and SV5 enclosures within the 3952 Model F05 frame is included in Figure 2-12 on page 33.

## 2.6 Disk drives and logical volumes

Serial Advanced Technology Attachment (SATA) disk drives in 3955 Model SV5 and 3955 Model SX5 are protected by RAID-5. Each 3955 Model SV5 and 3955 Model SX5 contains 14 SATA disk drives of size 250 GB, which are divided in two RAID-5 arrays of seven disk drives. Up to fourteen 3955 Model SX5 can be installed in IBM Virtualization Engine TS7510, six of them in TS7510 base frame and eight of them in TS7510 expansion frame. Both 3955 Model SV5, and two 3955 Model SX5 in expansion frame contain two spare disk drives.

Logical volumes (LUNs) are defined by the TS7510 itself, from each RAID array in a SV5 or SX5. LUNs in SV5 are used for boot and repository of Virtualization Engine 3954 Model CV5, and for saved data, while LUNs in SX5 are used only for saved data. For more information about how LUNs are defined, refer to Appendix A, “Sizing and performance examples” on page 281.

## 2.7 IBM Virtualization Engine TS7510 software

The IBM Virtualization Engine TS7510 Software Version 1 Release 1 5639-CC7, provides the software for IBM Virtualization Engine TS7510 and the software for management console, Virtualization Engine for Tape Console. 5639-CC7 provides tape library and tape drive emulation, including emulation of tapes (cartridges).This support includes the following features:

- Emulation
- Compression
- Import and export
- Network replication
- Virtual vault
- The management console interface to these features

These functions and terms are explained in the following sections.

### 2.7.1 Emulation of tape libraries, tape drives and tapes

IBM Virtualization Engine TS7510 creates a virtual copy of the IBM 3584 tape library. In IBM Virtualization Engine TS7510, you can configure a virtual 3594 with any tape drive and slot configuration that is suitable for your backups. You can configure up to 128 virtual tape libraries in a IBM Virtualization Engine TS7510.

Within a virtual tape library, you can configure virtual tape drives that look like the following tape drives:

- IBM Liner Tape-Open (LTO) Generation 2 tape drives
- IBM Liner Tape-Open (LTO) Generation 3 tape drives
- IBM 3592 model J1A tape drives

Up to 1024 virtual tape drives can be configured in the IBM Virtualization Engine TS7510.

Within a virtual tape library, you can configure virtual tapes. The size of virtual tapes is flexible: Initially, the capacity of each virtual tape is 5 GB, but as the data is saved on it, its capacity increases in increments of 5 GB or 7 GB until it reaches the capacity of emulated cartridge. The following tapes can be emulated in IBM Virtualization Engine TS7510:

**LTO Generation 2** Starting size is 5 GB, with an incremental growth of 5 GB, until it reaches the size of 200 GB

**LTO Generation 3** Starting size is 5 GB, with an incremental growth of 7 GB, until it reaches the size of 400 GB

**IBM 3592** Starting size is 5 GB, with an incremental growth 5 GB, until it reaches the size of 300 GB

Up to 8192 virtual tapes can be defined in the IBM Virtualization Engine TS7510.

The following lists some “maximums” supported on a single, fully configured TS7510 (“system”):

- Maximum virtual tape libraries: 64 virtual libraries per node, 128 virtual libraries per system
- Maximum number of virtual tape drives: 512 per server node; 1,024 per system
- Maximum number of virtual tape cartridges: 4,096 per server node; 8,192 per system
- Maximum number of concurrent backups: Up to the number of virtual tapes defined
- Maximum storage per system: 96 TB, presuming 2:1 compression

Virtual tape libraries, tape drives and tapes are managed through Virtualization Engine for Tape Console, described further in this chapter.

## 2.7.2 Virtual vault

The virtual vault is a storage area for virtual tapes that are not inside a virtual tape library. This enables virtual tapes to be exported from a virtual library defined in the TS7510 without necessarily being immediately deleted.

Using the Virtualization Engine for Tape Console interface, a virtual tape in the virtual vault can be:

- Imported into any defined virtual library within the TS7510
- Copied to a remote TS7510 or a physical tape library or drive
- Permitted to remain in the virtual vault indefinitely
- Aged out of the vault according to a user-defined policy
- Deleted immediately

The number of tapes that can be stored in the virtual vault is limited only by the available disk storage of the TS7510 configuration. Virtual tapes will only appear in the virtual vault after they have been moved from a virtual tape library. Tapes in the vault are sorted in barcode order.

> **Important:** The tape management software under i5/OS, such as Backup Recovery and Media Services (BRMS), is unaware of any actions taken on a virtual tape within the virtual vault, when that action is performed though the IBM Virtualization Engine TS7510.
>
> See 2.7.4, “Import, export, auto archive” on page 27 for information about when BRMS causes a virtual tape to move to a vault and thus knows about the move.

## 2.7.3 Data compression

Compression is an option of a backup operation. You can turn on or turn off compression using the Virtualization Engine for Tape Console. With compression turned on, a virtual tape drive will look to host as a real tape drive capable of hardware compression.

When using compression in IBM Virtualization Engine TS7510, consider that it might significantly decrease performance, while saving disk space within the IBM Virtualization Engine TS7510.

## 2.7.4 Import, export, auto archive

Import and export functions provide:

- Importing tapes from a physical tape library attached to IBM Virtualization Engine TS7510 to a virtual tape library
- Exporting tapes from a virtual tape library to the attached physical tape library

By using Virtualization Engine for Tape Console, you can import a tape from a physical tape library to any slot within a virtual tape library. With import, you can choose one of the following options, depending on the requirements for imported tape:

- Copy the entire tape to virtual tape library
- Use a physical link to a physical tape library and actually read from the physical tape
- Copy only the first 10 MB of physical tape

To export the virtual tape to a physical tape drive, the virtual tape must already be in a virtual vault. From an i5/OS and BRMS viewpoint, a virtual tape is moved to a virtual vault when ejected by BRMS or another backup management software product not running on i5/OS. You can also move a virtual tape to the virtual vault by using Virtualization Engine for Tape Console.

From the virtual vault, you can export the virtual tape to physical tape by using Virtualization Engine for Tape Console. When exporting, you can choose to retain the virtual tape for a certain amount of days, or delete it immediately after copying to physical tape.

Auto archive option is an automatic export performed when BRMS (or another backup software) ejects the virtual tape. You can set up auto archive so that a virtual tape is retained for a certain amount of days after being exported, or deleted immediately after export.

As discussed in the **Important** text box on page 11, you have to carefully consider how to best use the TS7510's capability to duplicate saved data onto a tape device, outside of any tape and backup management application, such as BRMS.

Remember that currently any tape and backup and recovery management products have no automated way of tracking these activities. Because most of these products expect to *own all such activities*, a volume with a duplicate volume serial number might cause problems with the recovery processes presumed by these products.

In this book, we assume all backup functions have been performed using BRMS.

### 2.7.5 Network Replication

Replication (feature 7421(Network Replication)) is a process that protects the data on a virtual tape by maintaining a remote copy of the virtual tape on another IBM Virtualization Engine TS7510 connected to the first one over the IP network. If this feature is installed on one TS7510 Virtualization Engine CV5 in a 3952 Tape Frame, and a second TS7510 Virtualization Engine CV5 is installed in that frame, then both TS7510 Virtualization Engines should have this feature installed.

We refer to the first IBM Virtualization Engine TS7510 as primary and to its tapes as primary tapes. We refer to the other as the target and to its tapes as target tapes.

At prescribed intervals, when the tape is not in use, changed data from the primary virtual tape is transmitted to the copy of primary tape called *replica resource* on the target server so that they are synchronized. The target server 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.

The following three methods are used to replicate tapes to a target IBM Virtualization Engine TS7510:

**Auto Replication** When Auto Replication is enabled for a particular tape, this tape is copied to the specified target TS7510 as soon as it is ejected to the virtual vault.

**Remote Copy** You initiate Remote Copy of a particular tape by using the Virtualization Engine for Tape Console. The full tape including barcode is replicated to the target site. From a BRMS viewpoint, the target of the copy must not contain a virtual tape cartridge with the same barcode identifier.

**Replication** The Replication process is either triggered by a scheduled event or when the virtual volume reaches a certain predetermined size. When Replication is configured, updates made to the primary tape are immediately copied to the target tape, therefore the two tapes are always in synchronized status.

The following sections provide some overview details on Remote Copy, Replication, and Auto Replication. This information is excerpted from *IBM Virtualization Engine TS7510: Tape Virtualization for Open Systems Servers*, SG24-7189.

#### 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 TS7510 and in the Replication Vault of the remote TS7510.

You cannot perform Remote Copy on a tape that has already been configured for Auto Replication. When using Remote Copy, the copied tape can reside either in one of the virtual tape libraries, in a virtual tape drive, or in the virtual vault. The Remote Copy option preserves the barcode from the TS7510, on which the remote copy initiated.

Figure 2-9 illustrates the Remote Copy movement. The primary TS7510 is on the left, and the remote backup is on the right.

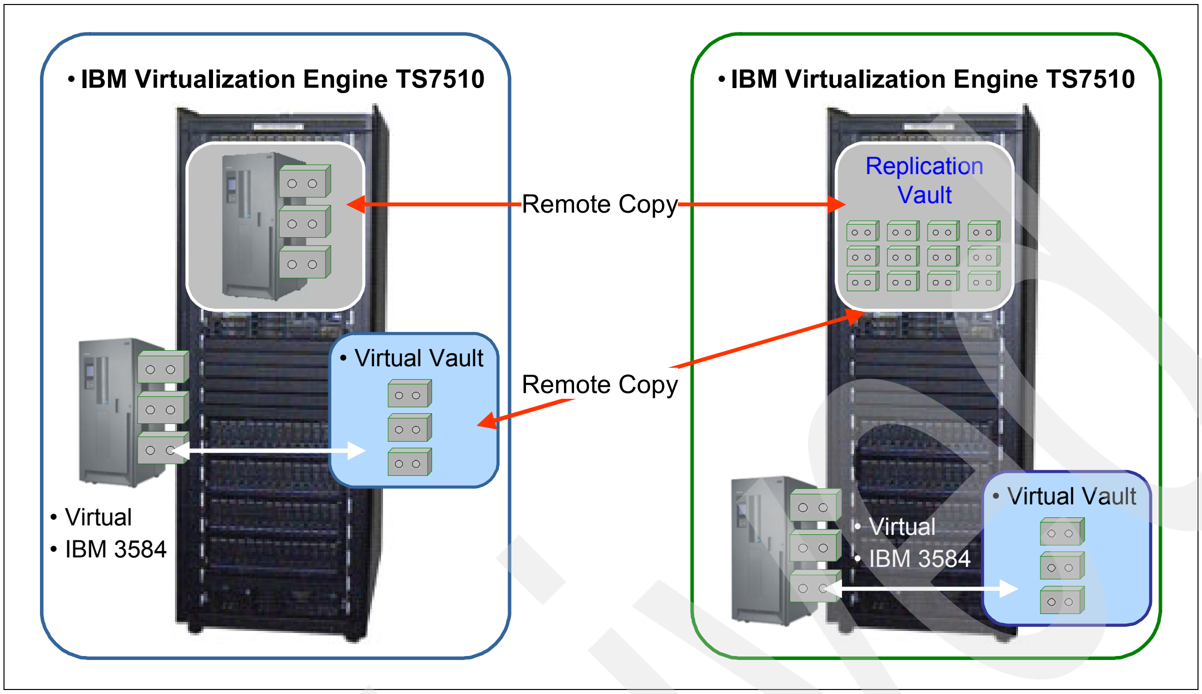



*Figure 2-9 TS7510: Remote Copy data movement*

BRMS is unaware that this function has been performed.

## Replication

The Replication process is either triggered by a scheduled event or when the virtual volume reaches a certain predetermined size. When Replication is configured, a primary virtual volume is created and linked to the virtual replica on the remote TS7510. 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 TS7510 until this linked relationship is broken. This condition is also known as *promoting a replica*. Its only purpose is to maintain an in-sync copy of the primary tape.

The replica tape simply gets incremental changes from the source tape, ensuring 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 no one else is writing to or accessing the replica), there is never a need to replicate or remote copy the entire tape at each replication interval.

Data traveling across the replication path can be compressed, encrypted, or both. Additional license codes are required to activate these features, which we explain later. If the replica is promoted, it is placed in the virtual vault on the remote TS7510, with the same barcode label as the source virtual tape. It can then be used like any other virtual tape.

Figure 2-10 illustrates replication movement. The left TS7510 is the primary engine, and the right TS7510 is the backup. Data replicates from the primary to the backup utilizing the replication process. When the primary engine fails in order to use a replica that is on the backup engine, the virtual replica sitting in the replication vault is promoted to a virtual volume and moved to the virtual vault. It is either placed in a virtual library on the backup or copied back to the primary.

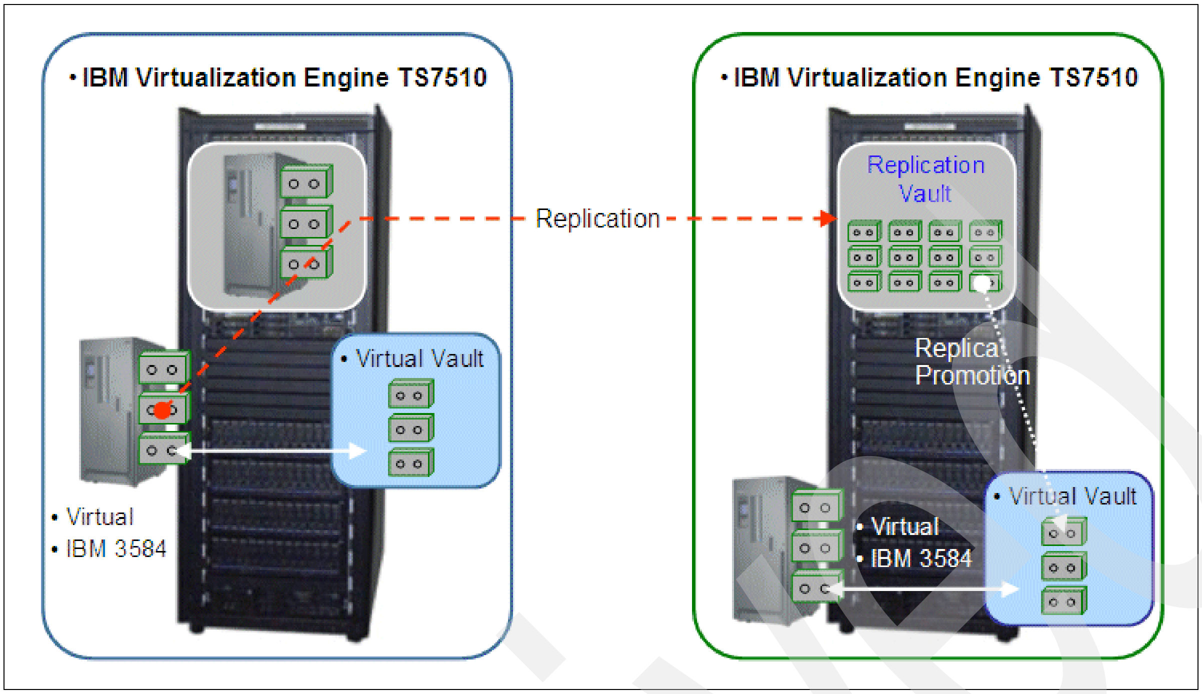



*Figure 2-10 Replication data movement*

BRMS is unaware that this function has been performed.

## Auto Replication

Auto Replication involves a one-time copy or move of the virtual tape as soon as the backup software (BRMS, in our examples in this book) has sent an **eject** command. Auto Replication provides for the same, one-time copy or move after the eject, but the destination is to the remote TS7510 instead of to a local physical 3584 or 3494 tape library.

Figure 2-11 illustrates the Auto Replication process. The left side shows the primary engine, and the right side shows the backup engine. The primary initiates the Auto Replication function. Also a one-time copy or move after the **eject** command is sent to the backup TS7510. The virtual volume is then placed in the replication vault.

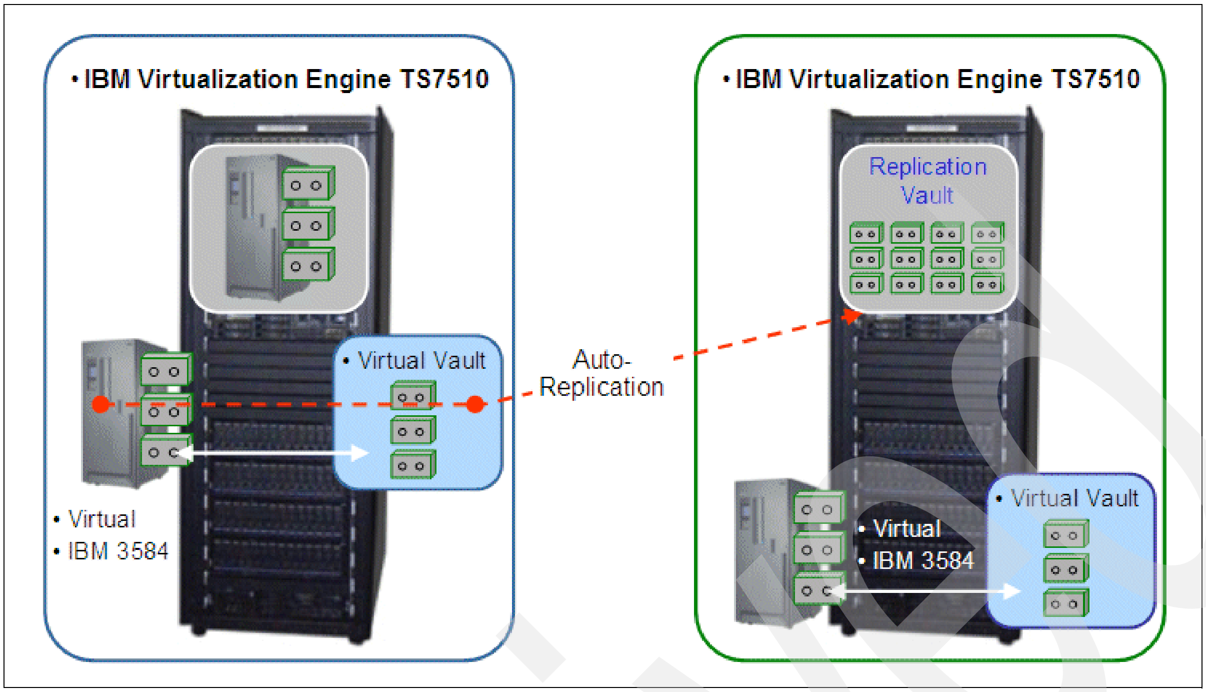



*Figure 2-11 Auto Replication data movement*

BRMS is unaware that this function has been performed.

## 2.7.6 Network Encryption

Encryption (feature 7422 (Network Encryption)) enables the TS7510 Virtualization Engine to support the Network Encryption function in the TS7510 V1R1 software. If this feature is installed on one TS7510 Virtualization Engine in a 3952 Tape Frame, and a second TS7510 Virtualization Engine is installed in that frame, then both TS7510 Virtualization Engines should have this feature installed. Both the local and target TS7510 Virtualization Engines must have feature numbers 7421 (Network Replication) and 7423 (Network Compression) enabled for Network Encryption to operate.

The Encryption option secures data transmission over the network during replication between two TS7510s. 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.

Neither i5/OS nor BRMS provide any specific support for this feature. That is, all encryption and decryption must be performed by the TS7510 itself.

## 2.7.7 Network Compression

Compression (feature 7423 (Network Compression)) enables the TS7510 Virtualization Engine to support the Network Compression function in the TS7510 V1R1 software. If this feature is installed on one TS7510 Virtualization Engine in a 3952 Tape Frame, and a second TS7510 Virtualization Engine is installed in that frame, then both TS7510 Virtualization Engines should have this feature installed. Both the local and target TS7510 Virtualization Engines must have feature numbers 7421 (Network Replication) and 7423 enabled for Network Compression to operate.

The Compression option enables compression of data during the replication process. For further information, see the *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769.

Network Compression is only used in data transfers of virtual tape volumes between the primary and remote TS7510.

Neither i5/OS nor BRMS provide any specific support for this feature.

## 2.8 Management console

The Virtualization Engine for Tape Console is the interface to the IBM Virtualization Engine TS7510. For the console, you use a PC connected to 3954 Model CV5 through Ethernet. You install management console software to this PC, and launch it. Virtualization Engine for Tape Console software uses Secure Sockets Layer (SSL) communication to the 3954 Model CV5, and in this way provides interface to IBM Virtualization Engine TS7510.

For more information about the management console, refer to:

- 4.2.1, "IBM TapeSystem Virtualization Engine for Tape Console" on page 59
- 5.2.4, "Ethernet Connection" on page 77

To provide more console interfaces to IBM Virtualization Engine TS7510, you can install Virtualization Engine for Tape Console software on any PC connected to CV5 via an IP connection, and launch it whenever the console interface to CV5 is needed.

It is your responsibility to manage which users (and their level of authorization) can use the Virtualization Engine for Tape Console at the same time.

## 2.9 Connections

An i5/OS partition is connected to IBM Virtualization Engine TS7510 through Fibre Channel adapters for tape, features #2756, #5704 and #5761. FC adapters (input/output adapters (IOAs)) in an i5/OS partition connect to Fibre Channel ports in 3954 Model CV5, and the ports have to be set up as FC targets for this.

The connection between FC adapter in a System i partition running i5/OS and FC port in the CV5 can be done in one of the following ways:

- Direct connection via a shortwave FC cable
- Connection via an FC switch, each connection between switch and FC adapter in i5/OS partition, and between switch and port in CV5, being shortwave. With this way of connection, multiple IOAs in i5/OS partition can be connected to one FC port in CV5.
- Connection via switches and inter-switch links (ISLs), connection between a switch and FC port in i5/OS partition or CV5 being shortwave, and connection between switches being longwave.

Using these ways of connecting, we can set up an environment with the IBM Virtualization Engine TS7510 connected to one or more i5/OS partitions and can be up to a 12 km distance.

A logical representation of possible IBM Virtualization Engine TS7510 connections to several i5/OS partitions is shown in Figure 2-12. Also depicted are a PC workstation with the Virtualization Engine for Tape Console software installed and a logical representation of the SV5 and CV5 enclosures within the 3952 Model F05 frame.

Figure 2-12 does not include the following *additional configurations* that could be possible with a TS7510:

- One or more "tape library devices" may be attached to the TS7510
- Other systems that support the TS7510 could also have connections to the same TS7510
- If the Network Replication feature is being used, there would be a second TS7510

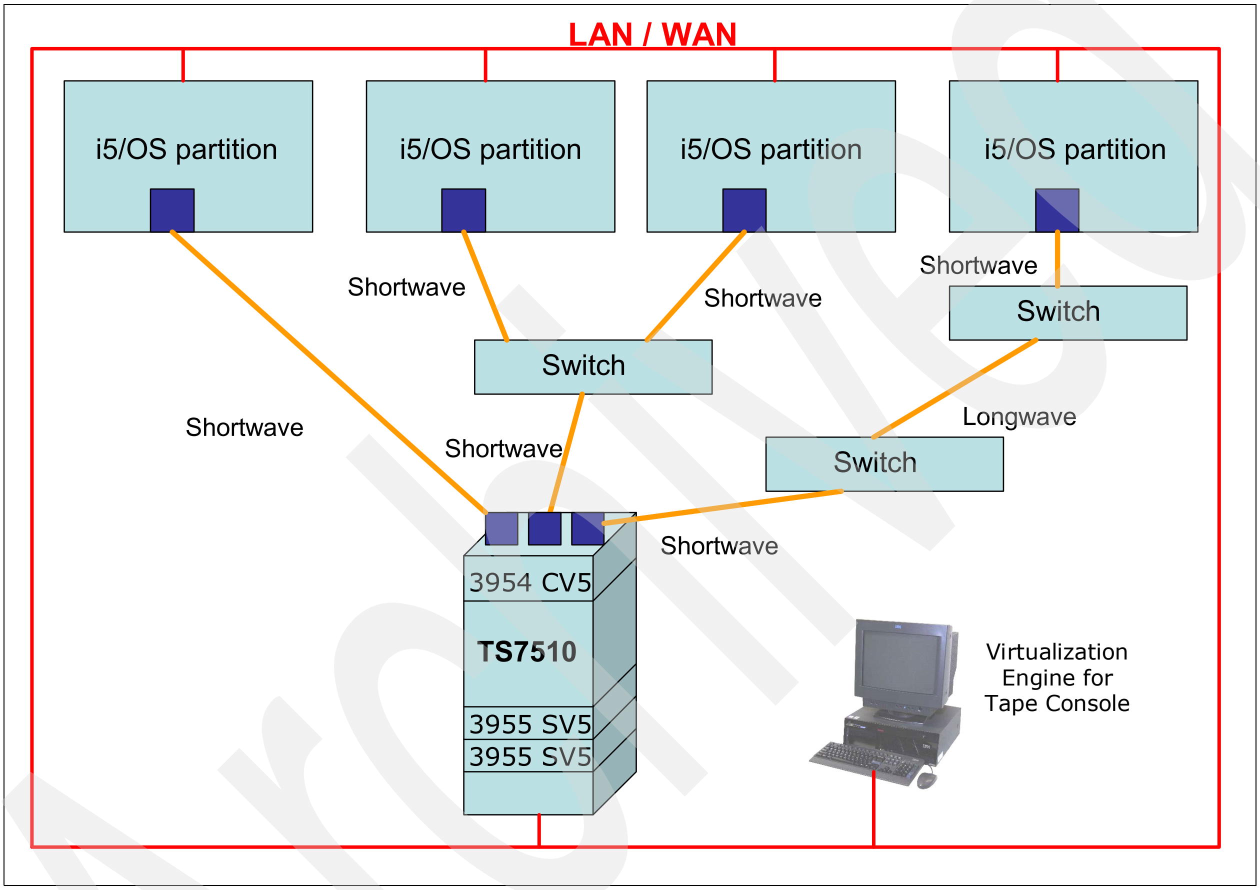



*Figure 2-12 Connecting IBM Virtualization Engine TS7510 to i5/OS partition*

For additional information about FC connection rules with a i5/OS partition, refer to:

- Chapter 3, "Planning for i5/OS and the TS7510" on page 35
- Chapter 5, "Installation and basic setup" on page 67

3

# Planning for i5/OS and the TS7510

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 chapter 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 TS7510 in your overall backup and recovery planning process.

**Attention:** In this book, we use the term i5/OS partition to mean both:

- A single partition within an IBM System i configuration running i5/OS when more than one partition might be configured.
- The entire IBM System i configuration running i5/OS when there are no specifically configured partitions. That is, the system is one i5/OS partition that owns all hardware.

## 3.1 How virtual tape library fits in with i5/OS backup and recovery strategy

This section starts with a simple list of topics to include in your backup and recovery policy, with an i5/OS viewpoint. It is not the intent of this book to describe the details of the many practical considerations you have to develop for a complete set of detailed backup and recovery processes.

Rather, this section gives you a *quick list* of things that you must consider, so we can discuss them in the context of using the IBM Virtualization Engine TS7510 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 book. 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:

- 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. Virtual tape library (VTL) may provide faster save and restore than a physical tape library in some cases, therefore, it might be a good idea to save regularly the frequently changing objects to a VTL and save entire system objects to a physical tape drive.

Note that i5/OS supports parallel and concurrent save operations to properly set up VTL configurations as it does for physical tape environments and V5R4 i5/OS virtual tape image catalog support.

Some customers who require 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 VTL, 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 TS7510 accordingly. For more information about sizing TS7510 capabilities under i5/OS, refer to Appendix A, “Sizing and performance examples” on page 281**.**

Customers with many systems or partitions might want to use VTLs to enable save of all systems in the same general save window time period, each of them to a different VTL.

All backup and recovery approaches require careful management of tapes, especially in the VTL environment because both virtual and physical tapes are used. This is especially valid for customers with many systems, each of them using VTL and physical tape library.

For examples that can help determine your processes, see 3.9, “Examples of using TS7510 with i5/OS” on page 44.

## 3.2 Planning for copying virtual tapes to physical tapes

The data on virtual tapes in TS7510 can be exported to tapes in a physical tape library attached to the TS7510, to provide long-term archiving of data. For this, the virtual tape has to be ejected by Backup Recovery and Media Services or BRMS (or backup software on non-i5/OS partitions), which moves it to a virtual vault in IBM Virtualization Engine TS7510. When the virtual tape is in the virtual vault, we can export it to physical tape by using commands from the IBM TapeSystem Virtualization Engine for Tape Console. Alternatively, we can set up to automatically export to a physical tape as soon as the virtual tape is in the virtual vault. For more information about this, refer to *IBM Virtualization Engine TS7510: Tape Virtualization for Open Systems Servers*, SG24-7189.

Presently, i5/OS does not formally support reading tape media data produced by the TS7510 writing directly to a physically attached tape device.

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.

## 3.3 Planning for failover

TS7510 provides several features internally to address failures within the 3954 Model CV5i and its disk controllers and disks. The disks within the attached 3955 Model SV5 and 3955 Model SX5 are themselves protected with Redundant Array of Independent Disks 5 (RAID-5) disk arrays.

You can purchase a dual node high availability (HA) configuration (feature 7420 (Failover/Failback)) with two 3954 Model CV5 Virtualization Engine servers. This HA configuration with the two 3954 Model CV5s comes with dual AC power within the 3952 Tape Frame Model F05 Frame. This dual mode 3954 Model CV5 configuration provides redundancy for node, disks, power, and tape/host connectivity, in case one of the 3954 Model CV5s fails.

### 3.3.1 High availability in case a path from Virtualization Engine to disk storage fails

The TS7510 is built with redundant pathing from each 3954 Model CV5 to each 3955 Model SV5.

Base configuration of TS7510 contains one Virtualization Engine CV5 and two Cache Controller SV5s. In case a path from Virtualization Engine to each controller fails, or a Cache Controller fails, Virtualization Engine still has access to disk storage within TS7510.

The same is true for high availability configuration of TS7510 where each Virtualization Engine connects to each Cache Controller with redundant paths.

### 3.3.2 Failover option (7420) of TS7510

A customer can decide for high availability configuration of TS7510, which includes two Virtualization Engines CV5, two Cache Controller SV5s, and optionally Cache Module SX5s. With this configuration, the customer can set up failover, which reduces downtime that can occur should the Virtualization Engine fail. In the failover setup, two Virtualization Engines CV5 are configured to monitor each other. If one Virtualization Engine fails, the other will take over its identity.

For more information about how to set up failover, refer to *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769.

Exactly how this feature provides high availability to a certain host server depends on the backup management software on the server. With some backup management software, the failover is transparent, but with others failover requires to restart the backup job. Given the scope of a “getting started” manual, failover scenarios are not covered in this book.

## 3.4 Planning for virtual tape libraries in TS7510

In this section, we describe the possibilities in functionality and throughput, which a TS7510 can offer. They are important for planning the number and configuration of virtual tape libraries (VTLs) used by i5/OS. We also present some suggestions for planning the VTLs.

### 3.4.1 Configuration rules for connecting TS7510 to an i5/OS partition

Tape can connect to i5/OS in Fibre Channel (FC) mode since software level V5R1; some significant improvements in FC tape attachment came with level V5R2. The following rules are valid for connecting FC tape to i5/OS since level V5R2:

- FC protocols Switched Fabric, Arbitrated Loop, and Point to Point are supported.
- Multiple FC targets and up to 16 devices are supported by one FC adapter (input/output adapter (IOA)) in i5/OS.
- When connecting via switches, a maximum of three inter-switch links are supported, one of them can be up to 10 m long, the other two can be up to 500 m long.

For more information about Fibre Channel connected tape to i5/OS, refer to:

- *The LTO Ultrium Primer for IBM eServer iSeries Customers*, REDP-3580
- *iSeries in Storage Area Networks A Guide to Implementing FC Disk and Tape with iSeries*, SG24-6220

The following rules are valid for FC and Small Computer System Interface (SCSI) attached tapes to i5/OS:

- Maximum one path is visible from i5/OS to any device.
- Every FC adapter in i5/OS must see at least one tape drive in a tape library, that has control path defined.

For more information about control path in a tape library, refer to *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946.

TS7510 is connected to i5/OS via FC adapters for tape, therefore the listed rules are valid for connection. In TS7510, a virtual tape library represents an FC device to i5/OS, therefore each FC adapter (IOA) can access up to 16 VTLs. But for performance reasons, we drastically limit this number, as is explained later in this section. Important for attachment of TS7510 to i5/OS is the fact that each VTL can have only one control path defined.

## 3.4.2 The number of tape drives in a VTL

When a physical tape library is attached to a System i partition running i5/OS, multiple FC adapters (IOAs) can connect to the tape library, each IOA to multiple tape drives in a tape library. This may be needed to achieve maximum performance for a larger number of tape drives within a given library partition.

In such a configuration, we have to define multiple controls paths, one for each set of unique tape drives. As a result, we end up with multiple TAPMLBs; each IOA will report a TAPMLB and the associated tape drives.

Vary one of the TAPMLBs on. During the varyon process, the system code searches out all drives associated with the physical tape library and then *pools* them under the TAPMLB that is being varied on. The end result is one TAPMLB with all attached drives.

An example of pooling with physical tape library is shown in Figure 3-1.

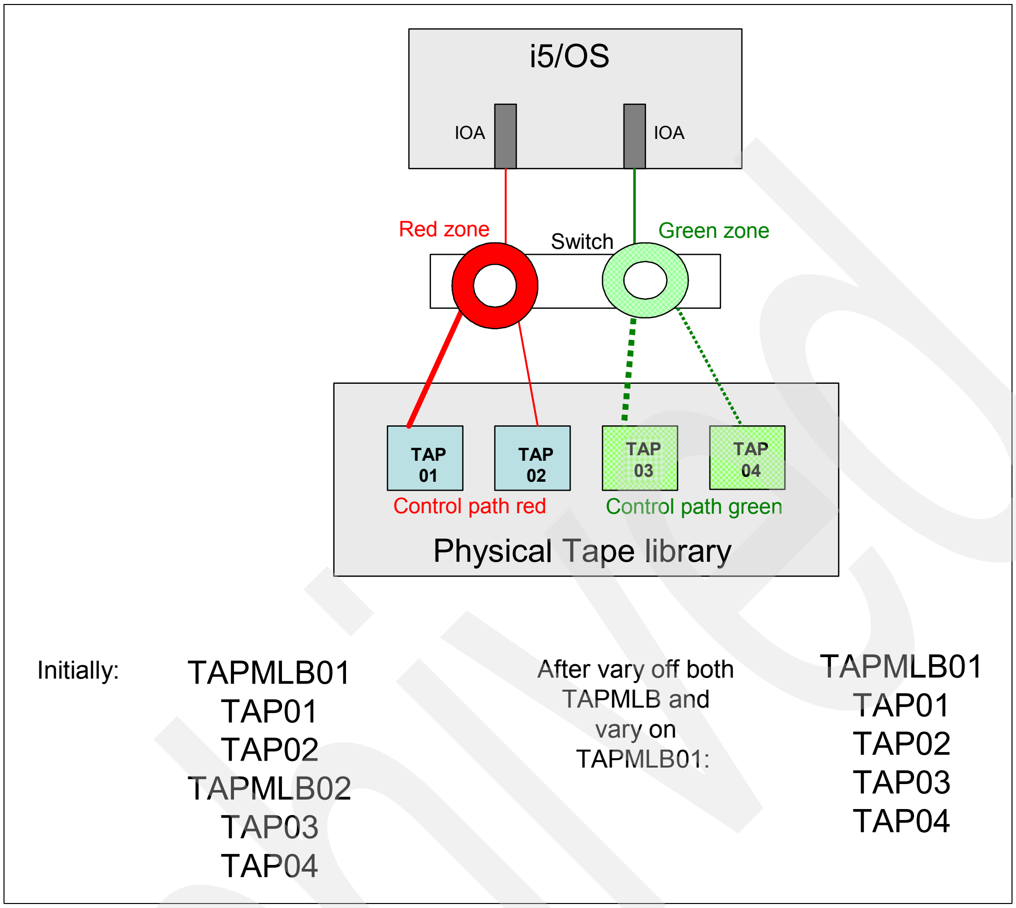



*Figure 3-1 Tape pooling with physical tape library*

A VTL appears to i5/OS similar to, but different from, a physical tape library. With the TS7510, only a single control path to its attached logical devices is possible. Because each VTL within a TS7510 can have only one control path defined, the tape pooling described for a physical tape library is not possible with a VTL. Therefore, it is not possible to save to the same VTL by using multiple IOAs.

This must be taken into account when planning for VTLs with i5/OS.

Because all virtual tape drives in a VTL are accessed by one IOA, it makes sense to define one virtual tape drive in a VTL, or define two virtual tape drives for parallel save in a VTL.

## 3.4.3 Connection and the number of VTLs for one IOA

TS7510 has four FC ports available for connecting host servers and physical tape library. Assuming that all four ports are used to connect host servers, the rough estimation for total available bandwidth is 500 MB/sec for base TS7510 configuration, and 600 MB/sec for high availability configuration.

In principle, each VTL can attach to multiple host adapters, and it can attach to each host adapter via multiple ports in TS7510. We decide which host FC adapters (IOAs) will access a VTL when we assign storage area network (SAN) clients to VTL using the Virtualization Engine console. We decide which ports in TS7510 will each host adapter 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 about how to do this, refer to *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769.

In System i environment, we attach a VTL to many host servers only if we plan to share the VTL among them. We do not attach some tape drives from a VTL 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 VTL and each i5/OS must have a control path defined.

We do not expect that many customers will share a VTL among multiple i5/OS partitions. They will rather define a VTL for each i5/OS and if needed move virtual tapes from one to another VTL by using the Virtualization Engine console.

Because each IOA in i5/OS establishes only one path to a VTL, it makes sense to zone switches or select target FC ports so that each IOA sees a VTL through only one FC port in TS7510.

Regarding this, we recommend that you assign one or more VTLs to one IOA in i5/OS, each VTL containing one or two tape drives. For planning the number of tape drives in a VTL, consider also parallel and concurrent save described in 3.6, "i5/OS functions with VTL" on page 42.

You might also want to assign each VTL to one IOA, multiple assignment using the same port in TS7510. These possibilities are shown in Figure 3-2.

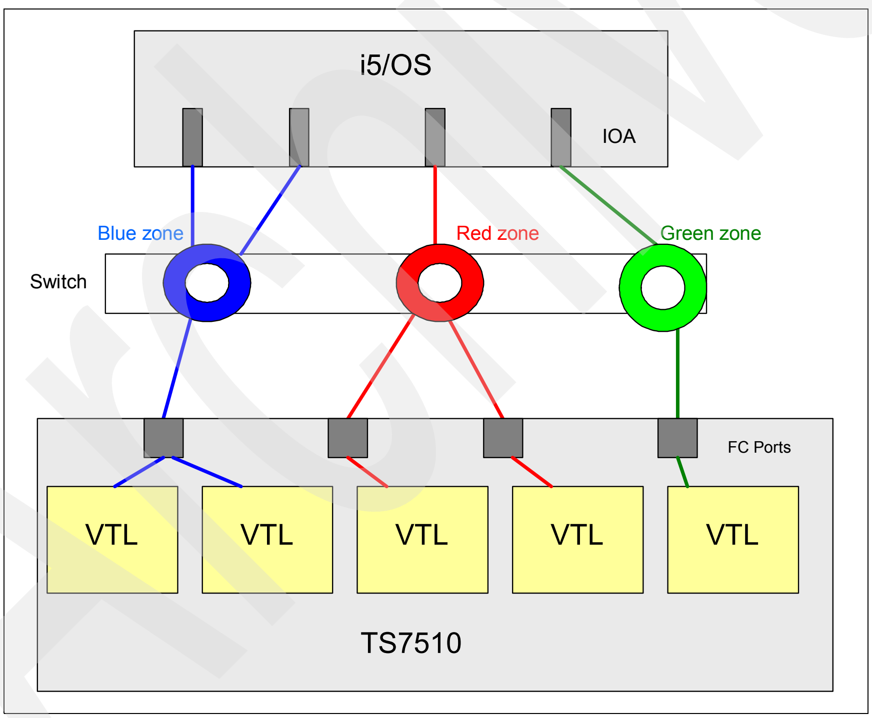



*Figure 3-2 Assigning VTLs to i5/OS*

When assigning multiple VTLs through one FC port in TS7510, take into account the following:

- One VTL can handle approximately 60 MB/sec for i5/OS workload.
- One FC port in TS7510 base configuration can handle approximately 120 MB/sec, and one port in high availability configuration can handle approximately 150 MB/sec, providing that all four ports are used for host connection.

Regarding this, plan for approximately two to three VTLs for one FC port in TS7510.

## 3.5 Using compression

Compression in a VTL is done by the Virtualization Engine; we can turn it on or off from a Virtualization Engine console. It can be turned on or off for the whole TS7510, not for individual VTLs.

When a VTL has enabled compression, it is seen by i5/OS as a device that is capable of hardware compression. When saving from i5/OS to a tape device, it is recommended to use compression of a device. This is achieved by specifying the parameter DTACPR(*DEV) in SAVLIB or SAVOBJ command. When using BRMS, we can specify it with the parameter *DEV for compression in BRMS backup policy or control group. If compression in TS7510 is turned on and the parameter DTACPR(*DEV) is used in i5/OS, saved data will be compressed within TS7510. If compression in TS7510 is turned off and the parameter DTACPR(*DEV) is used in i5/OS, no compression will be done.

When planning for compression in TS7510, consider that it slows down performances of save and restore.

## 3.6 i5/OS functions with VTL

To properly plan for TS7510 with i5/OS, it is important to know how i5/OS functions in save and restore can work with virtual tape libraries. Therefore, we discuss their usage with VTLs in this section.

### 3.6.1 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 to, for recovery purposes, know what objects are on what tape volumes. In the context of this book, Backup and Recovery Media Services, licensed program 5722-BR1 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 VTLs, or it can be done to multiple virtual tape drives within the same VTL. With parallel save to virtual tape drives from different VTLs, you might experience better save performances than with saving to multiple virtual drives within the same VTL, providing that each VTL is connected to separate IOA via separate port in TS7510. However, when using virtual tape drives from different VTLs, consider that you will have to do restore from tapes in different media location.

You can also decide to parallel save to virtual tape drives within the same VTL. This save might not perform as quickly as saving to different VTLs, but it provides easier management of tapes for restore.

For information about how to set up parallel save with BRMS and VTLs, refer to Chapter 6, “i5/OS, BRMS, and TS7510 in action examples” on page 129.

*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 VTLs. It might be enough to plan one tape drive in each VTL to be used for concurrent saves.

### 3.6.2 Save while active

The save while active (SWA) function is an option on several i5/OS save commands. It allows you to save parts of your system without putting your system in a restricted state. This is achieved in the following way: During saving of an object, all the application changes to this object go to a separate file so that the object status at a certain point in time is saved. After the save is done, the changes that were performed during save are applied to the object. Although SWA enables application updates when an object or library is being saved, it might slow down performances because of locking mechanism while creating files for changes.

There are no known unique save while active considerations when using the VTL support. If a customer decides for VTL mainly for performance reason, that is, to enable shorter save window, the customer will probably not use VTL together with SWA. But if the customer decides for VTL for another reason other than performance, for example consolidating multiple servers to use one backup device, the customer may consider SWA together with VTLs.

For more information about SWA, refer to the System i Information Centre at the following Web page:

http://publib.boulder.ibm.com/iseries/

## 3.7 Using BRMS with VTL

As mentioned, Backup, Recovery and Media Services (BRMS) for iSeries is the IBM strategic solution for planning and managing save and restore operations in an i5/OS partition. It greatly assists you to implement an organized approach to managing backups, and provides you an orderly way to retrieve lost or damaged data. With BRMS, you can more easily manage your most critical and complex backups. This is especially important when it comes to time to actually recover, as BRMS offers several backup reports that include steps to perform a recovery. BRMS is available as a software licensed product, 5722-BR1.

With Virtualization Engine TS7510, a customer can use many VTLs in an i5/OS, and he can consolidate many i5/OS partitions to use VTLs in the same Virtualization Engine TS7510. Depending on his needs, the customer can define different scenarios of VTLs in each i5/OS or partition, each VTL with its own tapes. This will introduce complexity to the customer's backup management. Therefore, we highly recommend that you use BRMS to help with the disciplined management of backups.

For more information about BRMS, refer to the *Backup Recovery and Media Services for iSeries: Version 5*, SC41-5345, book available in the iSeries Information Center.

For information about using BRMS with TS7510 VTLs, refer to Chapter 6, “i5/OS, BRMS, and TS7510 in action examples” on page 129. Although that chapter cannot teach you all the BRMS functions that you should consider using with the TS7510, it does cover several BRMS functions available for any real or virtual tape device.

## 3.8 Planning for installation

Physical planning for Virtualization Engine TS7510 is a customer responsibility. For this, we recommend that the customer follows instructions in the manual *IBM Virtualization Engine TS7510 Introduction and Planning Guide*, GC26-7767.

## 3.9 Examples of using TS7510 with i5/OS

In this section, we describe four customer cases of using the IBM Virtualization Engine TS7510 with i5/OS partitions. We believe that these examples show typical customer scenarios where use of the IBM Virtualization Engine TS7510 is a logical choice. Use these examples to help you plan for using this product as part of your specific backup and recovery processes.

### 3.9.1 Example 1: Four i5/OS partitions saving 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 3-1 shows these backup activities.

*Table 3-1 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 3-1, a maximum of 3.5 TB of data is being saved at the same time.

For information about how to size IBM Virtualization Engine TS7510 for the customer case, refer to Appendix A, “Sizing and performance examples” on page 281.

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 CV5 to plan. Then decide to use all available ports in CV5 to connect to all IOA in four partitions, or zone ports so that one or more partitions use the same port in CV5.

For information how to set up and use BRMS examples, refer to Chapter 6, "i5/OS, BRMS, and TS7510 in action examples" on page 129.

### 3.9.2 Example 2: Two i5/OS partitions saving user data, replicating saved data to remote site once a week

The customer has an i5/OS partition running Domino and another partition running WebSphere®. Disaster recovery solution for both partitions is provided by IBM Virtualization Engine TS7510. IBM Virtualization Engine TS7510's replication function enables the recovery of partitions on remote site.

On 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 IBM Virtualization Engine TS7510 based on the time period of how long to keep each backup, as described in Appendix A, "Sizing and performance examples" on page 281.

We consider that replication to the remote IBM Virtualization Engine TS7510 is the correct solution for the customer's needs to copy backups taken on Sunday to the remote site. For more information about replication, refer to Chapter 2, "Description and terminology of the TS7510" on page 15.

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.

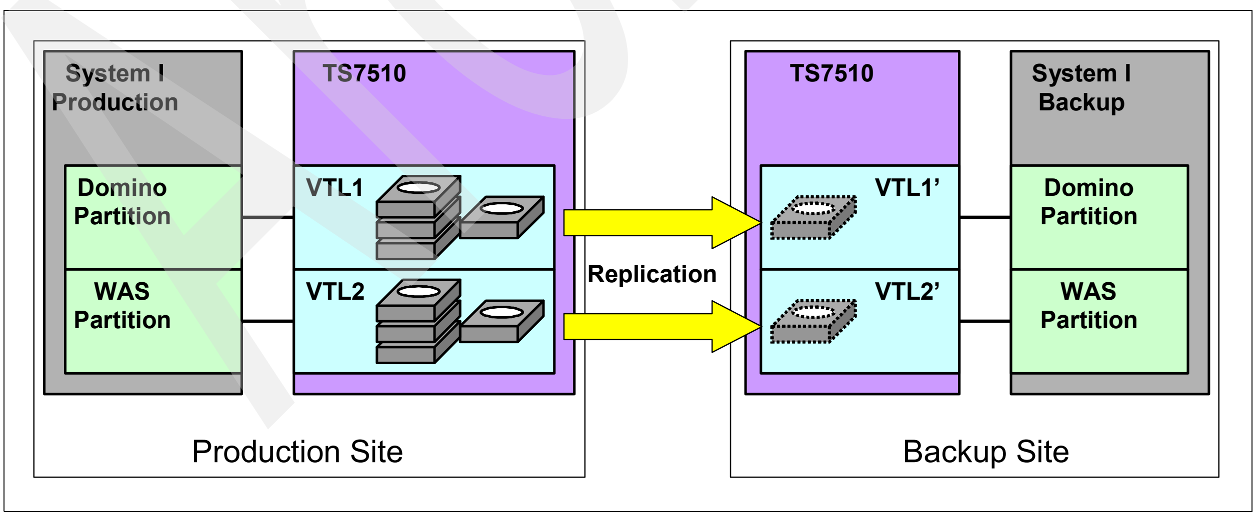



*Figure 3-3 IBM Virtualization Engine TS7510 replication example*

On production IBM Virtualization Engine TS7510, 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 5 generations data on Sunday for one month. Table 3-2 shows the requirement space for the production IBM Virtualization Engine TS7510.

On remote IBM Virtualization Engine TS7510, 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 3-3 shows the disk space estimation for saved Sunday data on the backup TS7510.

*Table 3-2 Production site: Disk space for IBM Virtualization Engine TS7510*

| | **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 |

*Table 3-3 Backup site: Disk space for IBM Virtualization Engine TS7510*

| | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** | **Sunday** | **Total** |
|---|---|---|---|---|---|---|---|---|
| Domino Partition | | | | | | | 1.5TB | 1.5TB |
| WebSphere Application Server partition | | | | | | | 1.0TB | 1.0TB |

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/second

370 Mb/second speed is required for replication. Of course, 1Gbps Ethernet infrastructure is essential.

4

# Hardware and software requirements

This chapter provides the information about the requirements for IBM Virtualization Engine TS7510. The information is divided into IBM Virtualization Engine TS7510, the management PC, and i5/OS. The chapter also contains ordering information.

Prior to reading this chapter, you should have a basic knowledge of the TS7510 architecture, which is explained in Chapter 2, “Description and terminology of the TS7510” on page 15, and Chapter 3, “Planning for i5/OS and the TS7510” on page 35.

# 4.1 Virtualization Engine TS7510 requirements

You can find IBM Virtualization Engine TS7510 requirements information in *IBM Virtualization Engine TS7510 Introduction and Planning Guide*, GC26-7767. In this section, we give you an overview of the requirements for installing the IBM Virtualization Engine TS7510 in your environment.

## 4.1.1 Physical site requirements

Physical site requirements can be found in Chapter 2, “Physical planning specifications for the IBM Virtualization Engine TS7510” of *IBM Virtualization Engine TS7510 Introduction and Planning Guide*, GC26-7767. It provides physical planning and site specifications for the IBM Virtualization Engine TS7510. You must prepare the following information to prepare a location for installation of the components.

- Power outlet locations, types, and ratings
- Frame locations
- Operator and service clearances
- Dimensions of the area containing all system components
- Cabling and wiring for connections to the host
- Cooling and heating
- Telephone service
- Safety and security
- Fire detection and suppression
- Floors (both raised and non-raised) that meet the operational and structural requirements necessary for the system components

This book provides some information to consider these matters based on *IBM Virtualization Engine TS7510 Introduction and Planning Guide*, GC26-7767.

Figure 4-1 shows the overall physical footprint of a 3952 Tape Frame. You must calculate the space that is needed for the IBM Virtualization Engine TS7510 units. The TS7510 units are stored within the 3952 Tape Frame.

Table 4-1 shows the physical dimension of a 3592 Tape Frame. You can use it to calculate the space for the IBM Virtualization Engine TS7510 units.

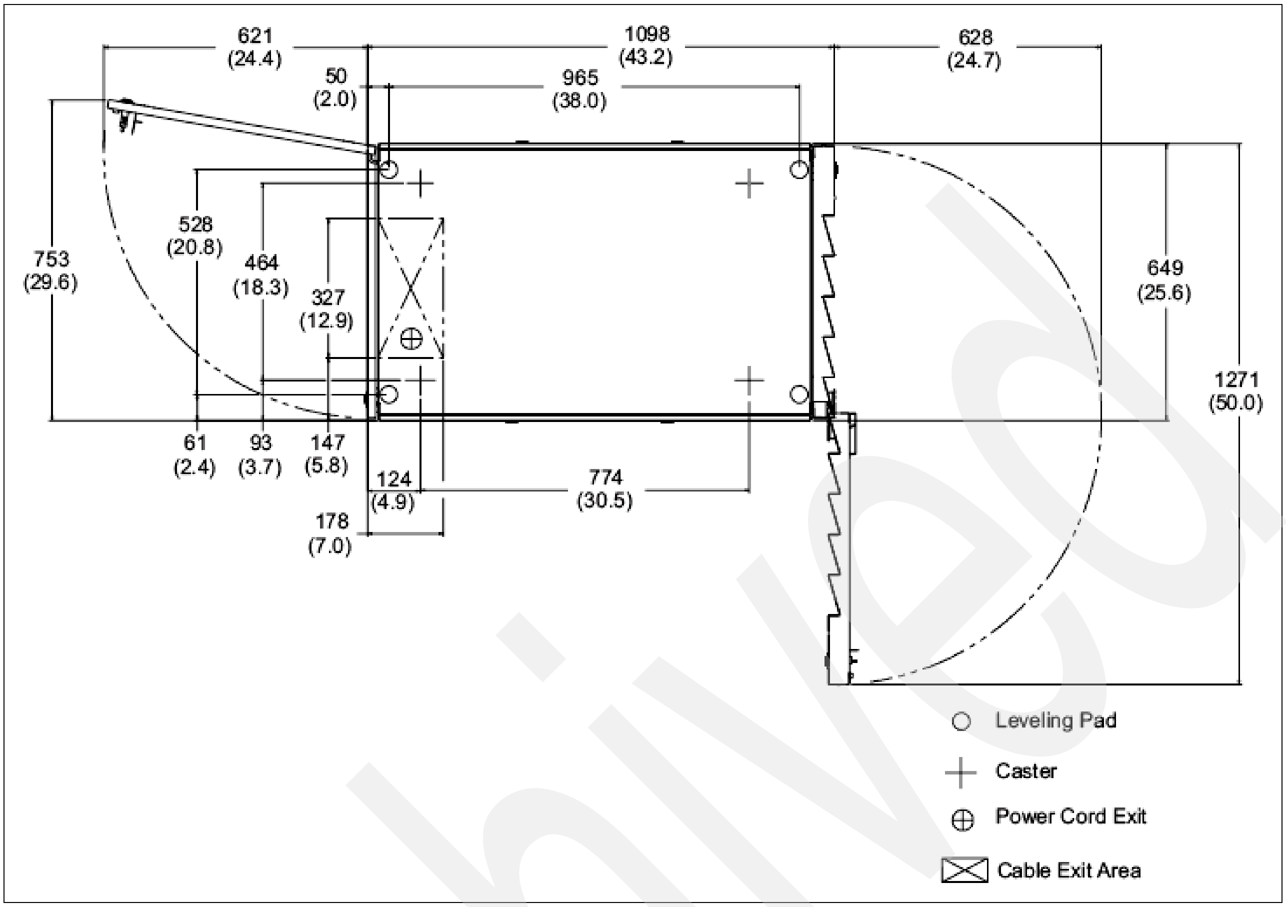



*Figure 4-1 3952-F05 physical foot print*

*Table 4-1 IBM Virtualization Engine TS7510 physical dimension*

| | Height | Width | Depth |
|---|---|---|---|
| 3952-F05 | 1804 mm (71.0 in) | 644 mm (25.4 in) | 1098 mm (43.2 in) |

Table 4-2 shows the IBM Virtualization Engine TS7510 components' weight to consider the total weight.

*Table 4-2 IBM Virtualization Engine TS7510 component weight*

| Unit | Weight |
|---|---|
| 3952 Tape Frame | 261 kg (575 lb) not configured; 695 kg (1450 lb) maximum configuration (contains two 3955 Model SV5, six 3955 Model SX5, 3954 Model CV5) |
| 3954 Model CV5 | 26 kg (58 lb) |
| 3955 Model SV5 | 40 kg (88 lb) |
| 3955 Model SX5 | 40 kg (88 lb) |

Table 4-3 lists the power requirements and the heat output of the IBM Virtualization Engine TS7510 components.

*Table 4-3 Heat output and electrical specifications*

| Unit | Heat output | Electrical power | Inrush current | Leakage current |
|---|---|---|---|---|
| 3955 Model SV5 | 1766 BTU/hr<br>0.518 kW | 0.51 kVA | | |
| 3954 Model CV5 | 1088 BTU/hr | 390 W | | |
| 3955 Model SX5 | 1088 BTU/hr | 390 W | | |
| 3952 Tape Frame with maximum configuration | 13.7 kBTU/hrs | 4.0 kVA | 300 Ampere | 11.5 mA |

The 3952 Tape Frame Model F05 contains a power supply that can attach to 200 V to 240 V ac at 50 Hz to 60 Hz.

Redundant power is available with the Dual AC Power feature (feature code 1903). This feature provides one additional Power Distribution Unit to allow connection to independent branch power circuits. If you order this feature, you receive two power cords. All components of IBM Virtualization Engine TS7510 are dual power ready. Without the Dual AC Power feature (feature code 1903), all components run on a single power distribution.

### 4.1.2 SAN network requirements

You do not have to consider i5/OS device drivers. For other platforms, you have to install and configure their own device drivers. But i5/OS device drivers are included in System i License Internal Code (LIC) and updated by program temporary fixes (PTFs).

Virtual tape library control path and drive data path failover are not currently supported for the IBM Virtualization Engine TS7510.

In a complex environment, an IBM Virtualization Engine TS7510 port will be connected to multiple hosts. IBM Virtualization Engine TS7510 supports logical unit number (LUN) masking (also known as LUN mapping). Without LUN masking defined, IBM Virtualization Engine TS7510 port is visible to every host initiator attaching that port. With LUN masking, you can make certain virtual devices invisible to some hosts. Also SAN zoning is a method of dividing Fibre Channel devices by some groups, which may be for security purposes. SAN zoning is not a function of IBM Virtualization Engine TS7510 but a function of SAN switch.

The IBM Virtualization Engine TS7510 utilizes dual ported QLogic 2342 2Gb shortwave adapters for physical connectivity. Physical connectivity is established to attach SAN cables to ports on four QLogic adapters. Establishing physical connectivity is identical regardless of whether the port is in initiator mode for attachment to physical tape resources, or in target mode for SAN client access to virtual tape resources.

## 4.1.3 Ordering information

To order the IBM System i5/OS request for price quotation (RPQ) that supports attachment of the IBM System Storage™ Virtualization Engine TS7510, contact your local IBM System Storage representative. They are to submit a request through the country-specific RPQ order process. The following information must be included in the description:

- Brief business case description
- Once, for each IBM i5/OS partition:
  - The IBM System i model feature number and i5/OS version level (V5R2, V5R3, or V5R4)
  - Fibre Channel adapter feature numbers to be used
  - SAN switches to be used including manufacturer and model/feature number
  - State whether you plan on using the Replication (TS7510- to-TS7510) feature
  - Backup software to be used, such as Backup Media and Recovery Services (BRMS) for i5/OS, 5722-BR1
  - Required availability date
- IBM mailing address, IBM country code, and IBM ship-to address (if outside the United States (U.S.)).

After the RPQ is submitted, it will be reviewed by development and service. When approved the submitter receives a letter stating the RPQ has been approved and a separate package will be mailed with a CD. This CD contains the required patches and installation instructions.

Feature codes are required for ordering the different options for the IBM Virtualization Engine TS7510. Table 4-4 through Table 4-8 on page 53 list the different feature codes and their descriptions.

Table 4-4 describes the machine types, the model types, and the feature codes for the 3954 Model CV5.

*Table 4-4 Feature codes associated with the 3954 Model CV5*

| Description | Machine type | Model | Feature |
|---|---|---|---|
| TS7510 Virtualization Engine | 3954 | CV5 | Not applicable |
| 13m LC/LC Fibre Cable | 3954 | CV5 | 6013 |
| 25m LC/LC Fibre Cable | 3954 | CV5 | 6025 |
| 61m LC/LC Fibre Cable | 3954 | CV5 | 6061 |
| Activate Virtualization Engine | 3954 | CV5 | 7100 |
| Failover/Failback Enable | 3954 | CV5 | 7420 |
| Network Replication | 3954 | CV5 | 7421 |
| Network Encryption | 3954 | CV5 | 7422 |
| Network Compression | 3954 | CV5 | 7423 |
| VE Preload – AAS | 3954 | CV5 | 9301 |
| Plant Install 3954-CV5 | 3954 | CV5 | 9320 |
| Field Merge 3954-CV5 | 3954 | CV5 | 9321 |
| No Factory Cables | 3954 | CV5 | 9700 |

Along with the 3955 Model SV5 and the 3955 Model SX5, feature codes are associated with the disk subsystems, as listed in Table 4-5.

*Table 4-5 IBM Virtualization Engine TS7510 3955 Model SV5 and 3955 Model SX5*

| Description | Machine type | Model | Feature |
|---|---|---|---|
| TS7510 Cache Controller | 3955 | SV5 | |
| TS7510 Cache Module | 3955 | SX5 | |
| 13m LC/LC Fibre Cable | 3955 | SV5 | 6013 |
| 25m LC/LC Fibre Cable | 3955 | SV5 | 6025 |
| 61m LC/LC Fibre Cable | 3955 | SV5 | 6061 |
| 3.5 TB SATA Storage | 3955 | SV5, SX5 | 7110 |
| Enable SX5 in Expansion Frame | 3955 | SV5 | 7400 |
| Plant Install 3955-SV5 | 3955 | SV5 | 9322 |
| Plant Install 3955-SX5 | 3955 | SX5 | 9324 |
| Field Merge 3955-SX5 | 3955 | SX5 | 9325 |

*Table 4-6 TS7510 Model F05 19-inch rack enclosure*

| Description | Machine type | Model | Feature |
|---|---|---|---|
| Dual AC Power | 3952 | F05 | 1903 |
| Remove 3955-SX5 from F05 | 3952 | F05 | 4745 |
| Plant Install 3954-CV5 | 3952 | F05 | 5726 |
| Field Install 3954-CV5 | 3952 | F05 | 5727 |
| Plant Install 3955-SV5 | 3952 | F05 | 5736 |
| Plant Install 3955-SX5 | 3952 | F05 | 5746 |
| Field Install 3955-SX5 | 3952 | F05 | 5747 |
| TS7500 Series Base Unit | 3952 | F05 | 7310 |
| TS7500 Series Expansion Unit | 3952 | F05 | 7311 |
| NEMA L6-30 Power Cord | 3952 | F05 | 9954 |
| RS 3750DP Power Cord | 3952 | F05 | 9955 |
| IEC 309 Power Cord | 3952 | F05 | 9956 |
| PDL 4.3m Power Cord | 3952 | F05 | 9957 |

The software feature codes differ from country to country. Table 4-7 lists the software and hardware feature codes associated with the 3954 Model CV5 for the U.S., Asia Pacific (AP), Latin America (LA), and Canada.

*Table 4-7 3954 Model CV5 for the U.S., AP, LA, and Canada*

| Program name | 3954-CV5 feature code | 5639-CC7 feature code | Charge metric |
|---|---|---|---|
| TS7510 V1R1 Software | | 3229 | Per server |
| Failover/Failback | 7420 | 3234 | Per server |
| Network Replication | 7421 | 3231 | Per server |
| Network Encryption | 7422 | 3232 | Per server |
| Network Compression | 7423 | 3232 | Per server |
| Console & Capacity Support | | 3233 | Per terabyte |

Table 4-8 describes the software and hardware feature codes associated with the 3954 Model CV5 for Europe, the Middle East, and Africa.

*Table 4-8 3954 Model CV5 for Europe, the Middle East, and Africa*

| Program name | 3954-CV5 feature code | 5639-CC7 feature code | Charge metric |
|---|---|---|---|
| TS7510 V1R1 Software | | U5DTC1 | Per server |
| Failover/Failback | 7420 | U5DNC1 | Per server |
| Network Replication | 7421 | U5DSC1 | Per server |
| Network Encryption | 7422 | U5DRC1 | Per server |
| Network Compression | 7423 | U5DPC1 | Per server |
| Console & Capacity Support | | U5DMC1 | Per terabyte |

## 4.1.4 Software maintenance

Software maintenance for one year is included in the initial price of the IBM Virtualization Engine TS7510 V1R1 software. To provide continuous software maintenance coverage, purchase one-year or three-year software maintenance renewal features prior to the expiration of the original software maintenance registration features. For Console & Capacity Support per TB, purchase software maintenance renewal for the total terabyte capacity managed by the IBM Virtualization Engine TS7510 at the time of renewal. Software maintenance renewals supersede and replace previous maintenance levels. If software maintenance has expired, you must order the after-license renewal program ID (5639-DD4 for one year and 5639-DD7 for three years) using the current maximum storage TB levels managed by the IBM Virtualization Engine TS7510 on the same basis as previously described.

Along with hardware and software feature codes, there are different levels of extended maintenance codes. Table 4-9 lists the first year extended maintenance codes. The four-character codes apply in the Americas, Asia, and Australia. The six-character codes apply in Europe, Middle East, and Africa. For example, TS7510 V1R1 Software for Registration shows 3243/U5DZC2. 3243 apply in the Americas, Asia, and Australia. U5DZC2 apply in Europe, Middle East, and Africa.

*Table 4-9 TS7510 V1R1 one-year maintenance*

| **Description** | **One-year maintenance agreement** | | |
|---|---|---|---|
| | **Registration (no charge feature code)** | **Renewal before expiration (charge feature code)** | **Renewal after expiration (charge feature code)** |
| TS7510 V1R1 Software Maintenance Program ID | 5639-DD3 | 5639-DD3 | 5639-DD4 |
| TS7510 V1R1 Software | 3243/U5DZC2 | 3244/U5DZC3 | 3251/U5D5C4 |
| Network Compression | 3235/U5DWC2 | 3236/U5DWC3 | 3252/U5D2C4 |
| Network Replication | 3237/U5DYC2 | 3238/U5DYC3 | 3248/U5D4C4 |
| Network Encryption | 3241/U5DXC2 | 3242/U5DXC3 | 3249/U5D3C4 |
| Console & Capacity Support per TB | 3245/U5DUC2 | 3246/U5DUC3 | 3250/U5D0C4 |
| Failover/Failback | 3239/U5DVC2 | 3240/U5DVC3 | 3247/U5D1C4 |

Each year of extended maintenance has its own set of feature codes. Table 4-9 describes the codes required for IBM Virtualization Engine TS7510 V1R1 software one-year extended maintenance after a license expires.

Along with the one-year maintenance extension, IBM also offers three-year agreements. Table 4-10 lists the maintenance feature codes required to handle the three different three-year agreements.

The column for program number 5639-DD5 in Table 4-10 describes the one-time charge feature numbers that are required for the IBM Virtualization Engine TS7510 three-year maintenance agreement upon initial purchase. The column for 5639-DD6 describes the one-time charge feature numbers that are required for the IBM Virtualization Engine TS7510 three-year maintenance agreement renewal codes used before maintenance expires. And the column for 5639-DD7 describes the one-time charge feature numbers required for the three-year maintenance agreement renewal codes of the IBM Virtualization Engine TS7510 after maintenance expires.

*Table 4-10 TS7510 V1R1 software three-year maintenance*

| **Description** | **Three-year maintenance agreement** | | |
|---|---|---|---|
| | **Initial purchase** | **Renewal before expiration** | **Renewal after expiration** |
| TS7510 V1R1 Software Maintenance Program ID | 5639-DD5 | 5639-DD6 | 5639-DD7 |
| TS7510 V1R1 Software | 3254/U5EBC5 | 3259/U5EHC6 | 3265/U5EPC7 |
| Network Compression | 3256/U5D8C5 | 3262/U5EEC6 | 3267/U5ELC7 |
| Network Replication | 3257/U5EAC5 | 3260/U5EGC6 | 3266/U5ENC7 |
| Network Encryption | 3253/U5D9C5 | 3261/U5EFC6 | 3270/U5EMC7 |
| Console & Capacity Support per TB | 3255/U5D6C5 | 3264/U5ECC6 | 3268/U5EJC7 |
| Failover/Failback | 3258/U5D7C5 | 3263/U5EDC6 | 3269/U5EKC7 |

## 4.1.5 Parts lists for the IBM Virtualization Engine TS7510

The following sections provide parts lists for the IBM Virtualization Engine TS7510.

### 3954 Model CV5 ship group items and FRU part numbers

Table 4-11 and Table 4-12 list the TS7510 Virtualization Engine Server 3954 Model CV5 ship group items and FRU part numbers.

*Table 4-11 TS7510 Virtualization Engine Server 3954 Model CV5 ship group part numbers*

| Part number | Description |
|---|---|
| 21P9086 | Safety Flyer |
| 38P7913 | UTP Crossover cable |
| 24R9131 | Ship Bracket Flyer |
| 23R3637 | CD ROM (TS7510 documentation) |
| 31R1150 | Install Guide (xSeries 346) |
| 31R2580 | SvrGuide CD (xSeries) |
| 39R5802 | CD ROM (xSeries 346 documentation) |
| 88P9229 | Rack Install Instructions |
| 95P3341 | Ship Group reference document |

*Table 4-12 TS7510 Virtualization Engine Server 3954 Model CV5 FRU part numbers*

| Part number | Description |
|---|---|
| 02R0726 | Cable, SCSI signal |
| 13M8293 | 3.0GHz Microprocessor |
| 13N1625 | Microprocessor heat-sink |
| 18P2140 | Hub FRU Kit |
| 24P3639 | DVD, 8/24X |
| 24P8175 | 2-Port FC QLogic 2342 Adapter |
| 25R5160 | Cable, Diskette drive |
| 25R5161 | Cable, IDE |
| 25R5162 | Cable, DVD-ROM power |
| 25R5163 | Cable, SCSI power |
| 25R5234 | Air Baffle |
| 26K4755 | U320 HDD backplane |
| 26K4756 | Media cage w/ Op Panel |
| 26K4759 | Chassis |
| 26K4760 | Top Cover |
| 26K4761 | Fan guide assembly |
| 26K4762 | PCI-X riser cage |

| Part number | Description |
|---|---|
| 26K4764 | PCI Riser card cage |
| 26K4768 | Fan assembly, 60mm x 60mm |
| 26K4771 | Misc Parts Kit |
| 26K4772 | FRU label |
| 26K6065 | Blank filler for heat sink |
| 26K6147 | Heat sink retainer bracket |
| 32R1956 | System Board |
| 33F8354 | Battery, 3.0 volt |
| 36L8645 | Diskette Drive, 12.7 MM |
| 36L8886 | Cord, 2.1M jumper |
| 48P9028 | DVD/CD-ROM interposer |
| 59P4740 | Thermal Grease Kit |
| 59P5236 | HDD filler |
| 73P2869 | Memory, 512MB, PC2-3200 |
| 73P9324 | RSA-II Slimline |
| 74P4411 | Power Supply, 625 watt |
| 74P4413 | Power cage |
| 90P4070 | Slide Kit |

## 3955 Model SV5 ship group items and FRU part numbers

Table 4-13 and Table 4-14 list the TS7510 Cache Controller 3955 Model SV5 ship group items and FRU part numbers.

*Table 4-13 TS7510 Cache Controller 3955 Model SV5 ship group part numbers*

| Part number | Description |
|---|---|
| 05N6766 | 05N6766 LC Coupler |
| 11P3847 | LC Wrap Plug |
| 24R0831 | Null Modem cable |
| 25R0325 | DS4100 Cable Instructions |
| 25R0397 | DS4100 Hardware Install |

*Table 4-14 TS7510 Cache Controller 3955-SV5 FRU part numbers*

| Part number | Description |
|---|---|
| 01K6670 | Rail Kit |
| 09L5361 | Bi-frucated power cable |
| 11P3880 | 13m LC-LC FC optical cable |

| Part number | Description |
|---|---|
| 11P3884 | 61m LC-LC FC optical cable |
| 17P6918 | Wrap Plug (loopback adapter) |
| 19K1253 | 25m LC-LC FC cable |
| 19K1280 | SFP LC (shortwave) |
| 19K1289 | Power Supply, 400W |
| 19K1293 | Fan Asm |
| 19K1297 | Switch, harness |
| 23R2878 | SV5 Bezel |
| 23R2894 | Bi-frucated power cable |
| 24P8062 | Battery |
| 24P8813 | Misc hardware kit |
| 25R0099 | DS4100 SATA RAID Controller |
| 25R0211 | SATA frame, midplane |
| 90P1349 | SATA 250GB drive |

## 3955 Model SX5 ship group items and FRU part numbers

Table 4-15 and Table 4-16 list the TS7510 Cache Module 3955 Model SX5 ship group items and FRU part numbers.

*Table 4-15 TS7510 Cache Module 3955 Model SX5 ship group part numbers*

| Part number | Description |
|---|---|
| 25R0350 | DS4000 Hdw Install |

*Table 4-16 TS7510 Cache Module 3955-SX5 FRU part numbers*

| Part number | Description |
|---|---|
| 01K6670 | Rail Kit |
| 19K1280 | SFP LC (shortwave) |
| 19K1289 | power supply, 400W |
| 19K1293 | blower Asm |
| 19K1297 | switch, harness |
| 23R2879 | SX5 Bezel |
| 24P8813 | Misc hardware kit |
| 25R0156 | SATA ESM (R2 firmware) |
| 25R0342 | SATA Frame, midplane |
| 90P1349 | SATA 250GB drive |

### 3952-F05 Frame ship group and FRU part numbers

Table 4-17 and Table 4-18 list the TS7510 3952-F05 Frame ship group and FRU part numbers.

*Table 4-17 TS7510 3952-F05 Frame ship group part numbers*

| Part number | Description |
|---|---|
| 18P8757 | Mag Serial Number Label |
| 31L8313 | Wrench |
| 44P1850 | Rear Tilt Kit |
| 95P2031 | Hotline Card |
| 23R2798 | MES Installation Instructions FC 5747 |

*Table 4-18 TS7510 3952-F05 Frame FRU part numbers*

| Part number | Description |
|---|---|
| 07H6655 | 6 inch Fastener |
| 11P3878 | LC-LC 2 Meter |
| 17P7356 | LC-LC 1 Meter |
| 19P5445 | LC-LC 3.2 Meter |
| 23R2894 | Bi-furcated RoHS |
| 23R3638 | FRU CVT Pubs |
| 25R2553 | 32A / 250V Line Cord |
| 25R2555 | 30A / 208V Line Cord |
| 25R2557 | 30A - R & S; 3750 Line Cord |
| 25R2558 | Aust/NZ - 250V Line Cord |
| 25R2559 | 30A – Korea Line Cord |
| 31L8313 | Foot Wrench |
| 39J1183 | PDU UTG 12-C13 |
| 67X8910 | Cbl Clamp |

## 4.2 Management of the TS7510 from a PC

The most important software for the management of IBM Virtualization Engine TS7510 is the IBM TapeSystem Virtualization Engine for Tape Console. The console software is included in the IBM Virtualization Engine TS7510 Software Version 1 Release 1 (5639-CC7). Virtualization Engine for Tape Console provides the management graphical user interface (GUI) interface to the TS7510 Virtualization Engine. You must install the tool in your management PC.

Other management software is optional and not used during normal operation of the TS7510. If you want to access 3954 Model CV5 directly, PuTTY or Remote Supervisor Adapter (RSA) provide a Linux interface. PuTTY is a free software to access the system over Telnet or

Secure Shell (SSH). PuTTY is an easy tool to access any Linux system. In the TS7510 environment, this is to access the 3954 Model CV5 via a network.

The RSA provides Remote Console over network. Remote Console function provides the BIOS configuration that PuTTY cannot provide.

The Fibre Array Storage Technology (FAStT) Storage Manager client is pre-loaded on the 3954 Model CV5 server and can be accessed using the RSA Remote Console. The FAStT Storage client software should also be installed on your management PC. The software provides some functions to manage the storages on IBM Virtualization Engine TS7510.

**Attention:** PuTTY, RSA, and FAStT Storage Manager client can access a Linux system or storage directly. You do not have to use these tools during normal operation of the TS7510. These should be used only with direction from IBM Support, when you have to perform detailed problem determination using the TS7510. They are available to the genera public for use with many *open system* types of configuration.

You can get more information by searching the following Web site:

http://www.ibm.com

For example, you can search with:

- “remote supervisor adapter II slimline” to get information about how to download software and use the RSA.
- “FAStT Storage client” to get information about FAStT storage solutions, including the IBM DS4000 products. IBM TotalStorage Fibre Array Storage Technology (FAStT) Storage Server is a Redundant Array of Independent Disks (RAID) storage subsystem that contains the Fibre Channel (FC) interfaces to connect both the host systems and the disk drive enclosures. The FAStT family provides a platform for storage consolidation in entry, midrange, and enterprise class open system environment.
- “putty” to get information about PuTTY. PuTTY is a free implementation of Telnet and SSH for Win32® platforms with an xterm terminal emulator. The advantage of using PuTTY versus the standard DOS Telnet client is that it offers a more user-friendly interface (better keyboard mapping) during a Linux installation.

  PuTTY can be downloaded for free from the PuTTY download page:

  http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html

### 4.2.1 IBM TapeSystem Virtualization Engine for Tape Console

The TS7510 Management Console Installation CD contains the Virtualization Engine for Tape Console software. The customer has to load this software on the TS7510 Management Console. The TS7510 Management Console (Figure 4-2 on page 60) is a PC provided by the customer. Refer to Chapter 5.3, “Installing IBM Total Storage Virtualization Engine TS7510 Console” on page 82, to install the Virtualization Engine for Tape Console software.

The Virtualization Engine for Tape Console is used for configuration, management, and service support for the IBM Virtualization Engine TS7510. You must ensure that the console machine is available and ready to install the console program before you plan to activate the IBM Virtualization Engine TS7510.

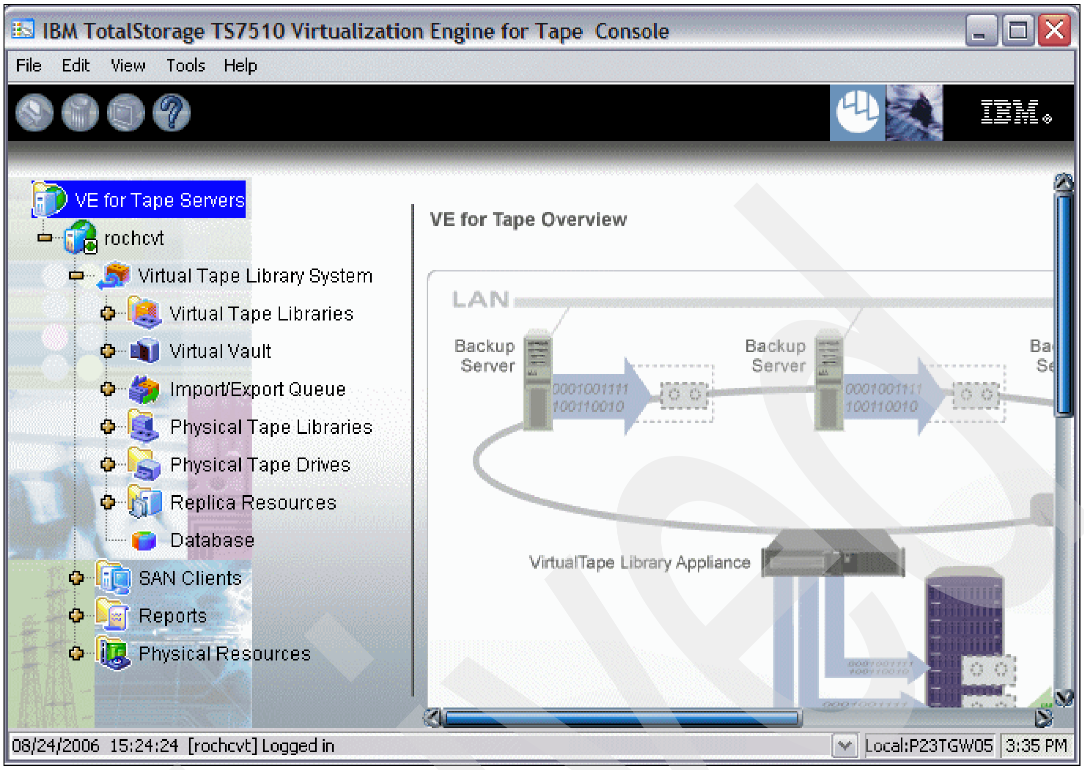
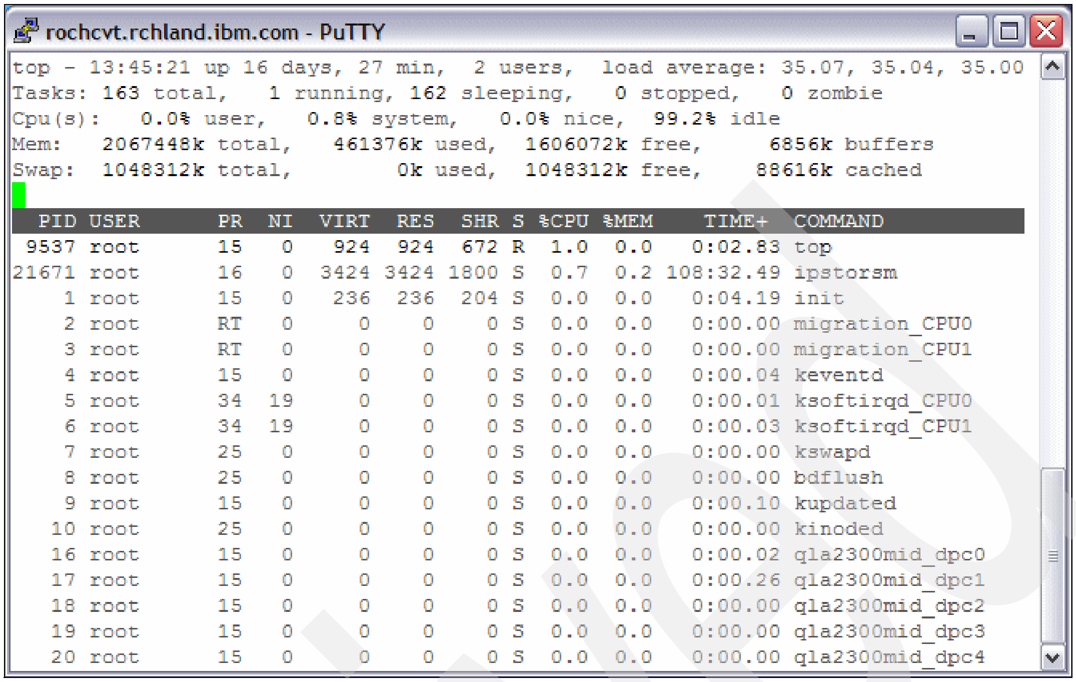



*Figure 4-2 TS7510 Management Console*

### 4.2.2 PuTTY

The PuTTY utility (Figure 4-3 on page 61) is on the Base Firmware Update CD. PuTTY is a SSH, Telnet, and Rlogin client for logging in to a multi-user computer from another computer, over a network. PuTTY can be used to log in to the 3954-CV5 Linux OS from the TS7510 Management Console. Install the PuTTY client on the TS7510 Management Console in case it is required during a Remote Support session.





```
top - 13:45:21 up 16 days, 27 min,  2 users,  load average: 35.07, 35.04, 35.00
Tasks: 163 total,   1 running, 162 sleeping,   0 stopped,   0 zombie
Cpu(s):   0.0% user,   0.8% system,   0.0% nice,  99.2% idle
Mem:   2067448k total,   461376k used,  1606072k free,     6856k buffers
Swap:  1048312k total,        0k used,  1048312k free,    88616k cached

  PID USER       PR  NI  VIRT  RES  SHR S %CPU %MEM    TIME+  COMMAND
 9537 root       15   0   924  924  672 R  1.0  0.0   0:02.83 top
21671 root       16   0  3424 3424 1800 S  0.7  0.2 108:32.49 ipstorsm
    1 root       15   0   236  236  204 S  0.0  0.0   0:04.19 init
    2 root       RT   0     0    0    0 S  0.0  0.0   0:00.00 migration_CPU0
    3 root       RT   0     0    0    0 S  0.0  0.0   0:00.00 migration_CPU1
    4 root       15   0     0    0    0 S  0.0  0.0   0:00.04 keventd
    5 root       34  19     0    0    0 S  0.0  0.0   0:00.01 ksoftirqd_CPU0
    6 root       34  19     0    0    0 S  0.0  0.0   0:00.03 ksoftirqd_CPU1
    7 root       25   0     0    0    0 S  0.0  0.0   0:00.00 kswapd
    8 root       25   0     0    0    0 S  0.0  0.0   0:00.00 bdflush
    9 root       15   0     0    0    0 S  0.0  0.0   0:00.10 kupdated
   10 root       25   0     0    0    0 S  0.0  0.0   0:00.00 kinoded
   16 root       15   0     0    0    0 S  0.0  0.0   0:00.02 qla2300mid_dpc0
   17 root       15   0     0    0    0 S  0.0  0.0   0:00.26 qla2300mid_dpc1
   18 root       15   0     0    0    0 S  0.0  0.0   0:00.00 qla2300mid_dpc2
   19 root       15   0     0    0    0 S  0.0  0.0   0:00.00 qla2300mid_dpc3
   20 root       15   0     0    0    0 S  0.0  0.0   0:00.00 qla2300mid_dpc4
```

*Figure 4-3 PuTTY*

> **Note:** The TS7510 Base Firmware Update CD contains the PuTTY installer. We recommend that you use them with direction from IBM Support, when you require problem determination.

## 4.2.3 FAStT Management Client

FAStT Storage Manager Client software application is used to access the TS7510 Cache Controller 3955-SV5 and attached TS7510 Cache Modules 3955-SX5. Access to FAStT Storage Manager is accomplished via the RSA port or by installing the FAStT Storage Manager client on the TS7510 Management Console.

Figure 4-4 on page 62 shows two 3955 Model SV5 on IBM Virtualization Engine TS7510. After double-clicking each 3955 Model SV5, you can see Figure 4-5 on page 62 displaying the status of the LUNs. The LUNs are configured at the shipment.

The FAStT Storage Manager Client is used to determine problems. Other cases are to update the firmware and NVRAM on the TS7510 Cache Controller 3955-SV5, and execute scripts to rebuild the attached TS7510 Cache Modules 3955-SX5.

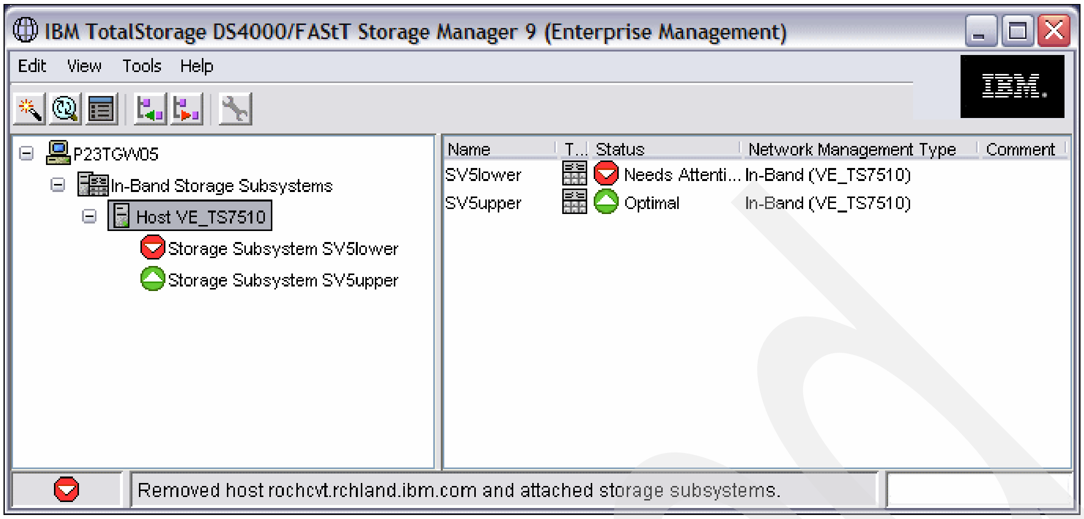



*Figure 4-4 FAStT Storage Manager Client*

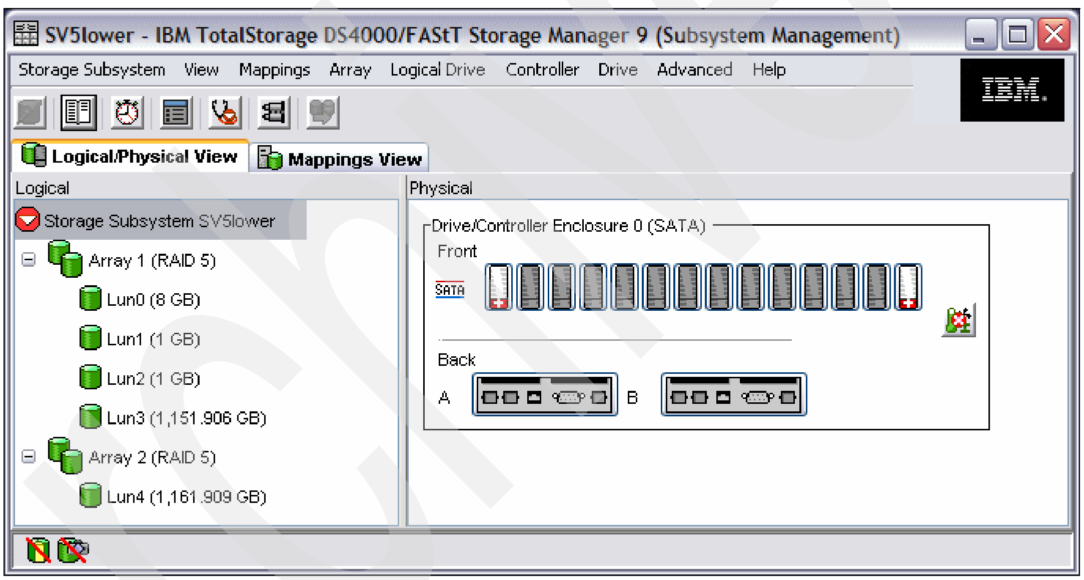



*Figure 4-5 FAStT Storage Manager Client Subsystem*

**Note:** The TS7510 Base Firmware Update CD contains the FAStT Storage Manager Client installer. We recommend that you use them with direction from IBM Support, when you require problem determination.

## 4.3 i5/OS requirements

The IBM Virtualization Engine for Tape Console is supported on a wide range of platforms. Table 4-19 shows the host systems supporting IBM Virtualization Engine TS7510. For the most current list of supported products or for more information about support, refer to:

http://www.ibm.com/servers/storage/tape

*Table 4-19 TS7510: Supported hardware platforms and operating system release levels*

| Platform | Minimum supported levels |
|---|---|
| IBM System i family | ► i5/OS partition: V5R2 or later<br>Backup Media and REcovery Services for iSeries, 5733-BR1:<br>V5R3 PTF SI23620 or later<br>V5R4 PTF Si23622 or later<br>► AIX partition: AIX 5L v5.2 or AIX 5L v5.3<br>► Linux on IBM POWER™ partition: Red Hat Enterprise Linux (RHEL) AS for POWER Version 4, Red Hat Enterprise Linux AS for POWER Version 3, SUSE LINUX Enterprise Server 9 (SLES 9) for POWER, SUSE LINUX Enterprise Server 8 for iSeries and pSeries<br>► ***Windows on IXS, IXA, iSCSI Wintel*: Supported on IXS, IXA, iSCSI**: Windows Server® 2003 R2 Standard Edition, Windows Server 2003 R2 Enterprise Edition, Windows Server 2003 Standard Edition, Windows Server 2003 Enterprise Edition; Windows Server 2003 Web Edition Windows 2000 Server; Windows 2000 Advanced Server **Supported on IXS and IXA only:** Windows 2000 Server, windows 2000 Advanced Server<br>► ***Linux on IXS, IXA, iSCSI Wintel*:**<br>**Supported on IXS, IXA only:**<br>Red Hat Enterprise Linux 3.0 ES Edition<br>Red Hat Enterprise Linux 3.0 AS Edition<br>SUSE Linux Enterprise Server 9<br>**Supported on IXA only:**<br>Red Hat Enterprise Linux 4 ES Edition<br>Red Hat Enterprise Linux 4 AS Edition, SUSE Linux Enterprise Server 8<br>SUSE Linux Enterprise Server 9<br><br>Note: Refer to the following Web site for the latest information including specific Windows operating system and Linux distributions supported and xSeries and IBM BladeCenter® models supported:<br>`http://www-03.ibm.com/systems/i/bladecenter` |
| RS6000, IBM System p™ family | AIX 5L Version 5.1, or later<br>RHEL 3, SLES 8, and SLES 9 |
| Wintel and xSeries | Microsoft Windows 2000 (build 2195 or later), Windows 2003 (build 3790, or later), Linux Red Hat Enterprise Linux (RHEL) 3.0, SUSE Linux Enterprise Server (SLES) 8 SP3, and SLES 9 |
| System z™ for Linux | SLES 8 SP3 and SLES 9 |
| HP | HP-UX 11.0, 11.i (64 bit), 11.23i, and 11.23pi |
| Sun | Solaris 8 and 9 |

## 4.3.1 i5/OS requirements

In order to attach a IBM Virtualization Engine TS7510 to an i5/OS partition, you need to have the i5/OS or OS/400 V5R2 or later. From an i5/OS viewpoint, there is no difference between attaching IBM Virtualization Engine TS7510 and attaching a physical tape library. Therefore, you have to get and apply the latest PTFs for i5/OS.

You do not have to consider i5/OS device drivers. For other platforms, you have to install and configure their own device drivers. But i5/OS device drivers are included i5/OS License Internal Code and updated by PTFs. You must apply the following PTF packages:

- i5/OS or OS/400 V5R2 or later
- Latest Cumulative PTF
- Latest IBM DB2® and HIPER Group PTF
- Latest Backup Recovery Solutions Group PTF

Visit the following URL and click Group PTFs to see the latest PTF information.

http://www-03.ibm.com/servers/eserver/support/iseries/fixes/index.html

Supported Fibre Adapters are shown below.

- 2765 - Fibre Channel Tape Controller (withdrawn from marketing)

  This can operate at up to 2 Gbps.

- 5704 - Fibre Channel Tape Controller

  This can operate at up to 2 Gbps.

- 5761 - PCI-X Fibre Channel Tape Controller

  This can operate at up to 4 Gbps.

### 4.3.2 i5/OS considerations for TS7510

You have to review the information provided in 1.6, “TS7510 support restrictions under i5/OS” on page 13.

You can configure the IBM Virtualization Engine TS7510 to look like three different types of tape drives. If you have physical tape drives to replicate or move the data, you have to use the same density for IBM Virtualization Engine TS7510.

- IBM Linear Tape-Open (LTO) Generation 2 tape drives with 200 GB cartridges
- IBM LTO Generation 3 tape drives with 400 GB cartridges
- IBM 3592 Model J1A tape drives with 300 GB cartridges

Two types of backup are being performed primarily in data centers today. It is important to understand the advantages of these types of backups and which belong in your backup environment. The two types of backup types are:

- Full backups: With this type of backup, everything that is on the server is backed up. While this is an effective way to back up a server or disk subsystem, it is wasteful when not necessary. In many environments, a full backup is taken periodically with intervening incremental backups.
- Incremental backups: This type of backup dramatically reduces the amount of tape, disk, or both required for all jobs. It is an alternative to the full backup.

One place where the TS7510 excels over a real tape device is in the area of incremental backups. Frequently, the amount of data actually saved when doing an incremental backup uses very little space on the tape media. To ease the tracking of backup media, that tape is not used to write any more data to. Therefore, you might end up with significant unused capacity on a high capacity tape media. With the TS7510, data is actually written to disk, therefore there is no unused tape media capacity for small amounts of backup data. In addition to less unused space on backups, restoring backed up data using the TS7510 should be faster than using a real tape library because the time to change “virtual cartridges” is faster than real cartridges.

In a medium to large System i environment, you probably will have a large number of tape media to manage. This is the environment we assume in this IBM Redbook and why we focus on BRMS to manage your backup and recovery. It is not realistic to try managing this environment simply using the i5/OS backup and recovery commands.

### Duplicating saved data consideration

When you want to export or import media between IBM Virtualization Engine TS7510 and physical tape media, you can choose to assign both the IBM Virtualization Engine TS7510 and physical tape drives to the i5/OS partition for duplicating media. You can use i5/OS Duplicate Tape (DUPTAP) or Duplicate Media using BRMS (DUPMEDBRM) commands to perform the duplication.

There may be other limitations on other hardware platforms or operating systems. Refer to Chapter 1, “Introduction TS7510 limitation” of *IBM Virtualization Engine TS7510 Introduction and Planning Guide*, GC26-7767.

## 4.3.3 Backup Recovery and Media Services for iSeries

Backup Recovery and Media Services for iSeries, 5722-BR1, is a program product that greatly simplifies setting up, monitoring, and generally managing backup and recovery processes run under i5/OS. While you can perform many backup and recovery processes using the i5/OS Save (SAVxxx) commands and the Restore (RSTxxx) commands, BRMS has established itself as the primary backup and recovery management product for i5/OS.

BRMS has both i5/OS command level and iSeries Navigator plug-in graphical interfaces to its functions and is particularly helpful in:

- Maintaining backup and restore history
- Easing the use of tape library server type devices, which the TS7510 emulates
- Providing a thorough “steps to perform for recovery” documentation that is complete and easy to follow

In this book, almost all of our backup (save) and recovery (restore) examples are using BRMS interfaces.

The IBM Redbook assumes that you have BRMS PTF levels:

- V5R3: SI23620
- V5R4: SI23622

5

# Installation and basic setup

This chapter provides a broad overview of the hardware and software installation and setup steps, and considerations for the IBM Virtualization Engine TS7510 and its connections to an IBM System i partition running i5/OS.



## 5.1 Introducing installation and basic setup

The IBM Virtualization Engine TS7510 hardware is shipped pre-assembled with software pre-loaded. However, several externally connected items, such as the IBM TapeSystem Virtualization Engine for Tape Console product, require setup and some software installation to facilitate the installation.

This section lists the major basic steps for getting this environment up and running and the following sections provide more details.

The IBM Systems Service Representative (SSR) who installs the IBM Virtualization Engine TS7510 is responsible for performing the following tasks during the installation:

- Unpacking and setting up the TS7510 frame
- Connecting the network cables. Also connecting Remote Supervisor Adapter (RSA) Ethernet for reliability, availability, and serviceability (RAS) functions of the 3954 Model CV5
- Connecting the Fibre Channel cables
- Setting IP addresses according to customer-provided network assignments
- Verifying that the TS7510 hardware is functioning properly
- Verifying the communications between TS7510 and Management Console

After the IBM Virtualization Engine TS7510 is installed and configured by the IBM SSR, the user or customer must perform the following tasks:

- Creating zones for the connected hosts
- Creating virtual libraries and the associated virtual tape drives
- Creating virtual volumes
- Installing IBM tape device drivers or the required drivers from the backup ISV
- Configuring the ISV software for using TS7510

## 5.2 Physical setup for IBM Virtualization Engine TS7510

The following sections show the physical setup for IBM Virtualization Engine TS7510.

- Rack setup
- Power connection
- SAN network installation
- Ethernet connection
- RSA configuration

### 5.2.1 Rack setup

This section shows the example of racking from base configuration to maximum configuration.

#### Base configuration without high availability

The base hardware configuration without high availability (HA) consists of:

- One 3954 Model CV5 server
- Two 3955 Model SV5 controllers
- One 3952 Tape Frame Model F05

Figure 5-1 shows this configuration, in which 4.98 TB of space is available for virtual tape creation. This configuration also gives you up to 64 virtual libraries, up to 512 virtual drives, and up to 4096 cartridges.

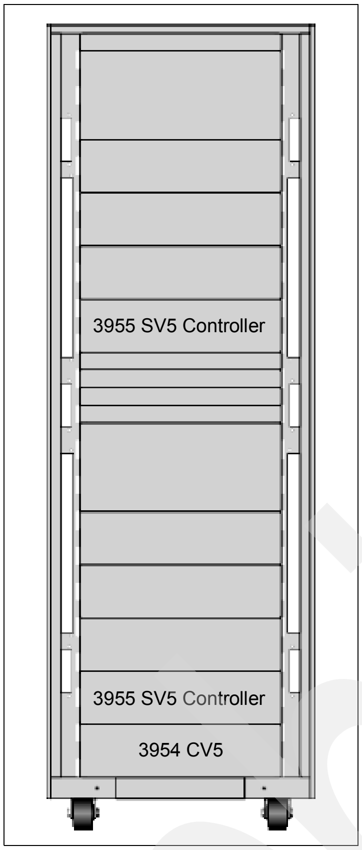



*Figure 5-1 Base IBM Virtualization Engine TS7510*

### Base configuration with high availability

You can purchase a dual node high availability (HA) configuration with two 3954 Model CV5 Virtualization Engine servers. A HA configuration with the two 3954 Model CV5s comes with dual AC power within the 3952 Tape Frame Model F05 frame. This dual mode 3954 Model CV5 configuration provides redundancy for node, disks, power, and tape/host connectivity, in case one of the 3954 Model CV5s fails.

Feature 7420 (Failover/Failback) enables hardware connections between two installed TS7510 Virtualization Engines in the same 3952 Tape Frame. This feature is required if two TS7510 Virtualization Engines are installed in the same frame. Both TS7510 Virtualization Engines in the failover pair must have the same installed features of Network Replication (#7421), Network Encryption (#7422), and Network Compression (#7423).

The base hardware configuration with high availability consists of:

- Two 3954 Model CV5 servers
- Two 3955 Model SV5 controllers
- One 3952 Tape Frame Model F05

Figure 5-2 shows this configuration in which 4.98 TB is available for virtual tape creation.

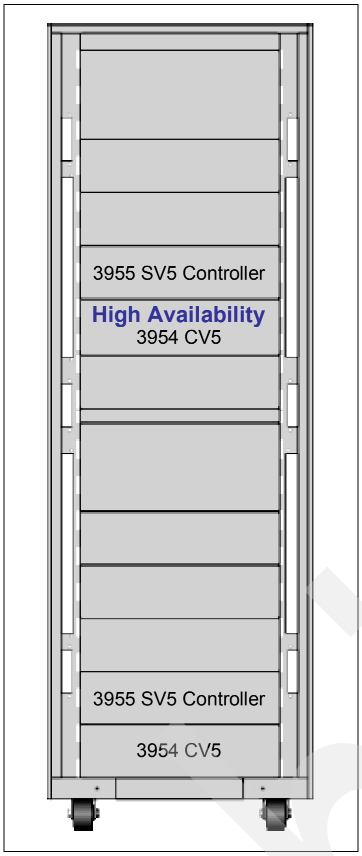



*Figure 5-2 Base IBM Virtualization Engine TS7510 with high availability*

In this HA configuration, the storage on all configured 3955 Model SV5 and 3955 Model SX5 is shared between the two 3954 Model CV5 nodes. The architecture of the TS7510 has the storage physically shared between the 3954 Model CV5 nodes to help provide the failover redundancy. Note that this capacity is not logically shared and is assigned to each node equally - in a balanced manner.

Exactly how this feature provides high availability to a certain host server depends on the backup management software on the server. With some backup management software, the failover is transparent, but with others failover requires to restart the backup job. Given the scope of a "getting started" manual, failover scenarios are not covered in this book.

For more information, refer to the failover chapter in the *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769.

## Incremental growth options

The IBM Virtualization Engine TS7510 is modular by design. It can grow in 3 TB increments by adding 3955 Model SX5 drawers one at a time. The primary rack design is capable of holding up to six expansion drawers with or without the high availability option.

When the base rack is full, a second rack can be attached, again growing in single drawer increments of 3 TB until the maximum number of eight drawers is reached.

**Note:** The first two disk drawers added in the expansion cabinet have 2.5 TB of usable space, due to the hot spare disks required in the configuration.

Figure 5-3 shows the maximum configuration, which consists of:

- Base rack
  - One 3952 Tape Frame Model F05
  - Two 3954 Model CV5 servers
  - Six 3955 Model SX5 controllers
- Expansion rack
  - One 3952 Tape Frame Model F05
  - Eight 3955 Model SX5 controllers

> **Important:** To expand beyond the base frame, the secondary 3954 Model CV5 (HA configuration) is required. Two 3954 Model CV5 controllers must be installed in the base frame before the expansion frame is permitted.

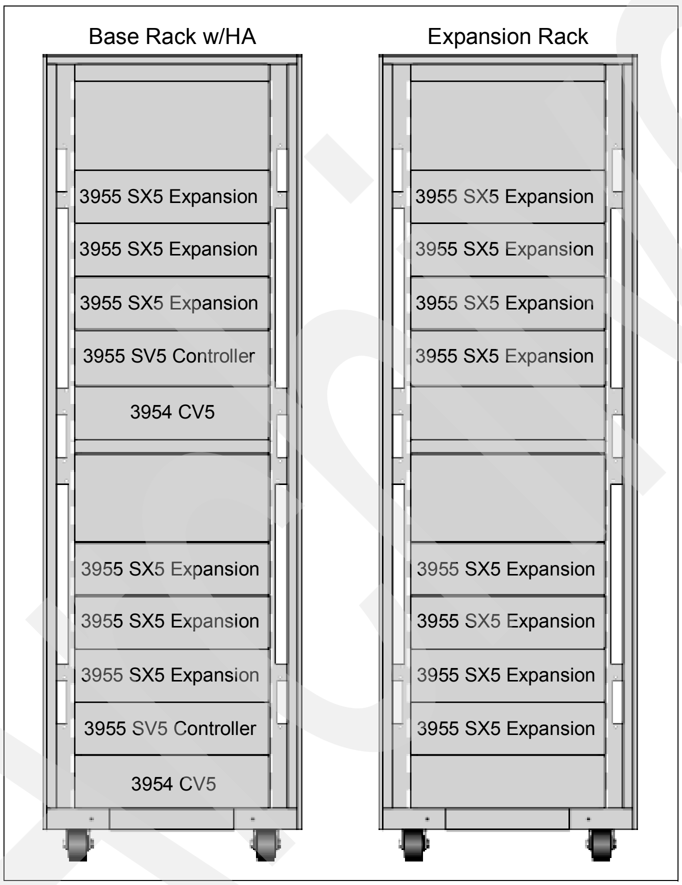



*Figure 5-3 IBM Virtualization Engine TS7510 Dual Racks fully expanded with HA*

## 5.2.2 Power connection

After racking all drawers, connect all bifurcated power cables to each of the Power Distribution Units (PDUs) within the 3952 Tape Frame. Inspect all cable connections and ensure positive seating and also inspect all power on/off switches for the drawers within the 3952-F05 frame. Ensure that they are all in the OFF position.

After all inspection has been completed, attach each power cable from the customer's power receptacles to each PDU in the 3952 Tape Frame.

**Attention:** Use caution when connecting the power cables to the 3952 Tape Frame unit PDUs. There are no breakers or EPO switches on the 3952 Tape Frame.

## 5.2.3 SAN network installation

Figure 5-4 shows the 3954 Model CV5 rear view and indicates where the QLogic PCI Adapter cards and adapter slots are. Four Fibre Channel ports on each IBM Virtualization Engine TS7510 3954 Model CV5 are reserved for internal connection between the 3954 Model CV5 and the TS7510 Cache Controllers (3955 Model SV5s). Adapter 0, Adapter 1, Adapter 2, and Adapter 3 ports are available for attaching customer backup servers (or backup clients) and customer physical tape drives. Initially, Adapter 0 and Adapter 2 are dedicated to customer client (or server) machine attachment, which requires that the ports operate in target mode, and Adapter 1 and Adapter 3 are dedicated to physical tape attachment, which requires that the ports operate in initiator mode. If you are not attaching physical tape drives to the IBM Virtualization Engine TS7510 or if you need more bandwidth to the customer Fibre Channel clients (or servers), then you can configure Adapter 1 and Adapter 3 as targets and three or four of the ports are dedicated to this function.

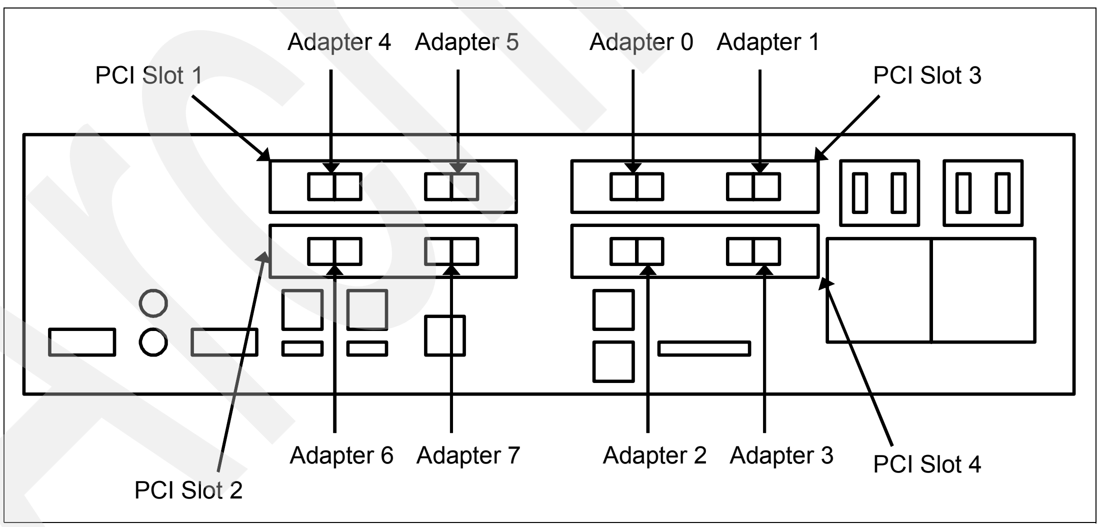



*Figure 5-4 3954 Model CV5 rear view*

Table 5-1 shows the relationship of each of the physical Fibre Channel ports on the QLogic PCI adapter cards, their default usage assignments, and the logical adapter number (also known as the TS7510 Virtualization Engine Management Console adapter number) that is assigned to each physical port (as shown in the Management Console display). Each PCI Fibre Channel card will have two logical adapters associated with it, one for each physical Fibre Channel port. Ports on each PCI card are numbered left to right (looking at them from the back of the 3954 CV5) as port 1 and port 2. The PCI slots (and the cards that occupy them) on the right side of the rear of the 3954 CV5 are numbered PCI slot 3 (on top) and PCI slot 4 (on the bottom). The PCI slots on the left are numbered PCI slot 1 (on top) and PCI slot 2 (on the bottom). Numbering of logical adapters begins with physical ports on the card in PCI slot 3, then PCI slot 4, then PCI slot 1, and then PCI slot 2.

*Table 5-1 3954 Model CV5 fibre channel port usage*

| TS7510 Virtualization Engine Management Console adapter number | TS7510 Virtualization Engine Server HBAs | Lower TS7510 Virtualization Engine Server attachments | Upper TS7510 Virtualization Engine Server attachments |
|---|---|---|---|
| Adapter 0 | PCI Slot 3: QLA2342 Port 1 | Target port for host attachment | Target port for host attachment |
| Adapter 1 | PCI Slot 3: QLA2342 Port 2 | Initiator port for real tape | Initiator port for real tape |
| Adapter 2 | PCI Slot 4: QLA2342 Port 1 | Target port for host attachment | Target port for host attachment |
| Adapter 3 | PCI Slot 4: QLA2342 Port 2 | Initiator port for real tape | Initiator port for real tape |
| Adapter 4 | PCI Slot 1: QLA2342 Port 1 | Lower 3955 SV5 - Controller A - Host 1 | Upper 3955 SV5 - Controller A - Host 2 |
| Adapter 5 | PCI Slot 1: QLA2342 Port 2 | Upper 3955 SV5 - Controller A - Host 1 | Lower 3955 SV5 - Controller A - Host 2 |
| Adapter 6 | PCI Slot 2: QLA2342 Port 1 | Lower 3955 SV5 - Controller B - Host 1 | Upper 3955 SV5 - Controller B - Host 2 |
| Adapter 7 | PCI Slot 2: QLA2342 Port 2 | Upper 3955 SV5 - Controller B - Host 1 | Lower 3955 SV5 - Controller B - Host 2 |

## IBM Virtualization Engine TS7510 internal Fibre cabling

Figure 5-5 through Figure 5-7 on page 76 show physical Fibre connection in Virtualization Engine for Tape Console. As Table 5-1 on page 73 shows, 3954 Model CV5 Fibre ports should be connected to 3955 Model SV5. Also 3955 Model SV5 ports should be connected to 3955 Model SX5.

Figure 5-5 shows cabling among single 3954 Model CV5 and two 3955 Model SV5s. The cabling between 3955 Model SV5 and 3955 Model SX5 is shown later.

- 3954 Model CV5 PCI Slot 1 Port 1: Lower 3955 SV5 - Controller A - Host 1
- 3954 Model CV5 PCI Slot 1 Port 2: Upper 3955 SV5 - Controller A - Host 1
- 3954 Model CV5 PCI Slot 2 Port 1: Lower 3955 SV5 - Controller B - Host 1
- 3954 Model CV5 PCI Slot 2 Port 2: Upper 3955 SV5 - Controller B - Host 1

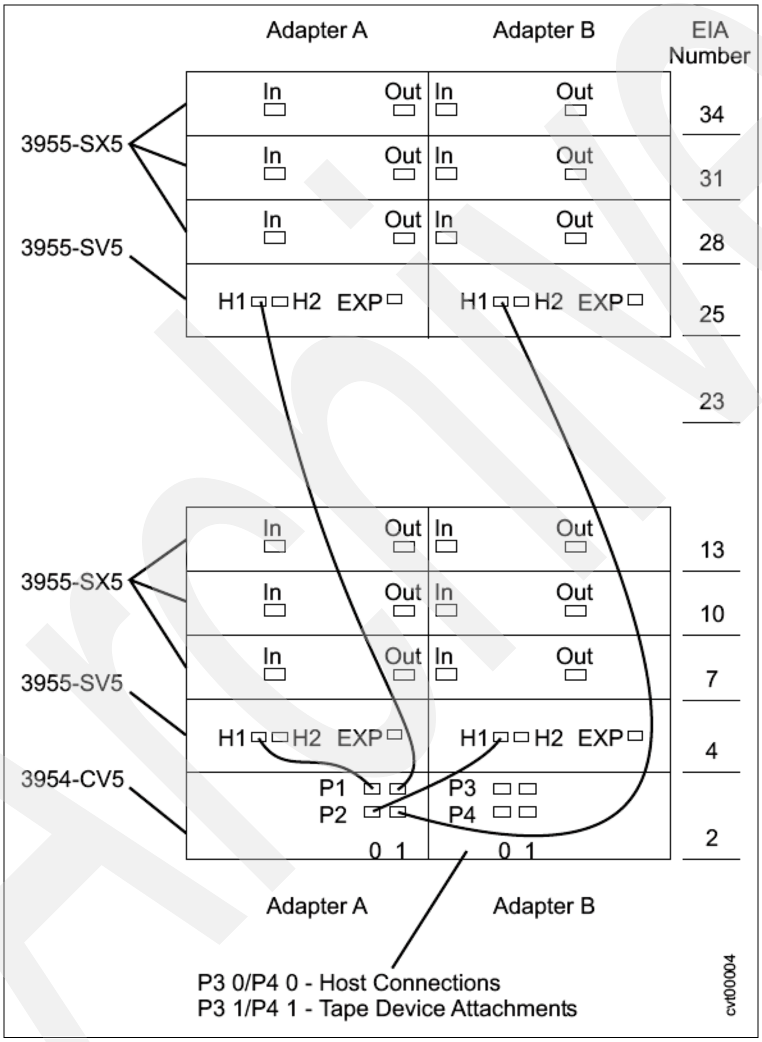



*Figure 5-5 Cabling one 3954-CV5 and two 3955-SV5s*

Figure 5-5 was taken from the *IBM Virtualization Engine TS7510 Hardware Installation, Setup, and Problem Determination Guide*, GC26-7766.

Figure 5-6 shows the cabling among two 3954 Model CV5s and two 3955 Model SV5s. The cabling between 3955 Model SV5 and 3955 Model SX5 is shown later.

- Lower 3954 Model CV5 PCI Slot 1 Port 1: Lower 3955 SV5 - Controller A - Host 1
- Lower 3954 Model CV5 PCI Slot 1 Port 2: Upper 3955 SV5 - Controller A - Host 1
- Lower 3954 Model CV5 PCI Slot 2 Port 1: Lower 3955 SV5 - Controller B - Host 1
- Lower 3954 Model CV5 PCI Slot 2 Port 2: Upper 3955 SV5 - Controller B - Host 1
- Upper 3954 Model CV5 PCI Slot 1 Port 1: Upper 3955 SV5 - Controller A - Host 2
- Upper 3954 Model CV5 PCI Slot 1 Port 2: Lower 3955 SV5 - Controller A - Host 2
- Upper 3954 Model CV5 PCI Slot 2 Port 1: Upper 3955 SV5 - Controller B - Host 2
- Upper 3954 Model CV5 PCI Slot 2 Port 2: Lower 3955 SV5 - Controller B - Host 2

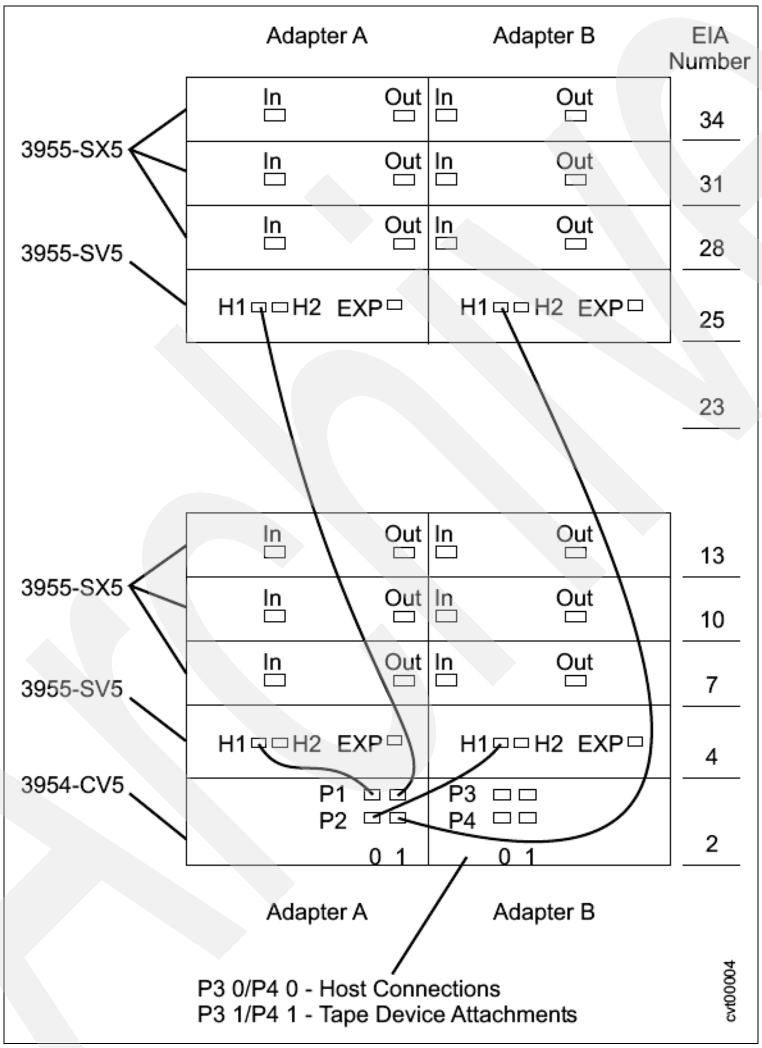



*Figure 5-6 Cabling two 3954-CV5s and two 3955-SV5s*

Figure 5-7 shows cabling between 3955 Model SV5 and 3955 Model SX5 in single 3952-F05 base frame. Whether the configuration is single 3954 Model CV5 or high availability, cabling between 3955 Model SV5 and 3955 Model SX5 is the same.

- 3954 Model CV5 left EXP Port: 3955 Model SV5 In Port
- 3954 Model CV5 right EXP Port: 3955 Model SV5 Out Port
- Upper 3955 Model SX5 Out Port: Lower 3955 Model SX5 In Port

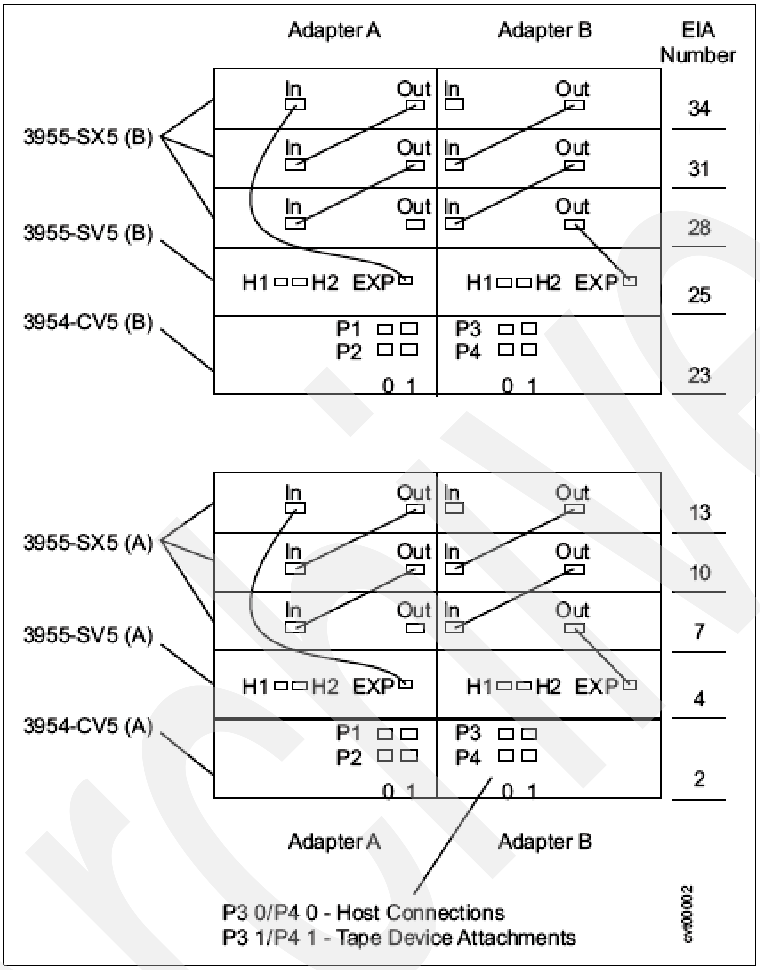



*Figure 5-7 Cabling two 3955-SV5s and one to three 3955-SX5s*

### IBM Virtualization Engine TS7510 external Fibre cabling

The adapters set on right side PCI slots should be connected to SAN clients or physical tapes. As mentioned previously, adapter 0 (Adapter PCI port 1 on PCI slot 3) and adapter 2 (Adapter PCI port 1 on PCI slot 4) are target mode to communicate with a SAN client. SAN client means hosts such as an i5/OS partition. Adapter 1 (Adapter PCI port 2 on PCI slot 3) and adapter 3 (Adapter PCI port 2 on PCI slot 4) are capable of being configured as both target mode and initiator mode. If the adapter is configured as initiator mode, it can be connected to physical tape for Import/Export function. Figure 5-8 shows which ports are target or initiator.

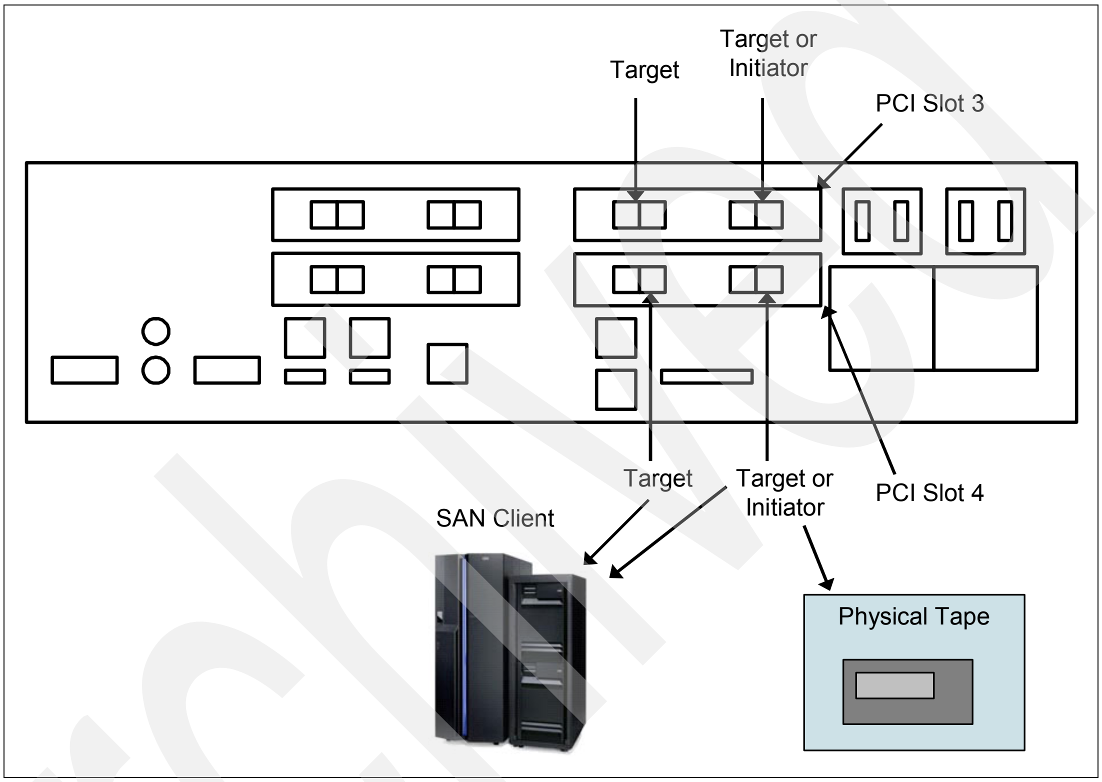



*Figure 5-8 IBM Virtualization Engine TS7510 external Fibre cabling*

## 5.2.4 Ethernet Connection

Ethernet 1 and Ethernet 2 ports carry both the inter-server health monitoring pulse, replication traffic, call-home traffic, Simple Network Management Protocol (SNMP) traps, and management control information. Both of these physical Ethernet interfaces will carry two IP addresses (in a failover configuration): One for the health monitoring traffic and one for all other functions. The RSA Ethernet port carries SNMP traps for the base 3954 CV5 server service events and provides a port for service login for field problem resolution.

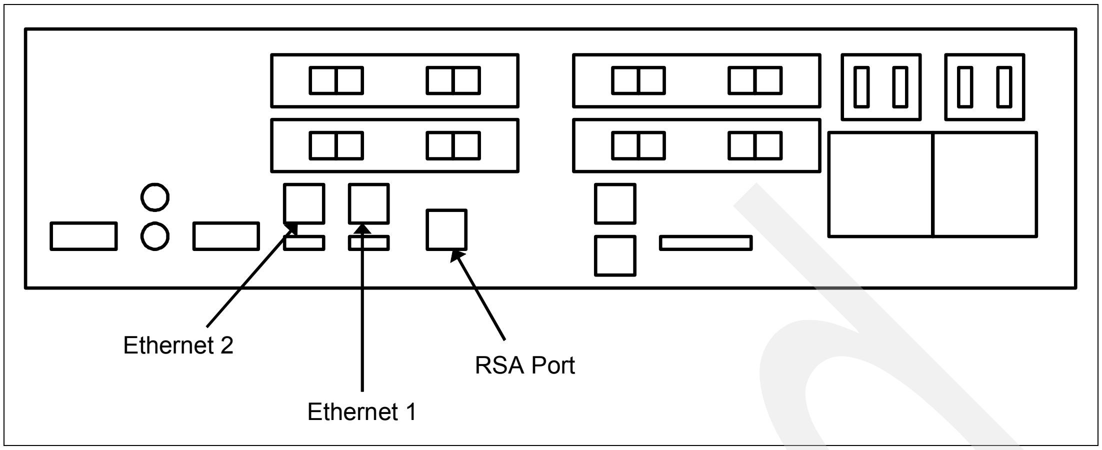



*Figure 5-9 3954 Model CV5 Ethernet ports and RSA port*

Each IBM Virtualization Engine TS7510 Server (3954 Model CV5) in the IBM Virtualization Engine TS7510 has Ethernet ports as shown in Figure 5-9. The factory default settings for these Ethernet ports are as follows:

- Left Port (Ethernet Port 2): DHCP enabled
  - This port is used for the Network Replication and Active/Active Failover features.
- Right Port (Ethernet Port 1): Static IP enabled (192.168.0.1, subnet mask 255.255.255.0)
  - This port is used for communication with the TS7510 Management Console.
  - This port is also used for the Network Replication and Active/Active Failover features.
- RSA Slimline: Static IP enabled (192.168.0.151, subnet mask 255.255.255.0)
  - This port is used for access from the TS7510 Management Console and is the primary service interface to the TS7510 Virtualization Engine.
  - This port is also used for e-mail and SNMP alerts to the system administrator.
  - RSA adapters that have not been initialized by manufacturing (including new FRUs) have a default IP of DHCP. If a DHCP host is unavailable, the RSA adapter assigns a static IP address of 192.168.70.125, subnet mask 255.255.255.0.

Use the Signal Cable labels (PN 95P3372) to correctly label the RSA, Ethernet-1, and Ethernet-2 cables for each 3954-CV5.

For initial communication with the TS7510 Virtualization Engine, the TS7510 Management Console must have its IP address configured for the same subnet (192.168.0.xxx, subnet mask 255.255.255.0). After communication between the TS7510 Management Console and Virtualization Engine has been established, the IP addresses of the TS7510 Virtualization Engine can be modified.

## 5.2.5 RSA configuration

**Important:** The information presented in this section is intended for properly authorized personnel to connect to the TS7510 and perform detailed analysis. It is not intended for normal customer operation with the TS7510. It is presented here only to indicate that the capability is available and provides information that can be discussed with the properly authorized service personnel. The RSA is available for a wide range of IBM xSeries servers.

To get more information about RSA, search `http://www.ibm.com` with "remote supervisor adapter II."

The 3954-CV5 has a RSA card to access and control the CV5 via a network for possible problem identification and analysis. You can use SNMP alerts to the SNMP server. Also RSA can be configured to generate e-mail alerts to the Simple Mail Transfer Protocol (SMTP) server. If you want to use these additional functions, refer to the *Remote Supervisor Adapter II User's Guide*.

You can attach your PC or laptop to RSA port on 3954-CV5. The port has an IP address that is assigned a factory default as follows:

**static IP** =192.168.0.151, **subnet mask** =255.255.255.0

The RSA port is used as the remote keyboard, mouse and video display for the 3954-CV5. You can access the RSA using Web browser via HTTP. The following steps show how to access the RSA.

Before you access to the RSA, assign accessible IP address to your PC and verify that your personal firewall does not block RSA access. For more information about RSA networking, refer to 5.3.4, "Setting the host name" on page 91.

1. From the TS7510 Management Console, or laptop, open a Web browser window and type the following: `http://x.x.x.x`, where *x.x.x.x* is the IP address of the RSA port.
2. Type the following default user ID and password. When you type the letters for the default user ID and password, ensure that you type all the letters in uppercase, and ensure that you use the number zero (0) in place of the letter "O" in PASSW0RD.
   - Remote Supervisor Adapter user ID: `USERID`
   - Remote Supervisor Adapter password: `PASSW0RD`
3. From the Remote Supervisor Adapter II Welcome USERID window, click the down arrow on the drop-down menu. Select **no timeout**, then click **Continue**.
4. From the Remote Supervisor Adapter II window, click **Tasks**, then **Remote Control**. See Figure 5-10.

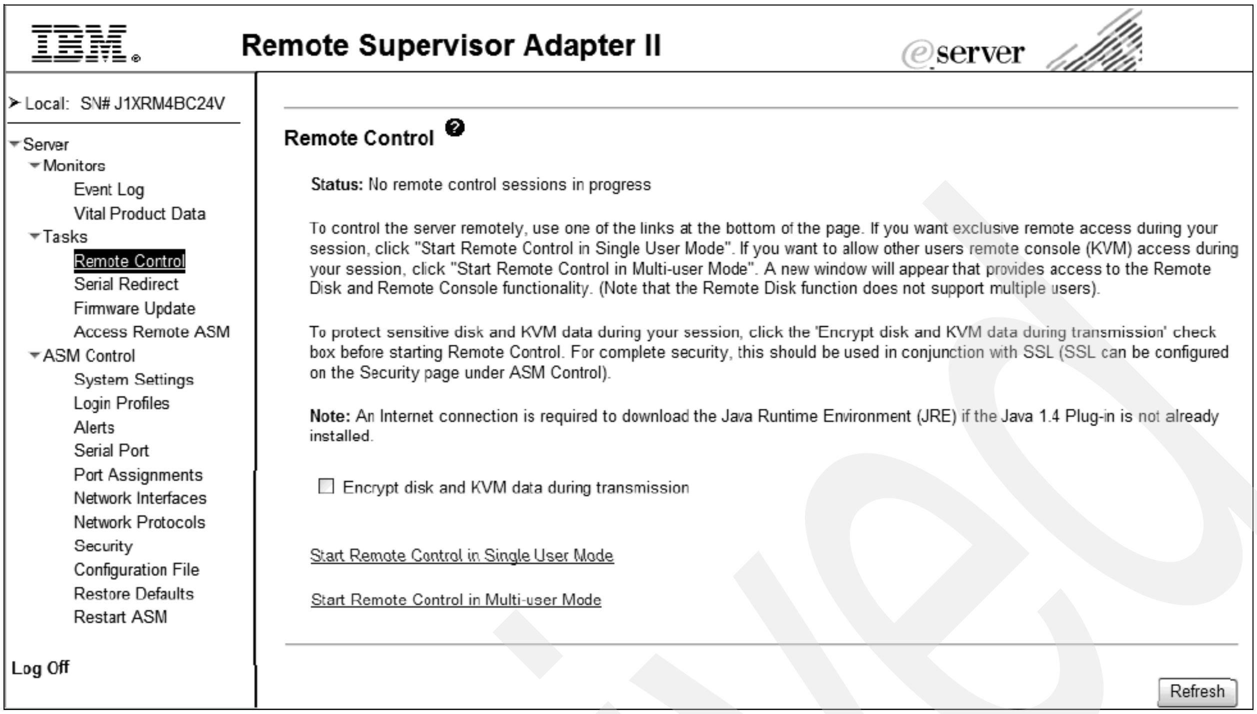



*Figure 5-10 Remote Supervisor Adapter II: Remote Control*

5. At the bottom of the window for Remote Supervisor Adapter II - Remote Control, select **Start Remote Control in Multi-user Mode**.
6. Now you can see the Remote Console for 3954-CV5 as shown Figure 5-11. Type the following default user ID and password.
   – User ID: `VETAPESERVICE`
   – Password: `SERVICE4U`

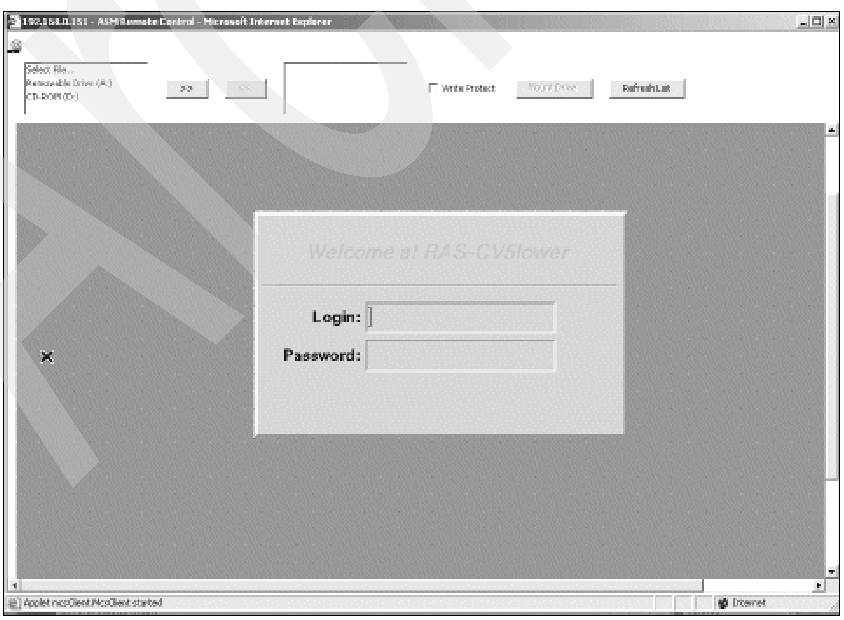



*Figure 5-11 Remote Supervisor Adapter II: 3954 Model CV5 Login window*

If you want to customize RSA IP address, restart 3954-CV5 and Press F1 to invoke the 3954-CV5 BIOS during the boot sequence on RSA Remote Console. You can see the BIOS screen as shown Figure 5-12.

1. From the Configuration/Setup Utility menu, use the down arrow on your keyboard to scroll down to **Advanced Setup**. Press Enter.

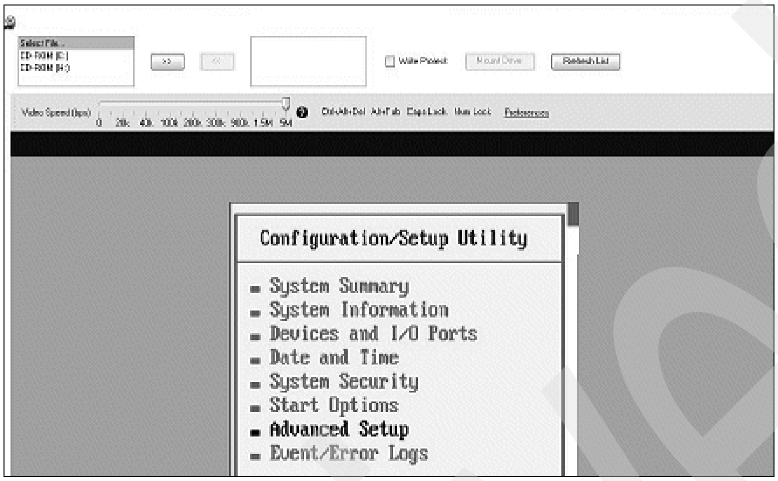



*Figure 5-12 Remote Supervisor Adapter II: BIOS Configuration/Setup Utility menu*

2. From the Advanced Setup menu (Figure 5-13), select **RSA II Settings**.

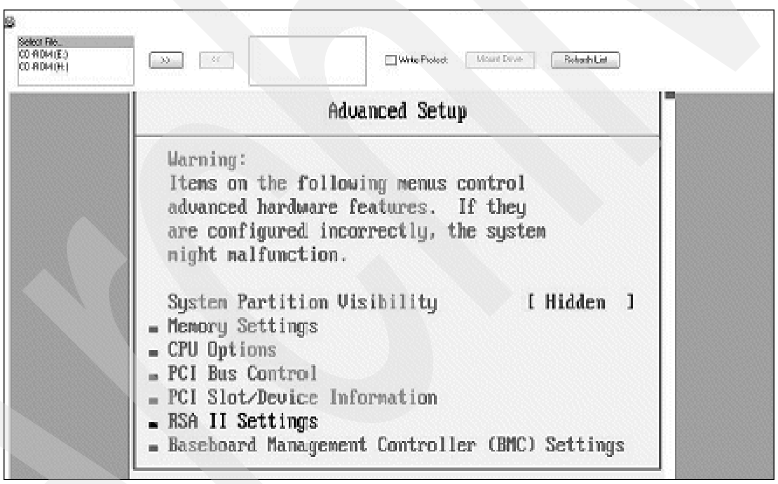



*Figure 5-13 Remote Supervisor Adapter II: BIOS RSA II Settings*

3. In Figure 5-14, you can configure **RSA IP address settings**.

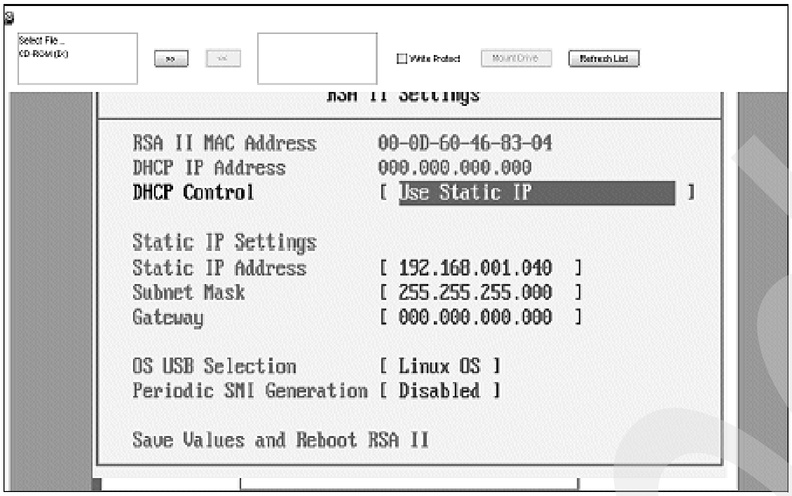



*Figure 5-14 Remote Supervisor Adapter II - BIOS RSA II IP address settings*

### RSA BIOS update

Determine whether or not you have the firmware installed. If you have the firmware installed, you should not do RSA BIOS update. If you do not have the firmware installed, perform the following steps:

1. From the Remote Supervisor Adapter II window as shown Figure 5-10 on page 80, select **Firmware Update** from the left menu.
2. Browse to the Base Firmware Update CD. 2. Select the **3955-Disk** directory, then the **RSA** subdirectory.

> **Note:** Firmware files are on the Base Firmware Update disk.

3. Select the appropriate firmware file to install.
4. Click **Update**.

## 5.3 Installing IBM Total Storage Virtualization Engine TS7510 Console

For configuration, management, and service support of the IBM Virtualization Engine TS7510, IBM provides a graphical user interface (GUI), which is called Virtualization Engine for Tape Console. The installation package, which contains the Virtualization Engine for Tape Console, is provided on a CD. You must install this Virtualization Engine Console on the Management Console server and, for your convenience, you can also install the Virtualization Engine Console on additional servers. The system must be a Microsoft Windows machine as described below.

- Hardware requirements
  - x86 (Pentium® or later) microprocessor
  - 512 MB memory
  - 175 MB of disk space for Virtualization Engine Console
  - Keyboard, mouse, and CD-ROM drive

– Super VGA monitor (at least 800 x 600 and 256 colors)
– One Ethernet port for attachment to the TS7510 management network
– One additional Ethernet port recommended for Internet access
– A Web browser and Java™-2 Java Runtime Environment (JRE™) installed

- Supported operating environments
  – Windows 2000 with Service Pack 4 (SP4)
  – Windows 2000 Advanced Server SP4
  – Windows 2000 Datacenter Server SP4
  – Windows 2003 Server Enterprise Edition
  – Windows 2003 Datacenter Edition

## 5.3.1 Installing IBM TapeSystem Virtualization Engine for Tape Console

Installing IBM TapeSystem Virtualization Engine for Tape Console is done by mounting the CD (Figure 5-15) marked LCD8-0207-xx, part number 23R3005 in your PC's CD tray.


*Figure 5-15 IBM Total Storage Virtualization Engine TS7510 Console: Installation CD*

It automatically launches the installation wizard. Perform the following steps:

1. Enter details or make changes as appropriate and click Next >.

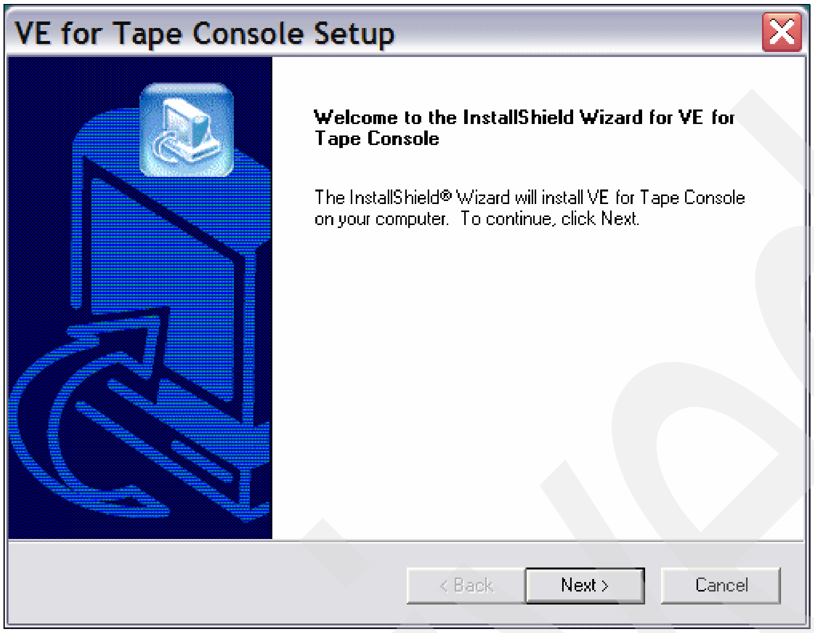



*Figure 5-16 IBM Total Storage Virtualization Engine TS7510 Console: Welcome*

2. The window shown in Figure 5-17 opens. Accept the license agreement. Click **Accept**.


*Figure 5-17 IBM Total Storage Virtualization Engine TS7510 Console: License Agreement*

3. Type in your user name and company name, as shown in Figure 5-18.

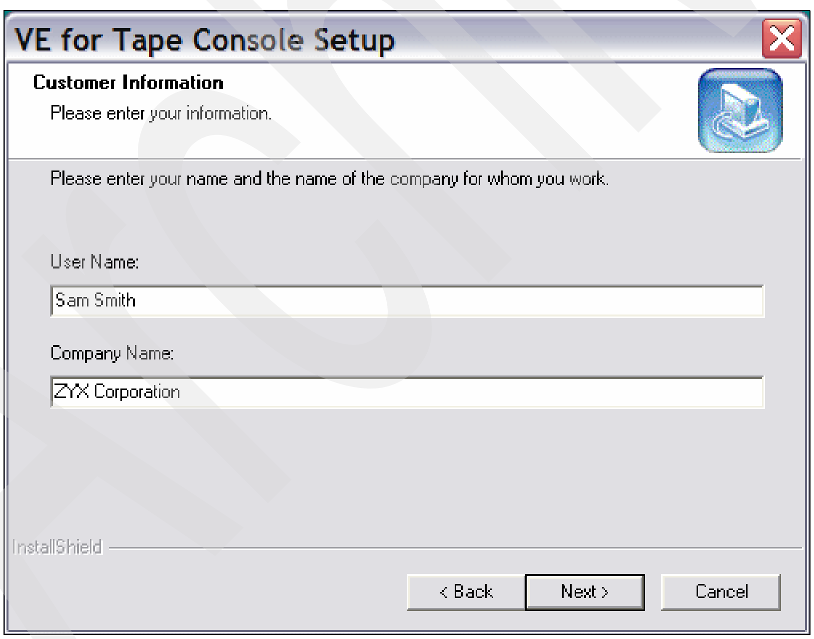



*Figure 5-18 IBM Total Storage Virtualization Engine TS7510 Console: Customer Information*

4. Accept or change the installation path. Click **Next**, as shown in Figure 5-19.

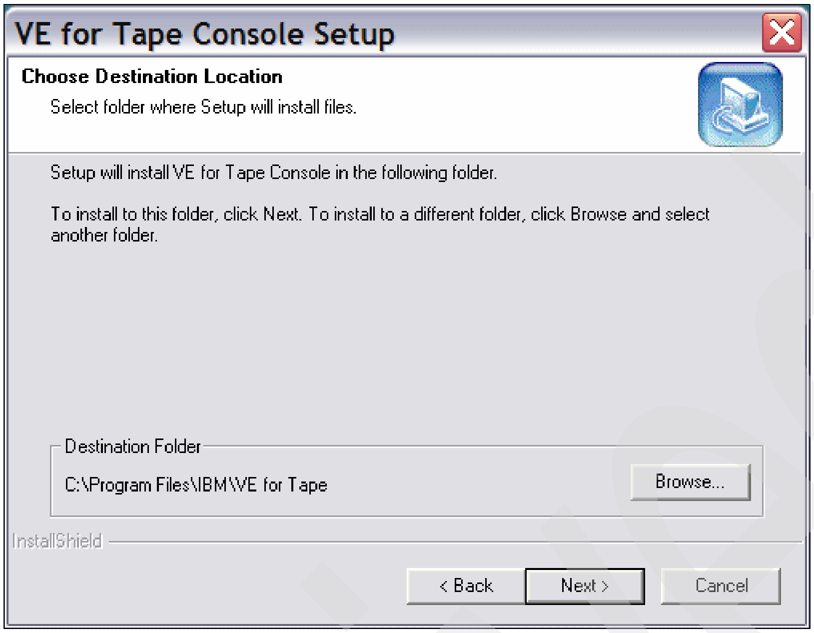



*Figure 5-19 IBM Total Storage Virtualization Engine TS7510 Console: Choose destination*

5. Accept or change the folder name in the Select Program Folder window, as shown in Figure 5-20. Click **Next**.


*Figure 5-20 IBM Total Storage Virtualization Engine TS7510 Console: Select folder*

6. Start copying files by clicking **Next**, as shown in Figure 5-21.

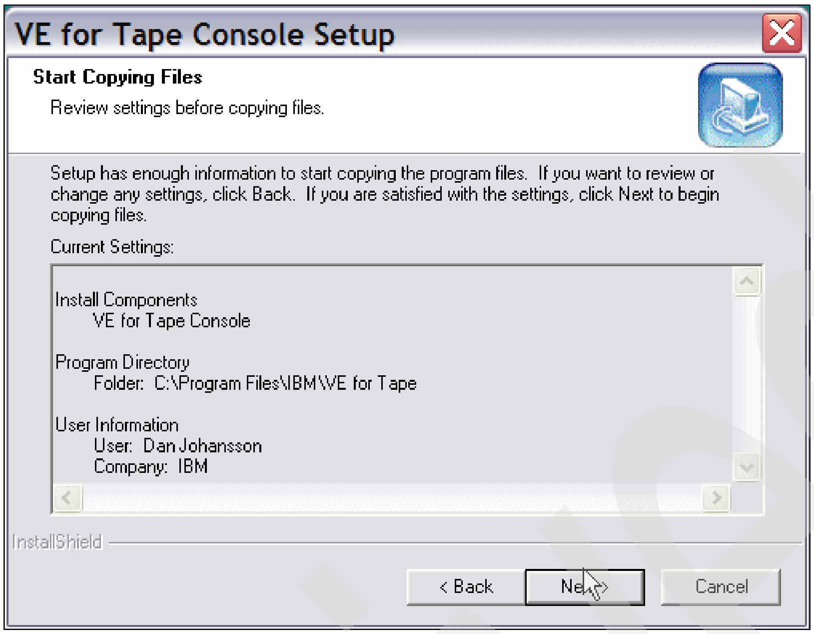



*Figure 5-21 IBM Total Storage Virtualization Engine TS7510 Console: Start copying files*

A progress window is shown (Figure 5-22).

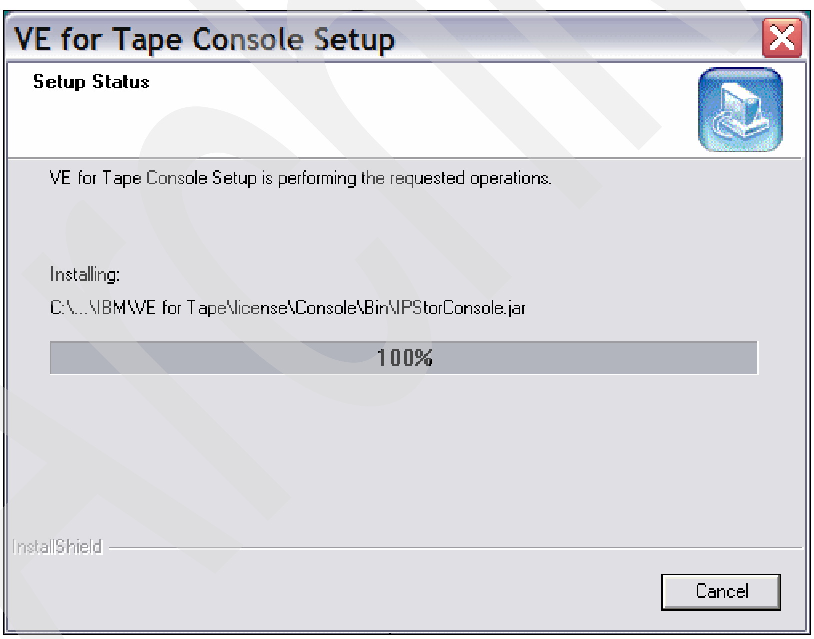



*Figure 5-22 IBM Total Storage Virtualization Engine TS7510 Console: Copying files*

7. Figure 5-23 shows that the installation is completed. Click **Finish**.

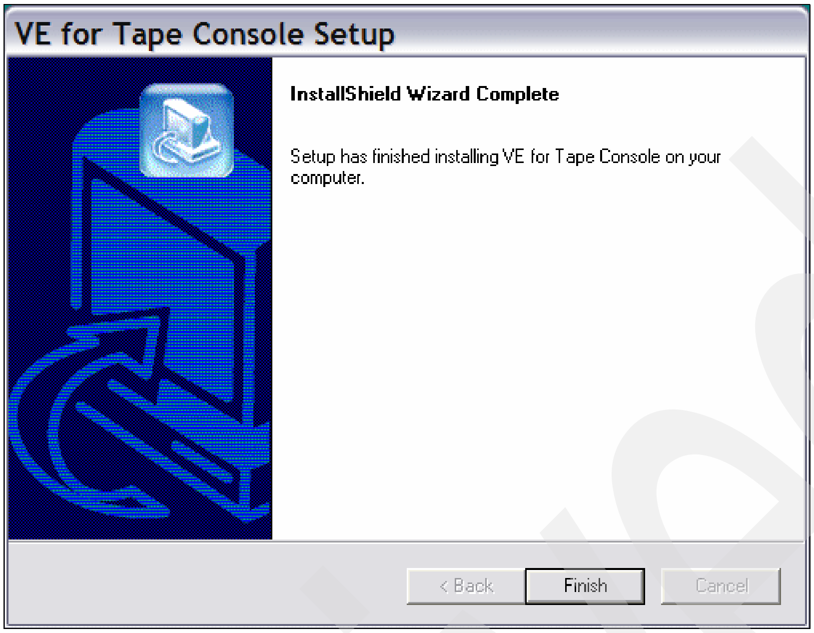



*Figure 5-23 IBM Total Storage Virtualization Engine TS7510 Console: Installation complete*

8. Remove the CD from the tray.

   Do not forget to back up your PC.

> **Note:** To launch the Management Console, either click the **TS7510 Virtualization Engine Management Console** icon on your desktop, or select **Start** → **Programs** → **IBM** → **VE for Tape** → **VE for Tape Console**.

## 5.3.2 Connecting to IBM Virtualization Engine TS7510

To connect to your TS7510 Virtualization Engine, perform the following steps:

1. Right-click the TS7510 Virtualization Engine Servers object and select **Add**.
2. Enter the IP address for the system to which you are connecting.

   > **Note:** If it is a first time connection, default network settings is configured on IBM Virtualization Engine TS7510. The following is the default network setting. Therefore, you have to assign static IP address to your PC and access to the following IP address directly.
   >
   > Right Port (Ethernet Port 1): Static IP enabled (192.168.0.1, subnet mask 255.255.255.0)

3. Log in using the default user name and password that was provided by your system installer, as shown in Figure 5-24.

   > **Note:** The default user ID and password are as follows:
   >
   > – Default user name: `VETAPEUSER`
   > – Default password: `VEUSERPASSWORD`

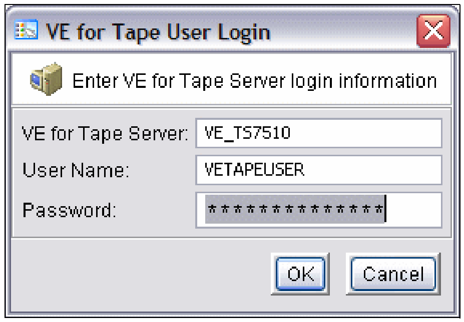



*Figure 5-24 Add connection to IBM TapeSystem Virtualization Engine for Tape Console*

If the connection is successful, you can see the server on Virtualization Engine for Tape Console. See Figure 5-25.

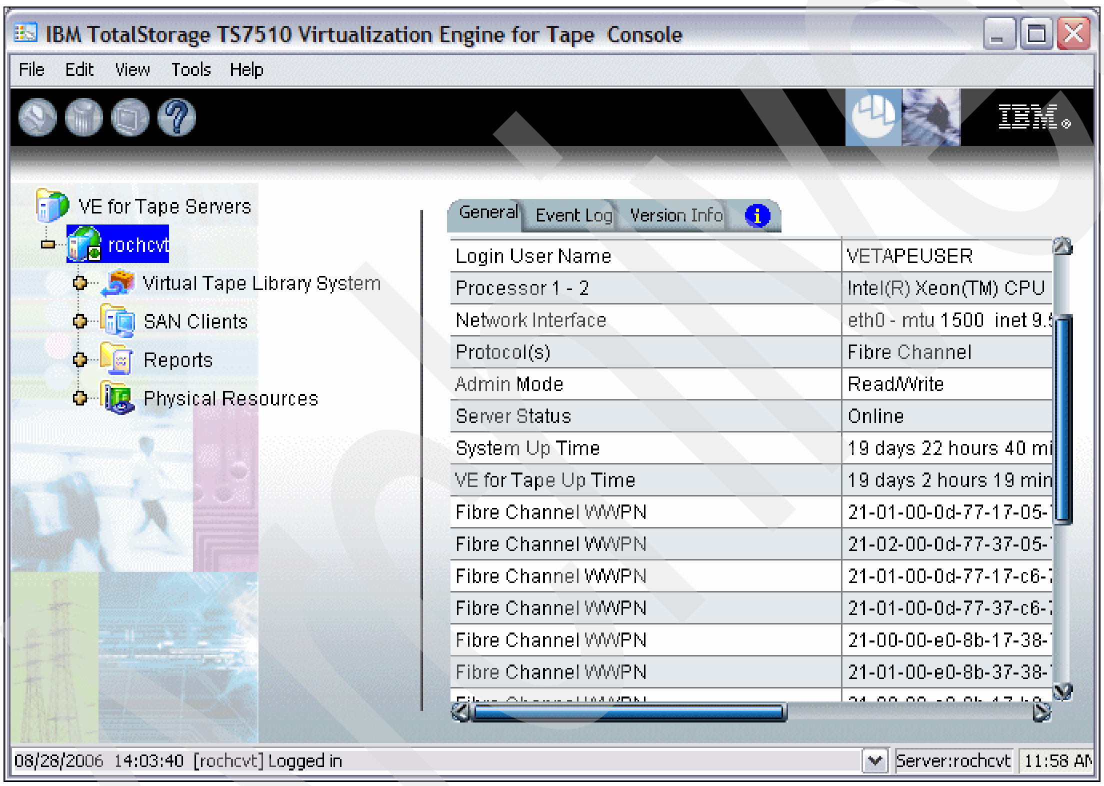



*Figure 5-25 Connecting to IBM Virtualization Engine TS7510*

## 5.3.3 Setting network information

When the IBM Virtualization Engine TS7510 hardware and Virtualization Engine for Tape Console were installed, default network setting was configured. Therefore, several configuration tasks were required. Now you have to set up information (such as IP addresses) that is specific to your network.

1. Right-click your IBM Virtualization Engine TS7510 server and select **System Maintenance** → **Network Configuration**.

2. Enter the following information about your network configuration:
   – Domain name: Internal domain name
   – Append suffix to DNS lookup: If a domain name is entered, it will be appended to the machine name for name resolution.
   – DNS: IP address of your DNS server
   – Default gateway: IP address of your default gateway

   > **Note:** In a single-node (non-failover) configuration, you must assign a dummy IP address to the ETH1 gateway or you will receive an error message.

   – NIC: List of Ethernet cards in the server

   See Figure 5-26.

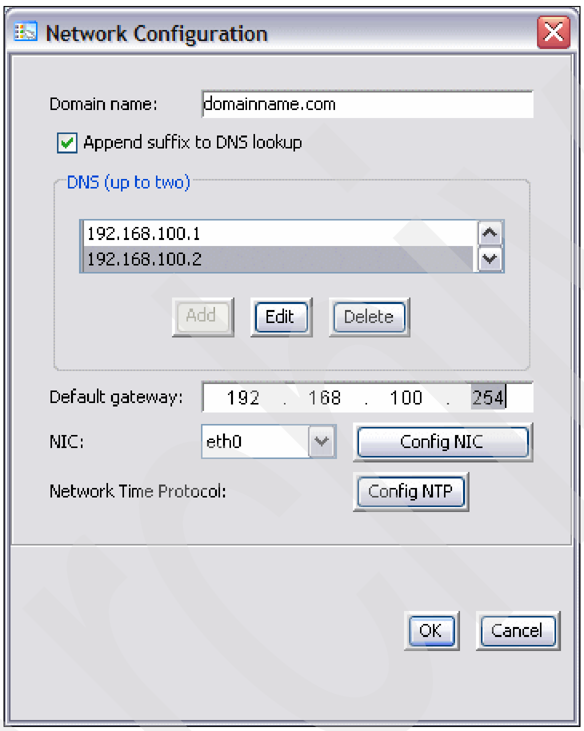



*Figure 5-26 Network Configuration for IBM Virtualization Engine TS7510 server*

3. Select **eth0** in the NIC: selection field and click **Config NIC** to configure each NIC.

4. Configure IP address for NIC eth0, as shown in Figure 5-27.

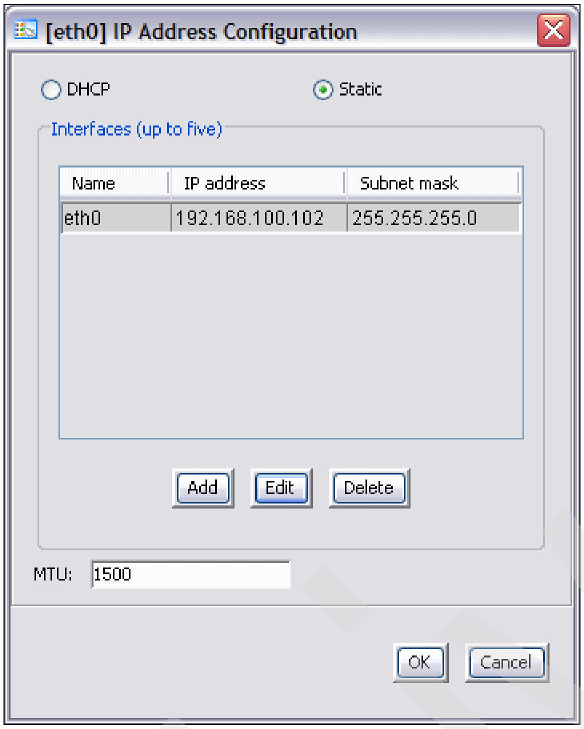



*Figure 5-27 IP Address Configuration*

> **Note:** If you select Static, you must click the **Add** button to add IP addresses and subnet masks.
>
> In the MTU field, set the maximum transfer unit of each IP packet. If your network environment supports it, set this value to 9000 for jumbo frames.

## 5.3.4 Setting the host name

To set the host name, perform the following steps:

1. Right-click your server and select **System Maintenance** → **Set Hostname**.
2. Enter a valid host name, as shown in Figure 5-28.

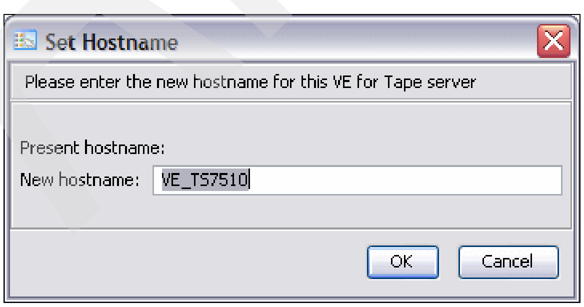



*Figure 5-28 Set Hostname*

3. A warning appears (Figure 5-29), click **Yes**.

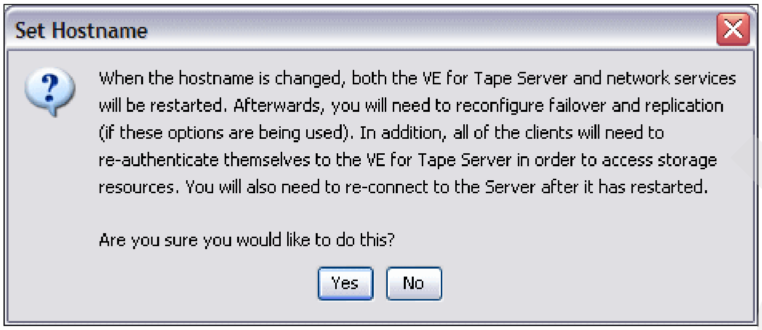



*Figure 5-29 Set Hostname Notification*

> **Note:** When you change its host name, Virtualization Engine for Tape Console network services will be restarted. It takes some time and you require re-authentication.

## 5.3.5 Changing the default password

Next you should change the default password. If the password remains as a default, anybody can connect to IBM Virtualization Engine TS7510. If you want to add another administrative user, see "Administrative User" on page 120.

1. Right-click your TS7510 server and select **Change Password**.
2. In the window that opens, type the original password (`VEUSERPASSWORD`), type the new password, and then type the new password again to confirm it.

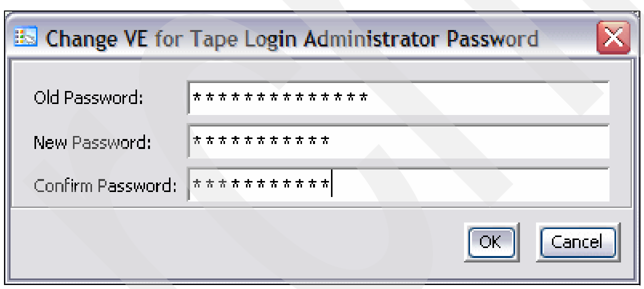



*Figure 5-30 Changing Administrator Password*

## 5.3.6 Changing the console option

For your convenience, you can change some console options, such as remember password or timeout for logging out. As shown in Figure 5-31 on page 93, we changed the timeout value to 0 so that we are never logged out.

Here, you also have the possibility to enable the advanced tape creation method. With this method, you can create different configurations, which do not follow rules for real tape. Use care if you create a configuration that deviates from real tape. Such configurations might not be supported by your backup application.

Without the advanced tape creation method, which is the default method, the creation of tape libraries and tape drives follow the rules of a real physical tape. Therefore, most of the required settings are predefined and must not be chosen by the user. For example, the volume size is predefined based on the cartridge type.

**Important:** We recommend that you do *not* use the advanced tape creation method, unless you need it and know exactly what you are doing.

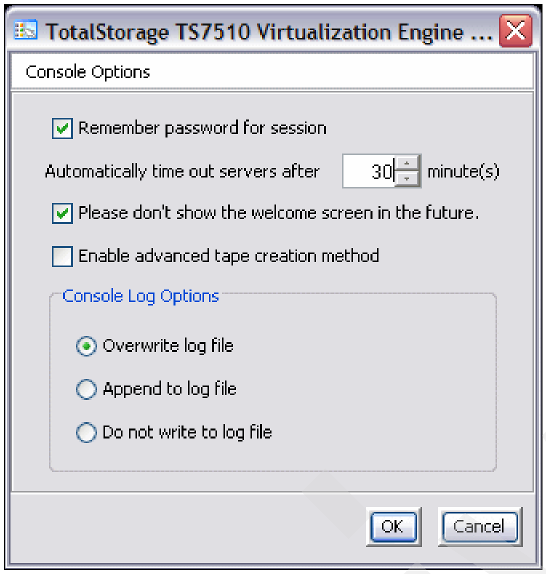



*Figure 5-31 Console Options window*

## 5.3.7 Setting Fibre mode

Four Fibre Channel ports are available for connection to the backup server and to the native tape drives and libraries. Two of the four ports are already set up as the initiator for host connections:

- **Adapter 0** (PCI Slot 3, Port 1)
- **Adapter 2** (PCI Slot 4, Port 1)

The two other ports are interchangeable either for real tape connections or for host connections. By default, those two adapters are set up for real tape connections:

- **Adapter 1** (PCI Slot 3, Port 2)
- **Adapter 3** (PCI Slot 4, Port 2)

An i5/OS partition or several other operating systems might need configuration adjustments if a real physical tape is connected to the TS7510. In general, this is not recommended. However, if you do this, adapter 1 and adapter 3 should be specified as target mode. Then all four ports could be available to i5/OS or other operating systems.

To change the interchangeable adapters:

1. Select **Physical Resources** → **Storage HBAs**. Right-click the adapter that you want to change and select **Enable Target Mode**, as shown in Figure 5-32.

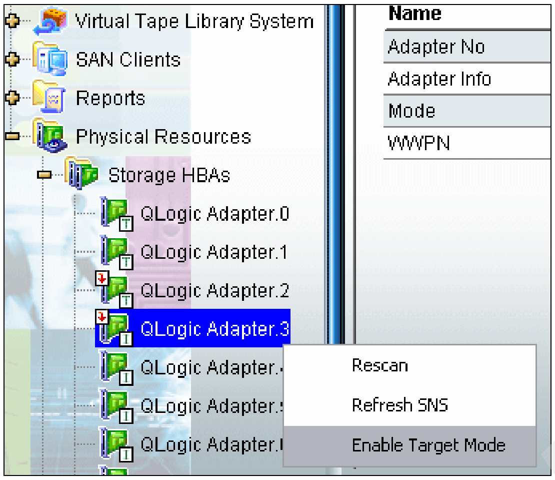



*Figure 5-32 Selecting the Enable Target Mode option*

2. In the Enable Target Mode window (Figure 5-33), select the **Soft Alpa creation method** option and click **OK** to enable the target mode.

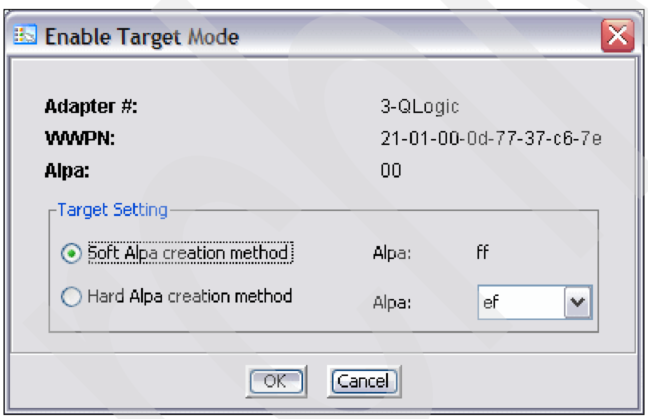



*Figure 5-33 Enable Target Mode window*

## 5.4 Setting up virtual tape library

The IBM Virtualization Engine TS7510 comes preconfigured with two virtual IBM 3584 libraries per 3954-CV5 Virtualization Engine. Each library comprises 12 virtual LTO-2 tape drives and 117 slots. Each library is preconfigured with virtual tape cartridges. The number of tape cartridges that are preconfigured is proportional to the total system capacity. Each default library and the associated drives have been assigned to the Everyone_FC client, and two of the four QLogic adapter ports are set to target mode (0 or 2). The default libraries are accessible as soon as the TS7510 is powered on. You can immediately start using these libraries without any additional configuration necessary through the VE Console.

## 5.4.1 Creating libraries, tape drives, and cartridges

You can use the default libraries, if they are suitable for your usage, or you can change or delete the default libraries, and you can create additional new libraries. Keep in mind the following rules:

- Up to 64 virtual libraries are supported by one single node.
- Up to 512 virtual drives are supported by one single node.
- Up to 4096 virtual tape cartridges are supported by one single node.
- One virtual library can contain same type drives.
  - No mixed configuration is supported.
  - LTO2 and LTO3, therefore, cannot exist in one virtual library.

For detailed information about how to create and change a virtual library, refer to the *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769.

To create a virtual tape library, follow these steps:

1. As shown in Figure 5-34, right-click the **Virtual Tape Library System** icon and select **New**. This starts the Creating Virtual Tape Library Wizard.

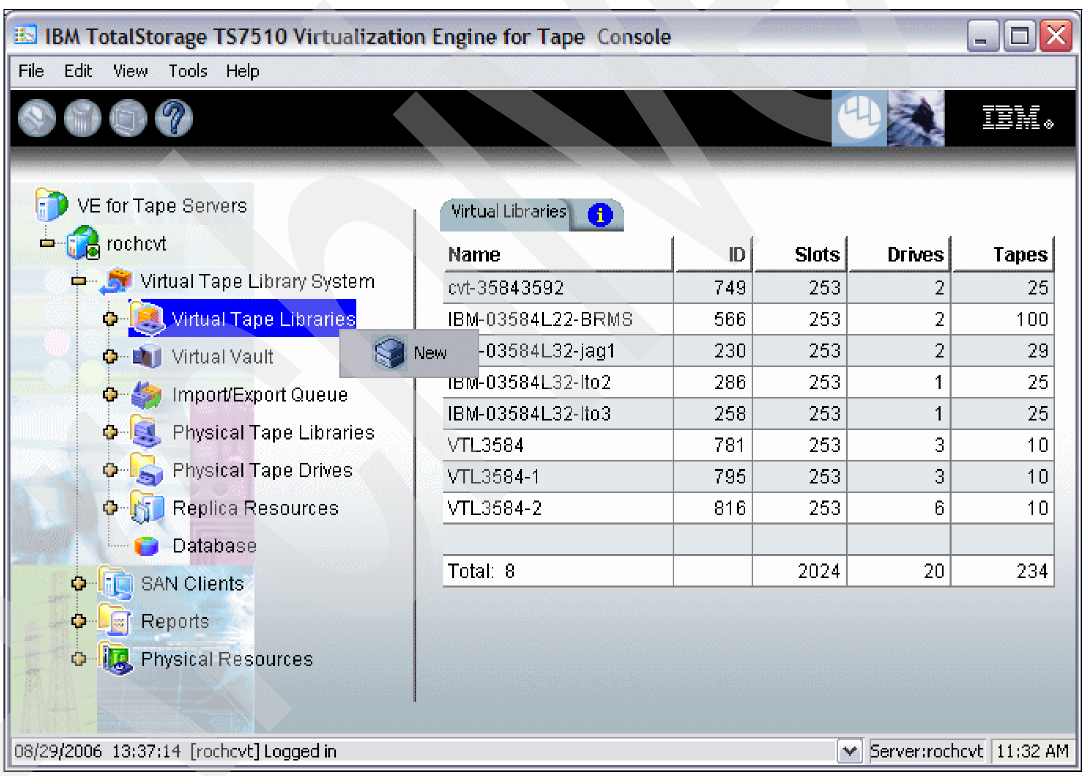



*Figure 5-34 Starting to create a new virtual library*

2. In the Specify Virtual Library Name and Type panel (Figure 5-35), select the library type, and type a name for the new virtual library.

   For all other applications, use IBM 3584-L32. In this example, for the library type, we select **IBM 3584-L32** and for Virtual Library Name, we enter `IBM-03584L32-123456`. Then click **Next**.

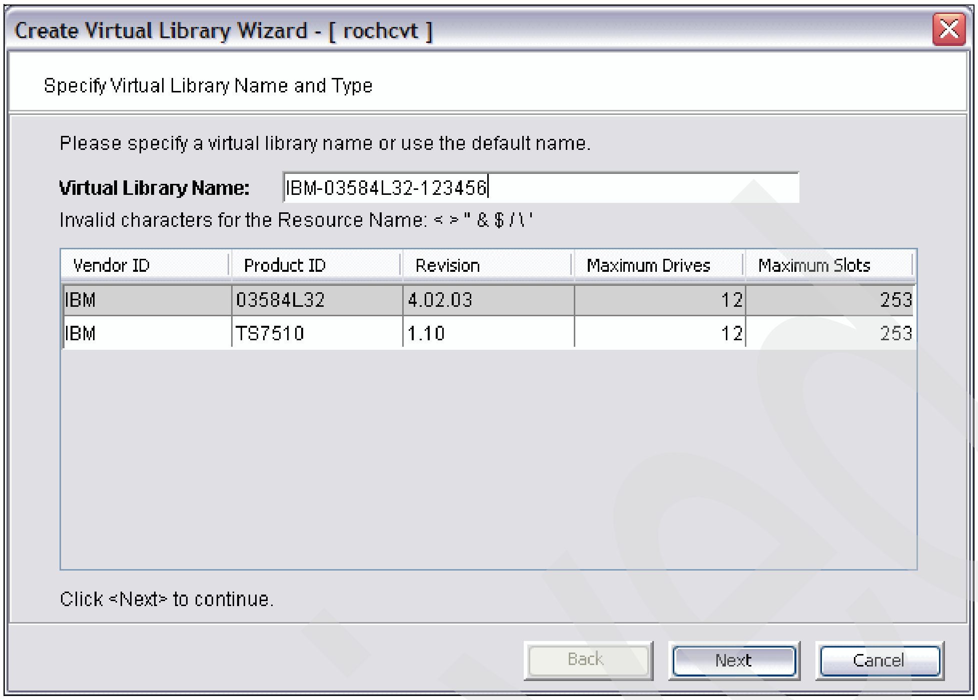



*Figure 5-35 Specify Virtual Library Name and Type panel*

3. Define the virtual tape drive. As shown in the Enter Virtual Drive Information panel (Figure 5-36), you can choose either **LTO Ultrium Generation 2**, **LTO Ultrium Generation 3**, or **3592-J1A** as the tape drive.

   In the example, after selecting **ULTRIUM 3** and specifying Virtual Drive Name Prefix, we click **Next**.

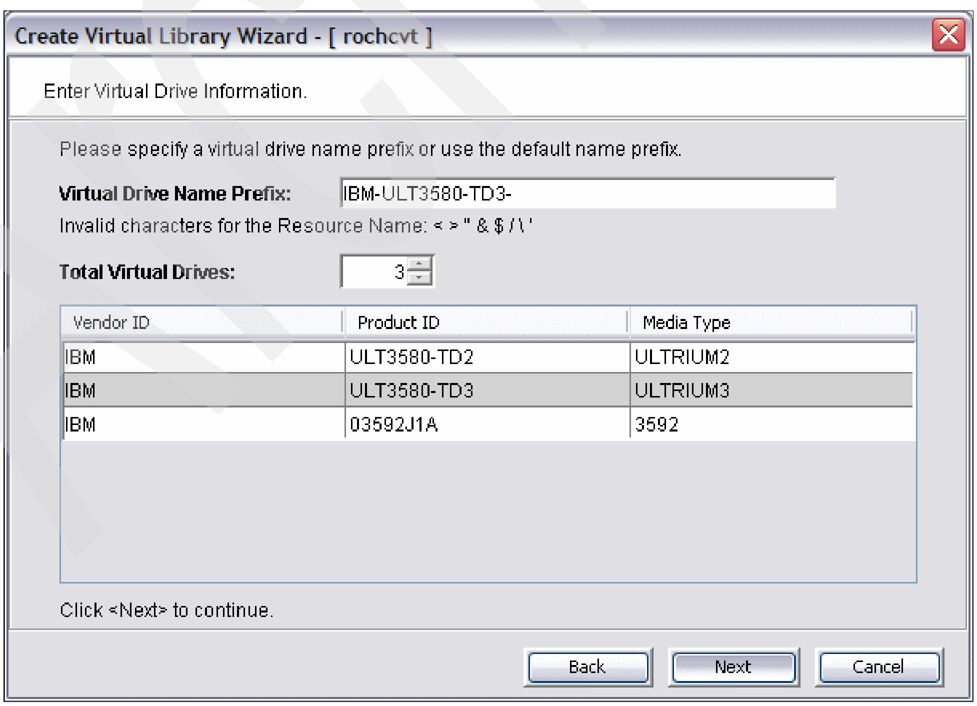



*Figure 5-36 Selecting the tape drive*

4. In the Enter Virtual Library Information panel (Figure 5-37), we can select Auto Archive / Replication. You can select this option if the TS7510 should automatically move or copy virtual volumes to physical tape or to another TS7510, whenever a virtual tape volume is moved to the input/output station (I/O station)

   But Auto Archive function is for a non-System i platform. If this virtual tape library assigns to only i5/OS, you should not select Auto Archive. If another Virtualization Engine TS7510 is available for replication, you can select Auto Replication function.

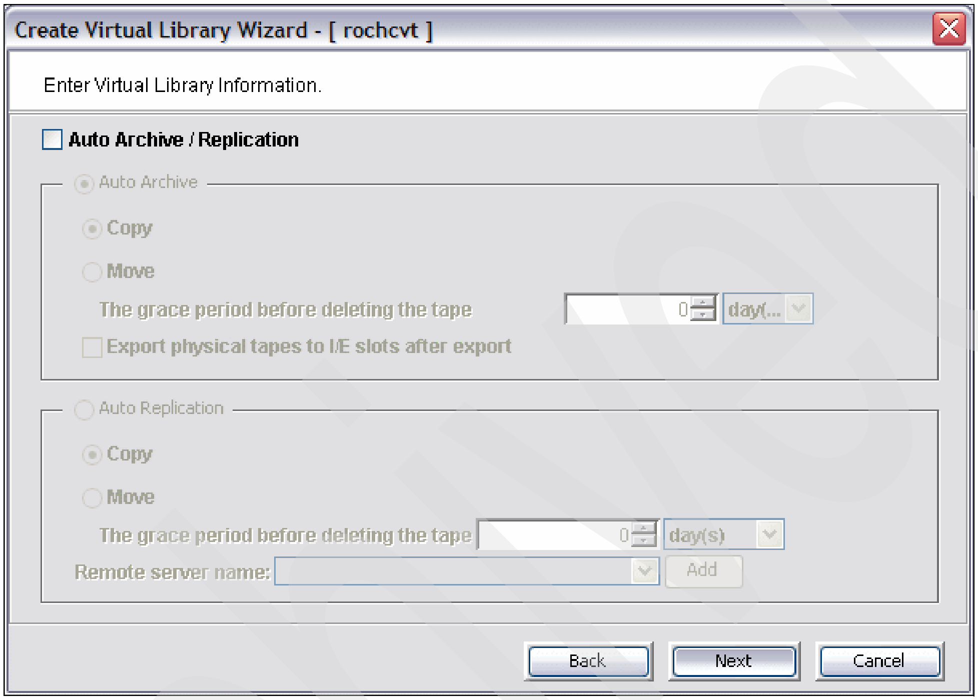



*Figure 5-37 Selecting the Auto Archive / Replication option*

5. In the next panel (Figure 5-38 on page 98), specify a volume range. This defines only the barcode range for the virtual volumes, but does not create the virtual volumes.

   In our example, we select a different barcode range than our physical tape library has in use. As you can see in Figure 5-38 on page 98, we choose the volume range `AA0000` to `AA0099`.

   Also in this panel, you can select the size of the virtual library slots and the size of the Import/Export Slots. We want to create an virtual library with **253** slots to allow for a possible growth in the next few years. You can use the Export to physical tape check box to limit the maximum size of a virtual tape in order to match a physical cartridge. We leave the I/O station at the default of **10** slots.

   Click **Next**.

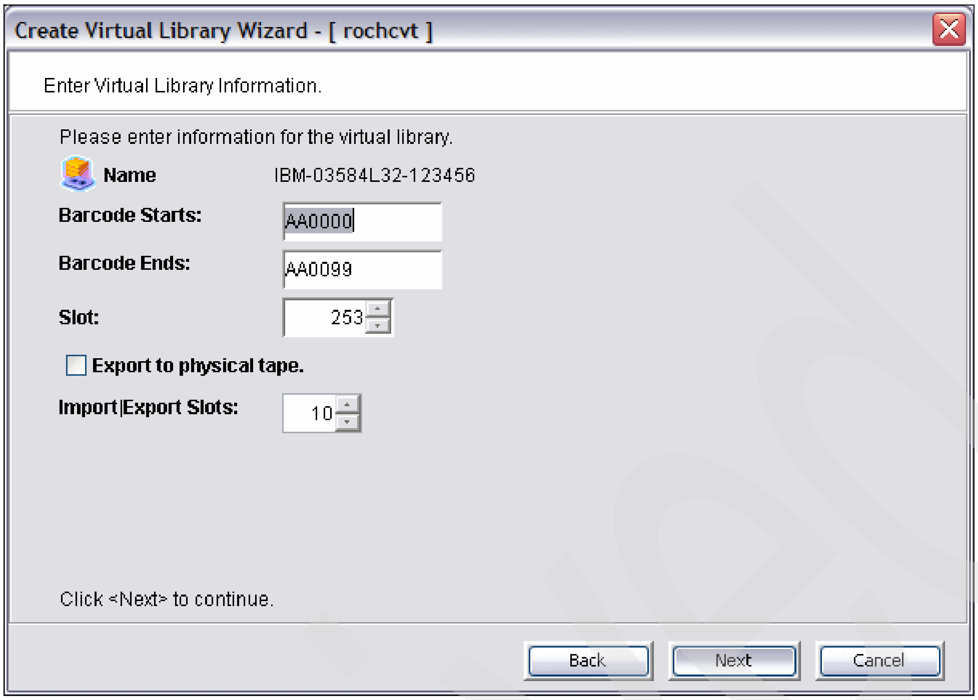



*Figure 5-38 Virtual volume barcode range*

6. In the Create Virtual Library panel (Figure 5-39), verify the details and click **Finish** if it is correct. Then the virtual library is created and creation status is shown (Figure 5-40 on page 99).

   Click **Finish**.

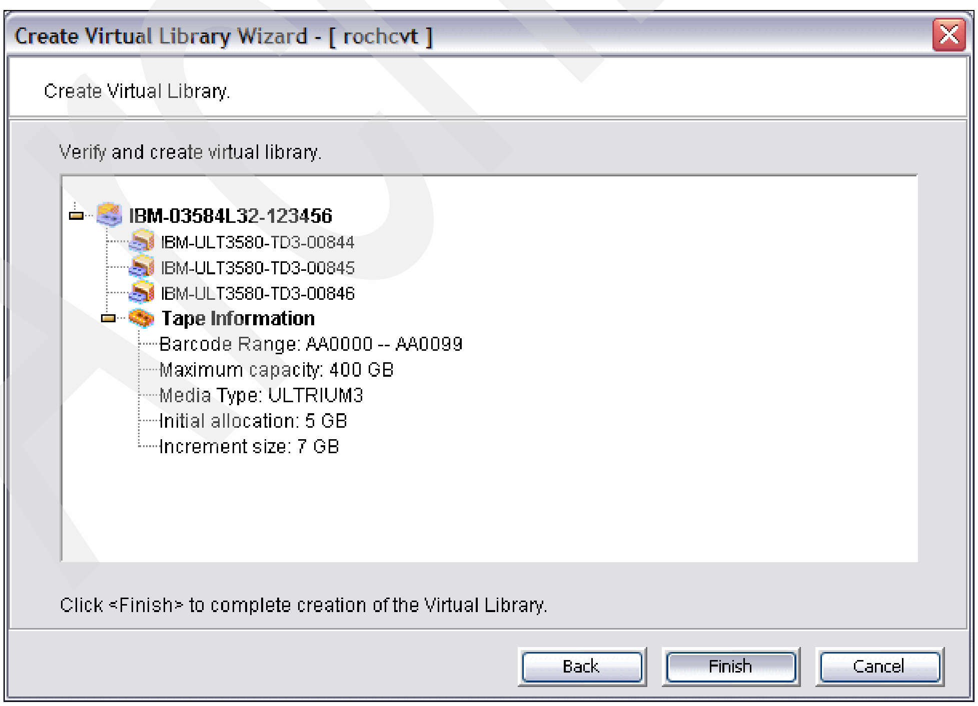



*Figure 5-39 Virtual library details*

7. The Virtual Tape Library Creation Status window opens as shown in Figure 5-40. **Click OK**.

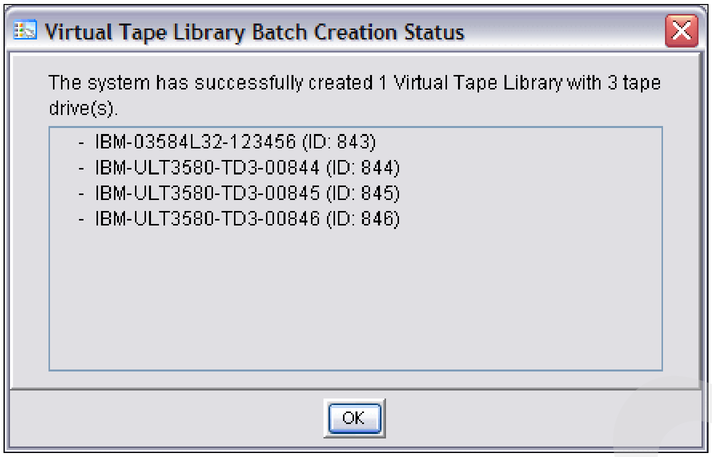



*Figure 5-40 Virtual Tape Library Creation Status*

8. After you create the virtual library, you are asked to create tapes for the virtual tape library just created, as shown in Figure 5-41. Then you can create virtual volumes.

   Click **Yes**.

.

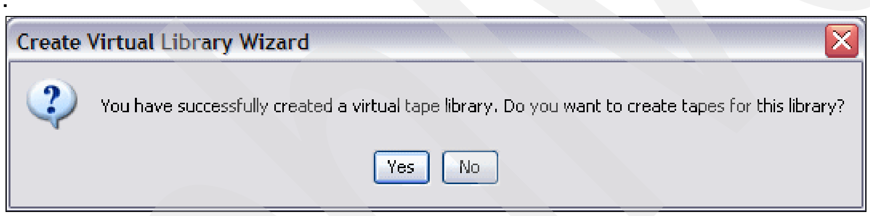



*Figure 5-41 Create tape volume wizard*

   The Create Virtual Tape Wizard starts.

9. In the Specify Batch Mode Information panel (Figure 5-42 on page 100), you can choose the initial virtual tape size. The default size for all media types is 5 GB. This means that at least 5 GB of space is required for all virtual tape volumes. You can change this value, but it is not necessary, because while writing to a virtual volume, the volume expands its size in increments defined by the increment size. The increment size is 5 GB for LTO2 and 3592 and 7 GB for LTO3. In this example, we keep the default initial size.

   Click **Finish**.

   The TS7510 creates 10 virtual tapes with barcode labels that match the physical barcode labels and have an initial size of 5 GB.

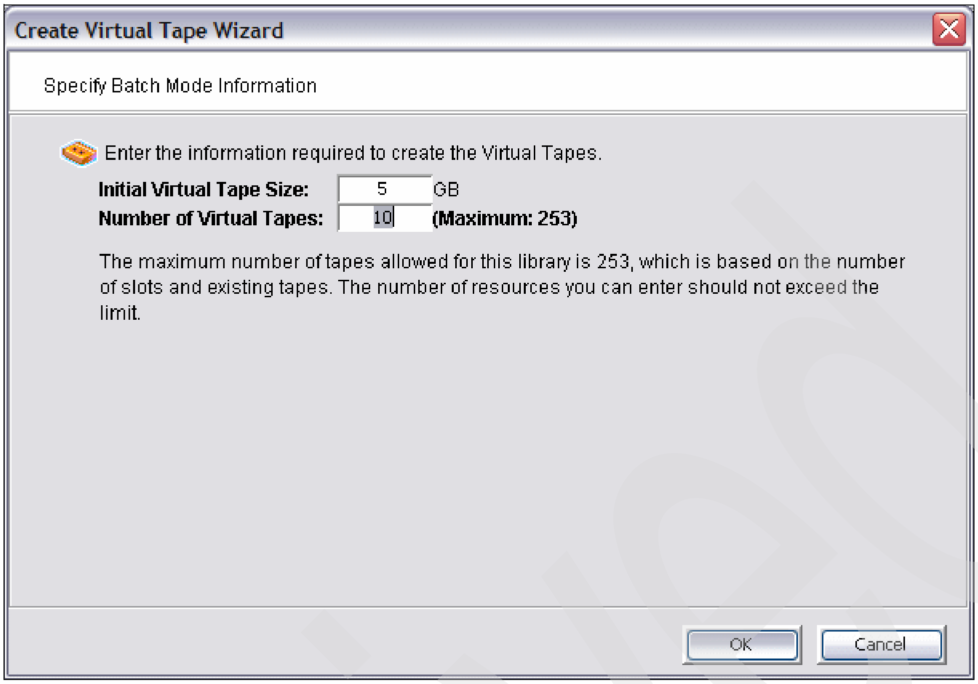



*Figure 5-42 Setting the initial virtual tape size*

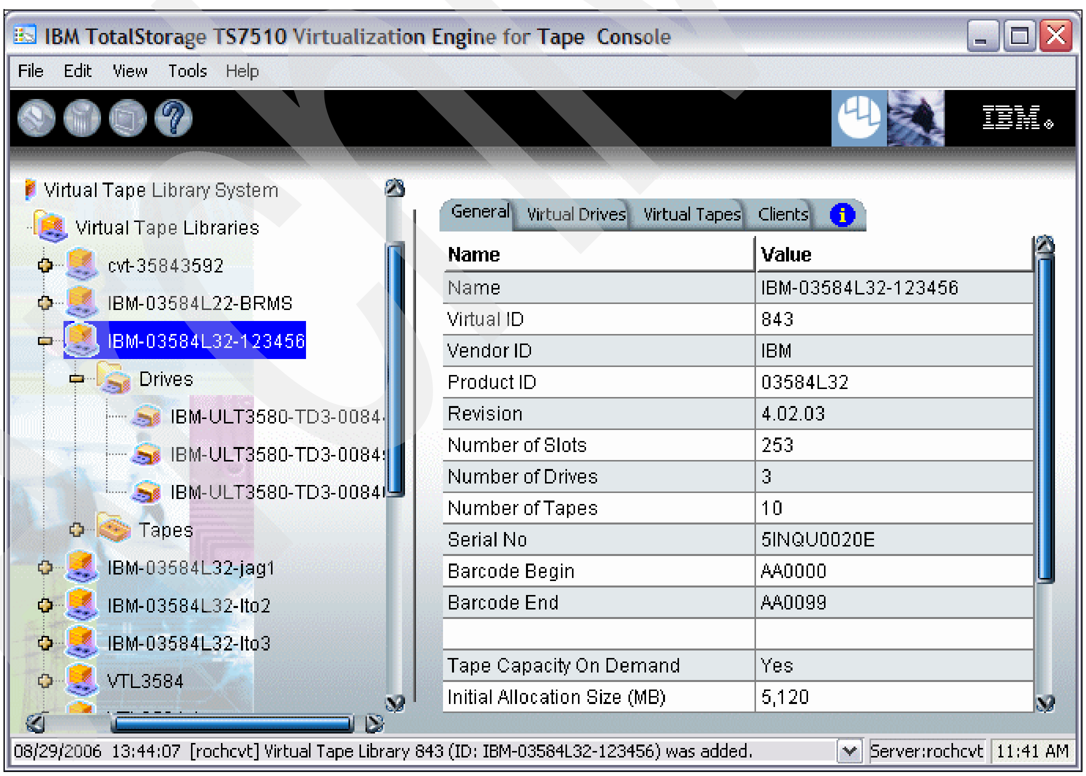



*Figure 5-43 Virtual library summary*

Figure 5-43 shows an overview of the newly created library. We have now created a virtual library. Other than the libraries that are already created by default, this newly created library is not yet assigned to any host. Therefore, to make this library usable by any host, we must add SAN Clients to IBM Virtualization Engine TS7510, which is explained in 5.4.2, “Adding an i5/OS partition as a SAN client to IBM Virtualization Engine TS7510”. Also we must assign a host to the library, which is explained in 5.4.3, “Assigning a host to a library and drives” on page 105.

### 5.4.2 Adding an i5/OS partition as a SAN client to IBM Virtualization Engine TS7510

In the physical world, you assign tape drives and tape libraries to a host by creating appropriate SAN zones. With SAN zones, you can separate hosts from connecting to every tape drive. With the tape virtualization of the IBM Virtualization Engine TS7510, you can have several tape drives and several tape libraries on one single Fibre Channel port. Therefore, SAN zoning, which is based on Fibre Channel ports, might not be sufficient for separating hosts. For that reason, the IBM Virtualization Engine TS7510 allows you to create access rules on a host basis.

For security purposes, you can assign a specific virtual library and its virtual tape drives definition to specific clients. For general usage, you can use the Everyone_CF client. This everyone client is a generic client that you can assign to all or some of your virtual library-device definitions.

You can select how the client will see the virtual devices in any of the following ways:

- *One to one*: This limits visibility to a single pair of WWPNs. A WWPN is a worldwide port name that is uniquely assigned to each Fibre Channel (FC) adapter port. The WWPN consists of exactly 16 hexadecimal characters (0 - 9 and A - F). In the following section, you see setup windows that use the WWPN.
- *One to all*: You have to select the client’s Fibre Channel initiator WWPN.
- *All to one*: You have to select the server’s Fibre Channel target WWPN.
- *All to all*: You create multiple path data paths. If ports are ever added to the client or server, they will be automatically included in your WWPN mapping.

The following section shows an example of a one to one SAN client setup. Before you assign a tape library to an i5/OS partition, you must add this partition as a SAN client to the IBM Virtualization Engine TS7510. The term SAN client refers to a client host connecting to the IBM Virtualization Engine TS7510, such as our i5/OS partition.

To add a SAN client, perform the following steps on the Virtualization Engine for Tape Console:

1. Right-click the **SAN Client** icon and select **Add**, as shown in Figure 5-44.

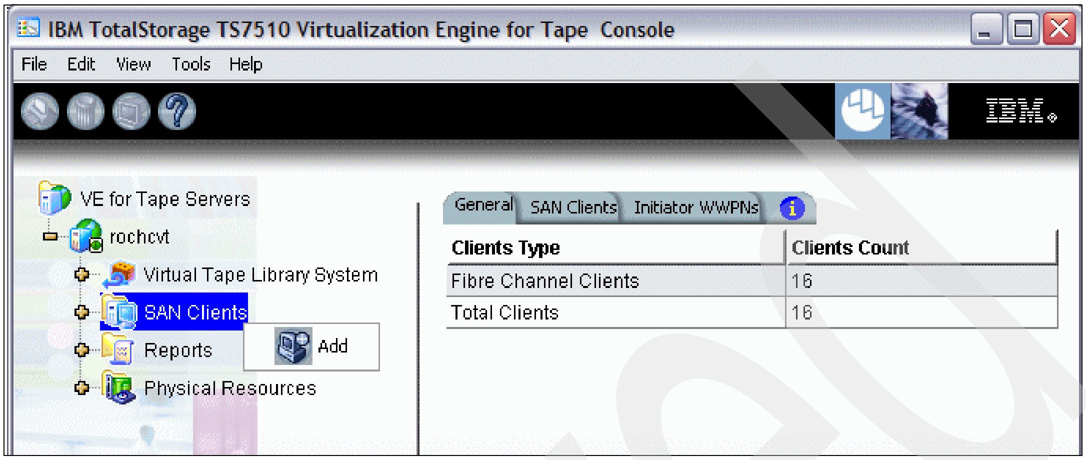



*Figure 5-44 Adding SAN clients*

2. In the Enter the Fibre Channel Client Name panel (Figure 5-45), type the client name. Client name indicates the name of initiator IOA (i5/OS partition Fibre Channel adapter). You can specify the name as you want. Then click **Next**.

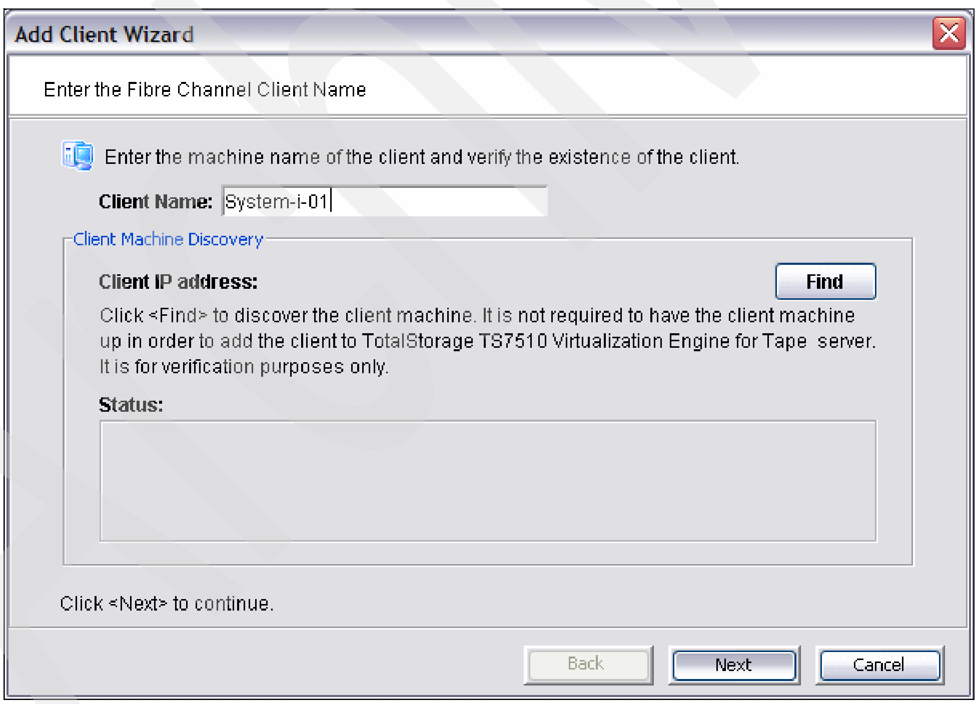



*Figure 5-45 Add Client Wizard: Specifying the client name of the Fibre Channel*

3. In the Set Client Fibre Channel Properties panel (Figure 5-46 on page 103), select the WWPN of the client, and the WWPN of the Fibre Channel host bus adapter (HBA) that you want to add. The WWPN of the Fibre Channel HBA is printed on the card. If you want to know from i5/OS, see "System Service Tools" on page 276, which explains how to get WWPN from SST.

If your client has several Fibre Channel HBAs and you want to connect to the TS7510 over several Fibre Channel links, you must select the corresponding WWPNs of those Fibre Channel HBAs. Then click **Next**.

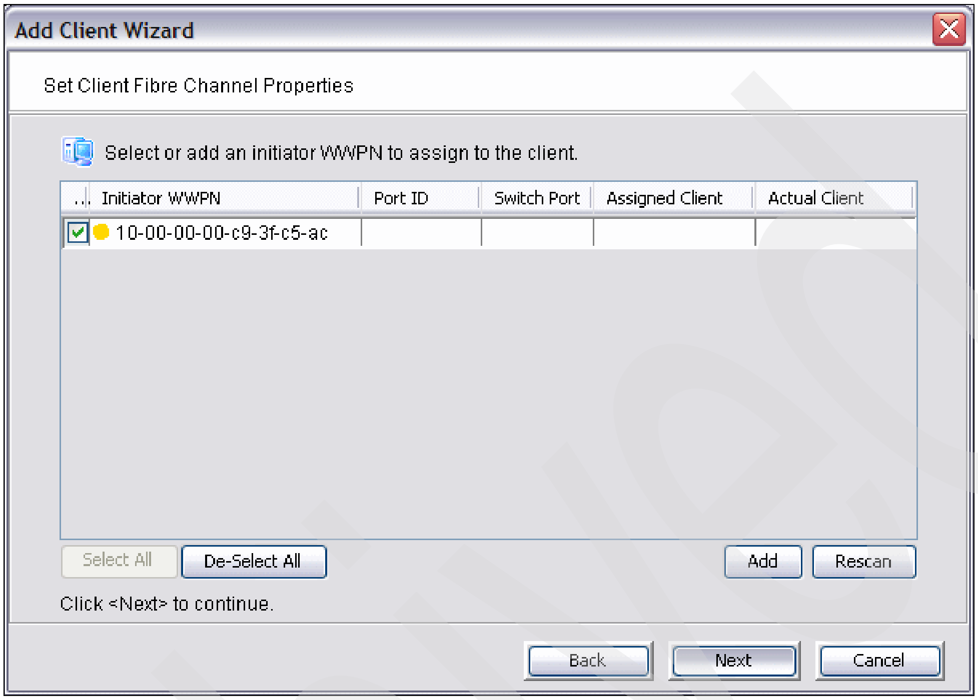



*Figure 5-46 Add Client Wizard: Selecting the WWPN*

4. In the Fibre Channel Option panel (Figure 5-47), determine whether you want to use Volume Set Addressing (VSA) for this adapter. This 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.

   You should *not* select **Enable Volume Set Addressing** for an i5/O partition connection.

   The next field (Figure 5-47) shows selection of the **Enable IBM i-Series Server Support**. This parameter was originally made available in case it was needed. With the required base level TS7510 software available to support an i5/OS partition, this selection is no longer required. It now serves no purpose and will be removed from future TS7500 product enhancements.

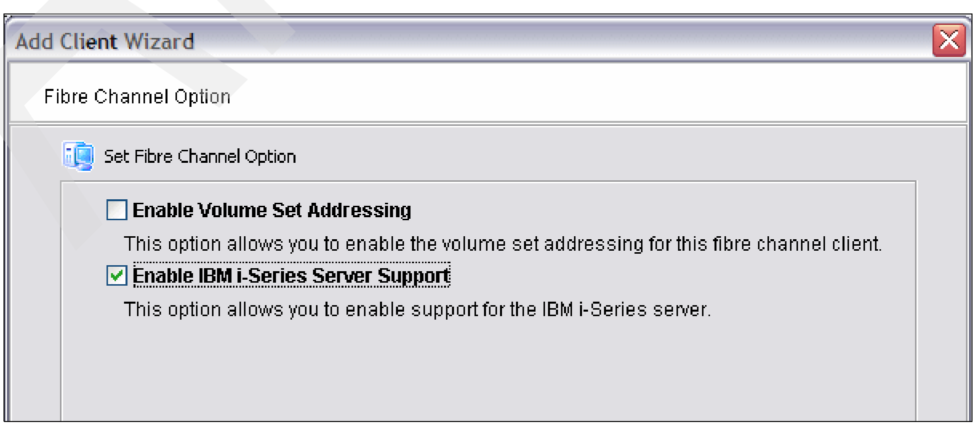



*Figure 5-47 Fibre Channel Option panel*

5. The Add the Fibre Channel Client panel (Figure 5-48) shows a summary of your selections. If the information is correct, click **Finish**, and your SAN client is added. If the information is not correct, click the **Back** button to make any necessary corrections.

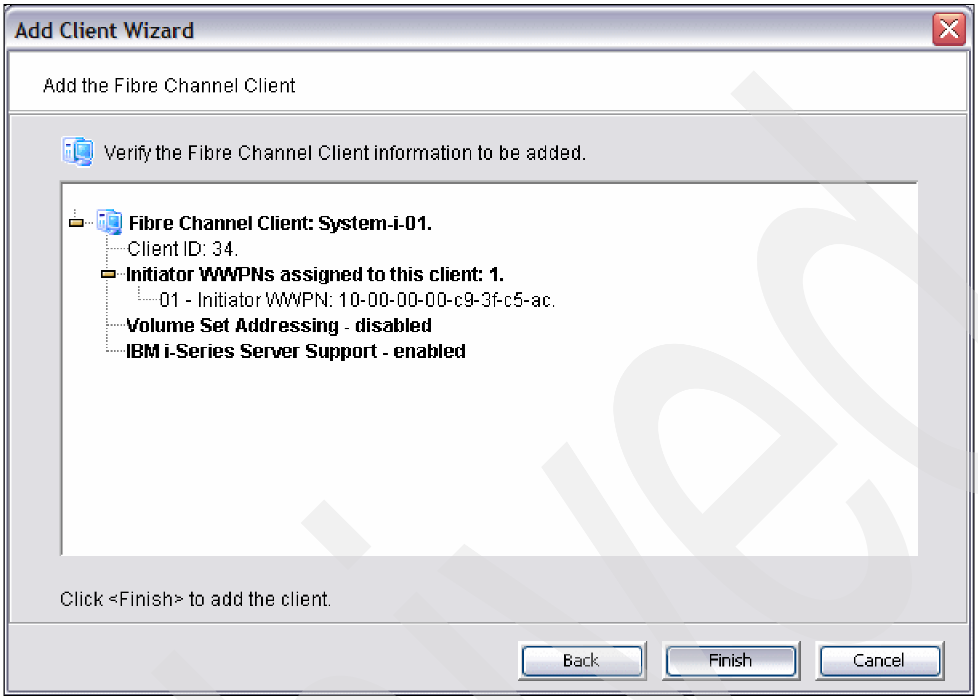



*Figure 5-48 Add Client Wizard: Summary panel*

## 5.4.3 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 IBM Virtualization Engine TS7510 to use. With this option, you can balance the workload to different Fibre Channel HBAs (target ports) by assigning a number of drives to one Fibre Channel HBA and other drives to other Fibre Channel HBAs on the IBM Virtualization Engine TS7510.

To assign a host to the library, follow these steps:

1. Right-click the **host** icon and select **Assign**, as shown in Figure 5-49.

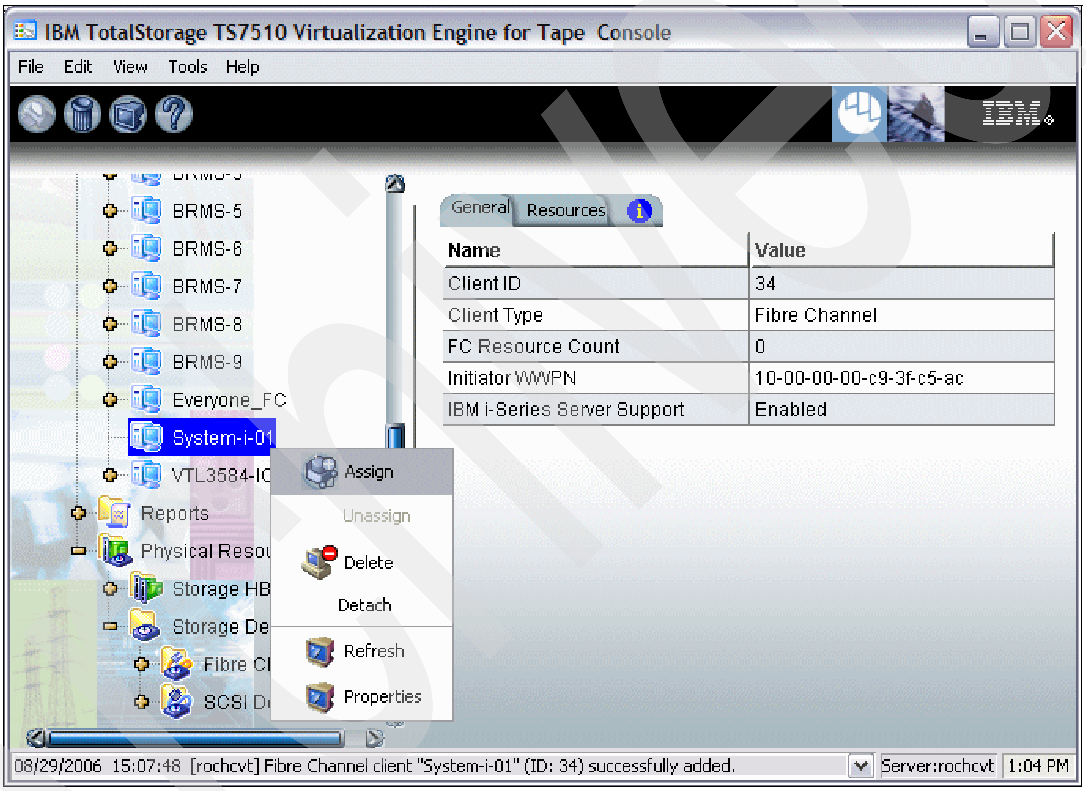



*Figure 5-49 Selecting Assign to assign a SAN host to a virtual library*

2. In the Select Tape Libraries or Drives panel (Figure 5-50), 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.

   You can assign the complete library with drives over a Fibre Channel target port. Alternatively, you can assign the drives individually by selecting the “Allow drive(s) in the library to be assigned individually” check box.

   For example, you can 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**.

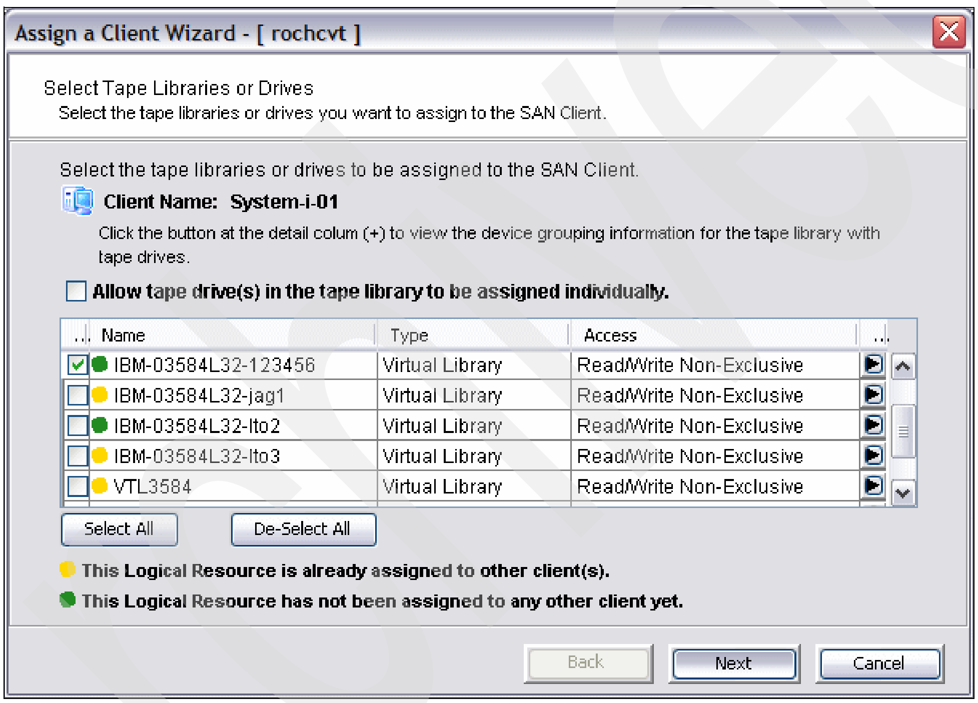



*Figure 5-50 Assigning a client to the library and drives*

3. In the Select a Fibre Channel Target panel (Figure 5-51), select the Fibre Channel HBA to use for the connection to the host. This selection is available only if several paths from the host to the TS7510 exist. This means that several zones must be created, because only one initiator and only one target should be in one zone.

   If your i5/OS partition has several Fibre Channel HBAs for connecting to the TS7510, you must select each Fibre Channel HBA WWPN connecting to the correct Fibre Channel adapter on i5/OS partition.

   After selecting the WWPN, click **Next**.

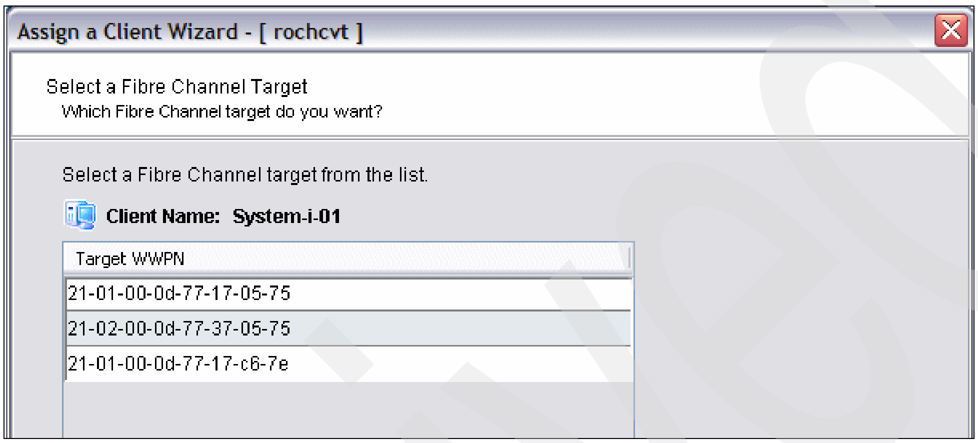



*Figure 5-51 Selecting a target WWPN*

4. In the Assign Tape Libraries or Drives to the SAN Client panel (Figure 5-52), verify your selection before you make this assignment. If everything appears to be correct, click **Finish**. To make changes, click the **Back** button.

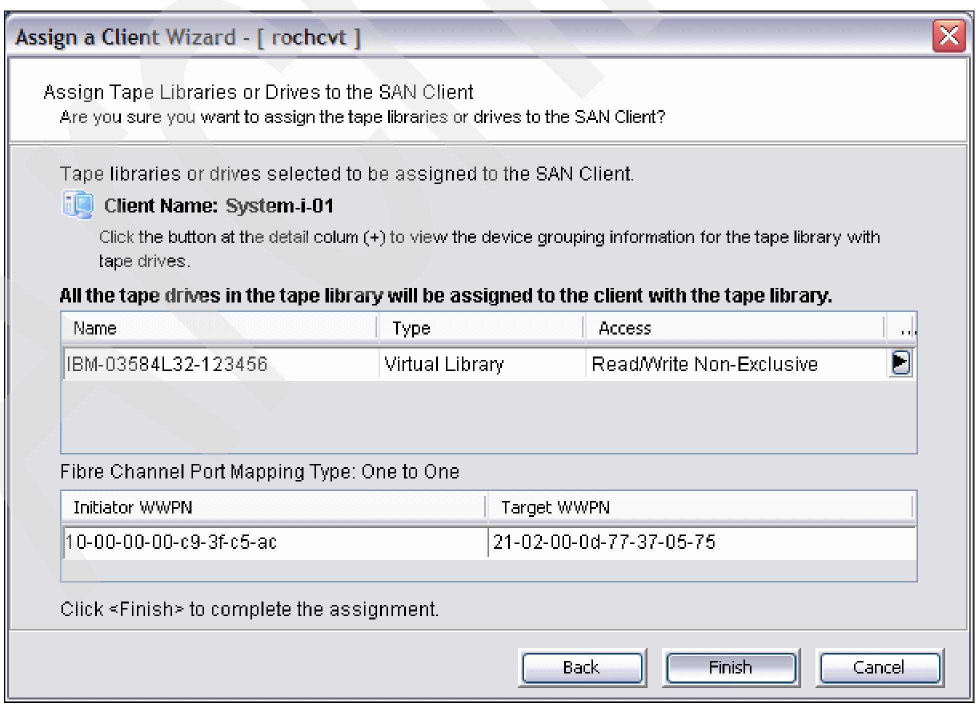



*Figure 5-52 Summary of the client assignment*

We have now assigned the first three tape drives and the library to host System-i-01 (the name assigned to the Fibre Channel adapter owned by our i5/OS partition), as shown in Figure 5-53.

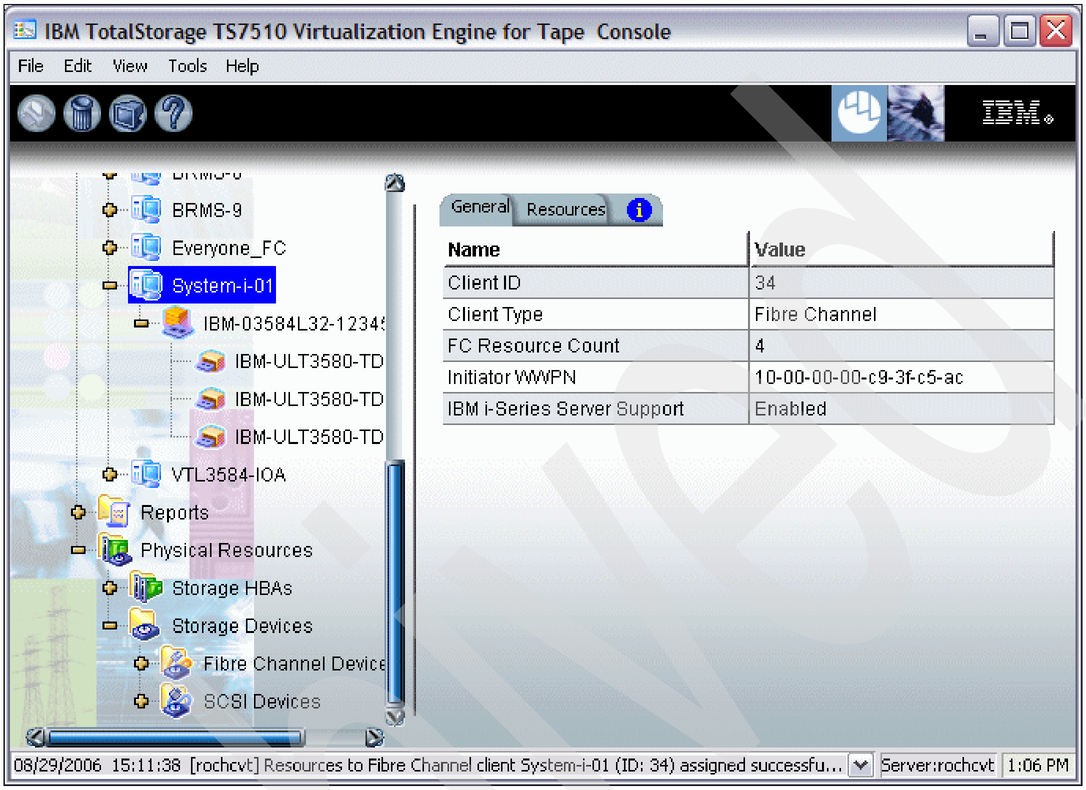



*Figure 5-53 Assigned tape library*

## 5.5 Using IBM Virtualization Engine TS7510 from i5/OS partition

If the assigning virtual tape library of IBM Virtualization Engine TS7510 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 of an IBM Virtualization Engine TS7510.

### 5.5.1 Recognition of a virtual tape library using i5/OS commands

If the virtual tape library is recognized, you can verify it by Work with Storage Resources (WRKHDWRSC TYPE(*STG)) command. See Figure 5-54 on page 109; the example shows that TAPMLB03 and TAPMLB04 belong to one 5704 Fibre Channel Tape Controller Adapter.

> **Important:** 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 and to get the directions to perform IOP-reset if you need help do this.

You have to determine which virtual tape library on IBM Virtualization Engine TS7510 is TAPMLB04. The Work with Storage Resources screen (Figure 5-54) does not show exactly which virtual tape is TAPMLB04. The tape drive serial number shows which TAPxx device is the tape drive on the IBM Virtualization Engine TS7510. Select TAPMLBxx (04 in our example) with **9=Work with resource**. Press Enter.

```
    Work with Storage Resources

 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           5704-001   Operational         Tape Controller
         TAPMLB03       3584-032   Operational         Tape Library
   9     TAPMLB04       3584-032   Operational         Tape Library
```

*Figure 5-54 WRKHDWRSC TYPE(*STG) command: TAPMLB device*

In Figure 5-54, you see which TAPMLBnn tape libraries are associated with the Fibre Channel Tape Controller (DC01 5704, in our example). The associated IOP is shown as CMB01.

In Figure 5-55, 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 5-56.

```
    Work with Storage Controller Resources

  Type options, press Enter.
    5=Work with configuration descriptions   7=Display resource detail

  Opt  Resource        Type-model  Status              Text
       TAPMLB04         3584-032   Operational         Tape Library
   7     TAP05          3580-003   Operational         Tape Unit
         TAP06          3580-003   Operational         Tape Unit
         TAP07          3580-003   Operational         Tape Unit
```

*Figure 5-55 WRKHDWRSC TYPE(*STG) command: TAP device*

The Display Resource Detail screen (Figure 5-56) 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 (6317110 in our example). You can confirm the association between the TAPnn device and virtual tape drive on IBM Virtualization Engine TS7510 by following the text after Figure 5-56.

```
  Display Resource Detail

Resource name . . . . . . . . :   TAP05
Text . . . .. . . . . . . . . :  Tape Unit
Type-model . . . . . . . . . :   3580-003
Serial number . . . . . . . . :   00-6317110
Part number . . . . . . . . . :
```

*Figure 5-56 WRKHDWRSC TYPE(*STG) command: Tape Unit Serial number*

Check the tape drives using Virtualization Engine 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 5-57 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 screen.

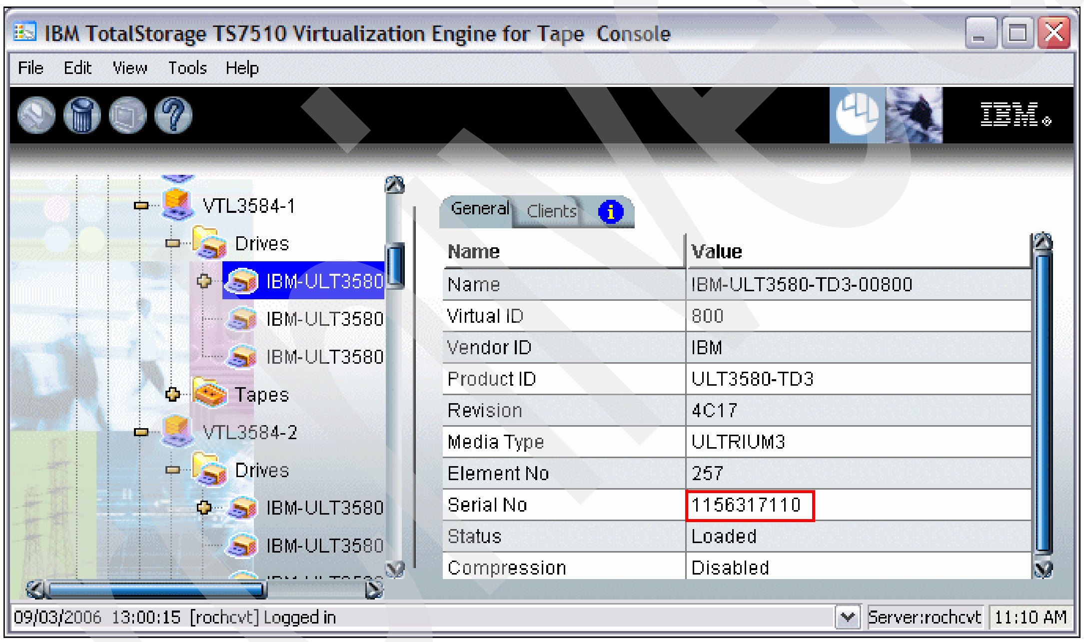



*Figure 5-57 Virtualization Engine for Tape Console - Tape Unit Serial Number*

**Important:** As described in 1.6, “TS7510 support restrictions under i5/OS” on page 13, 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 TS7510 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.

## 5.5.2 Using a virtual tape library from a 5250 interface

When i5/OS recognizes the virtual tape library, you can use the virtual tape library as though it is a physical tape library and use the virtual tape drive as though is a physical tape drive. We strongly recommend using the Backup Recovery and Media Services (BRMS) for iSeries product to manage tape library and tape medias. Keeping track of the library and tape device i5/OS objects needed and the data backed up to specific tape volumes with just the i5/OS save and restore commands is not practical. The following shows an example of using the IBM Virtualization Engine TS7510 without BRMS. Refer to Chapter 6, “i5/OS, BRMS, and TS7510 in action examples” on page 129.

### Work with Media Library Status (WRKMLBSTS) command

Use the Work with Media Library Status (WRKMLBSTS) command to manage tape library status. You can vary on and vary off the tape library and allocate and deallocate tape drives. After you vary on TAPMLBXX device and allocate some tape drives, you can specify DEV(TAPMLBXX) parameter when using SAVLIB, SAVOBJ, CHKTAP and so on. Figure 5-58 is an example of the WRKMLBSTS command.

```
      Work with Media Library Status

Type options, press Enter.
  1=Vary on   2=Vary off   3=Reset resource       4=Allocate resource
  5=Allocate unprotected   6=Deallocate resource   8=Work with description

      Device/                                                 Job
Opt     Resource     Status                 Allocation           name
      TAPMLB04       VARIED ON
        TAP05        OPERATIONAL            UNPROTECTED
        TAP07        OPERATIONAL            UNPROTECTED
        TAP06        OPERATIONAL            UNPROTECTED


                                                                      Bottom
Parameters or command
===>
F3=Exit   F4=Prompt   F5=Refresh   F9=Retrieve   F12=Cancel   F17=Position to
F23=More options
```

*Figure 5-58 WRKMLBSTS command*

### Work with Tape Cartridges (WRKTAPCTG) command

Use the Work with Tape Cartridges (WRKTAPCTG) command to manage tape media on a specified TAPMLB device. Figure 5-59 shows the status just after TAPMLB04 has been recognized. All media status is shown as `Inserted`. You can add the medias using 1=Add. When you add the medias to an i5/OS partition, you can specify whether the media is available for another partition or not.

After adding the media, use the WRKTAPCTG command to enable you to initialize the media, display the data, duplicate the media, check the media, and so on.

```
      Work with Tape Cartridges

Library Device:   TAPMLB04

Type options, press Enter.
  1=Add   2=Change   4=Remove   5=Display   6=Print ...


     Cartridge   Volume      Media
Opt  ID          ID          Type        Status
     000J0A      *UNKNOWN    L3          Inserted
     000J0B      *UNKNOWN    L3          Inserted
     000J0C      *UNKNOWN    L3          Inserted
     000J0D      *UNKNOWN    L3          Inserted
     000J0E      *UNKNOWN    L3          Inserted
     000J0F      *UNKNOWN    L3          Inserted
     000J0G      *UNKNOWN    L3          Inserted
                                                                  More...
Parameters or command
===>
```

*Figure 5-59 WRKTAPCTG command*

### SAVE commands

After initializing the virtual medias, you can save the data to the virtual medias. You just specify a TAPMLB device name to DEV parameter and virtual medias to Volume identifier parameter. Figure 5-60 shows the example of the Save Library (SAVLIB) command.

```
Save Library (SAVLIB)

Type choices, press Enter.

Library  . . . . . . . . . . . . LIB          > XLIB
                           + for more values
Device . . . . . . . . . . . . . DEV          > TAPMLB04
                           + for more values
Volume identifier  . . . . . . . VOL          > 000J0A
```

*Figure 5-60 SAVLIB command example*

**Note:** If you want to use tape drive directly without a library function, the following steps enable this:

1. Vary off the tape library holding the tape device with WRKMLBSTS command. Or deallocate the tape device using 6=Deallocate resource on the WRKMLBSTS command.
2. Vary on the tape device with WRKCFGSTS CFGTYPE(*DEV) CFGD(*TAP).
3. The tape device is now available directly. You can issue the SAVLIB DEV(TAPnn) command.

## 5.5.3 Recognition of a virtual tape library 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 5-61 on page 113. The example shows TAPMLB02, TAPMLB03, and TAPMLB04. Open your Server on iSeries Navigator and select **Configuration and Service** → **Hardware** → **Tape Devices** → **Tape Libraries**. Then 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 IBM Virtualization Engine TS7510 is TAPMLB04. The iSeries Navigator window does not directly show which virtual tape library on IBM Virtualization Engine TS7510 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 IBM Virtualization Engine TS7510. Right-click **TAPxx** and select **Properties,** as shown in Figure 5-61.

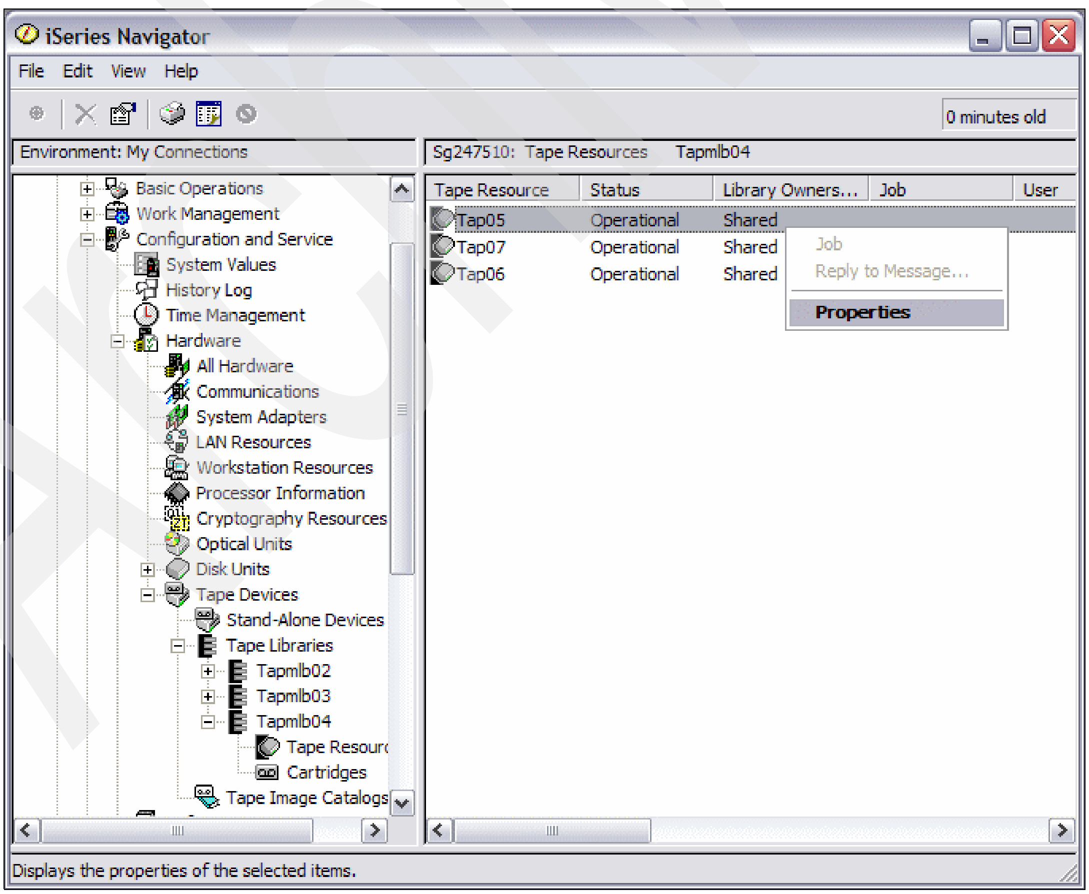



*Figure 5-61 iSeries Navigator: Recognition of Virtual Tape Library*

See Figure 5-62. The properties of the tape device shows its serial number. Use the last seven digits shown (6317110 in our example) to correlate with the corresponding serial number shown using the Virtualization Engine for Tape Console interface.


*Figure 5-62 iSeries Navigator: Tape device Properties*

From the Virtualization Engine 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 5-63. Compare the last seven digits of this window's serial number with the one shown in the iSeries Navigator window.

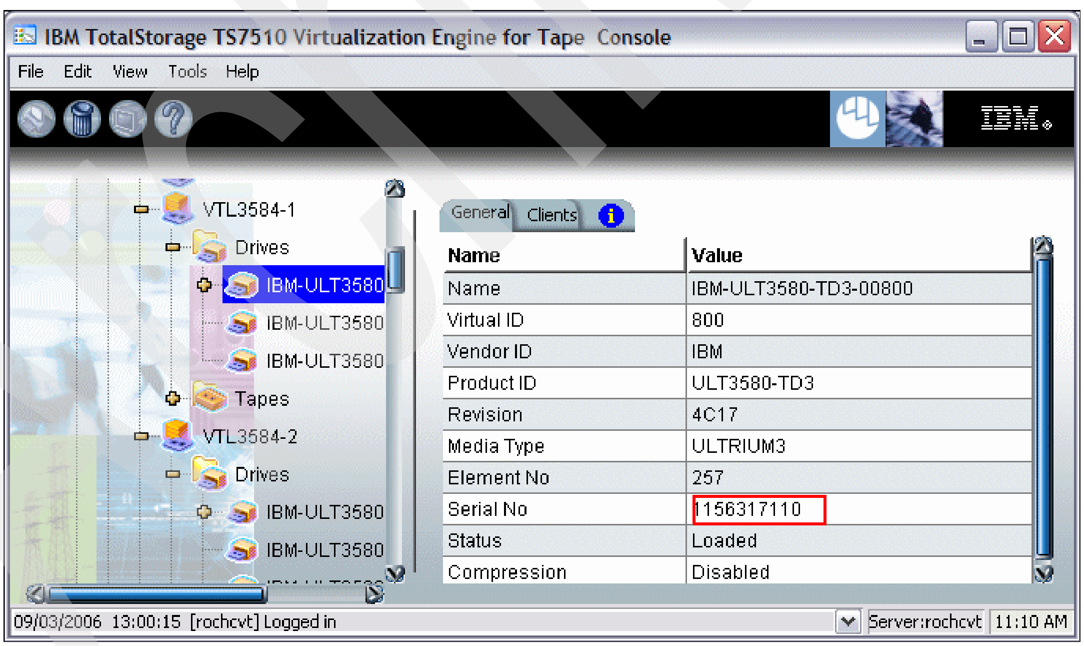



*Figure 5-63 Virtualization Engine for Tape Console: Tape Unit Serial Number*

## 5.5.4 Using virtual tape library from iSeries Navigator

When the i5/OS partition recognizes the virtual tape library, i5/OS uses the virtual tape library as though it is a physical tape library. Also, i5/OS uses the virtual tape drive as though it is a physical tape drive. We recommend the BRMS product for managing tape library and tape devices and media.

You can use virtual tape library without BRMS. The following are examples of using IBM Virtualization Engine TS7510 without BRMS. Refer to Chapter 6, "i5/OS, BRMS, and TS7510 in action examples" on page 129.

The following section describes an example of using the V5R4 iSeries Navigator interface. You can refer to iSeries Navigator online Help to help set up and use the backup application.

> **Note:** You cannot use both the BRMS and backup application on iSeries Navigator. If you want to use the backup application, you must uninstall the BRMS product plug-in to your iSeries Navigator interface on your workstation.

1. Use (open) your iSeries Navigator session to your i5/OS partition. Expand the **Backup** folder and select **Policies**, as shown in Figure 5-64. Double-click **Daily**, **Weekly** or **Monthly**.

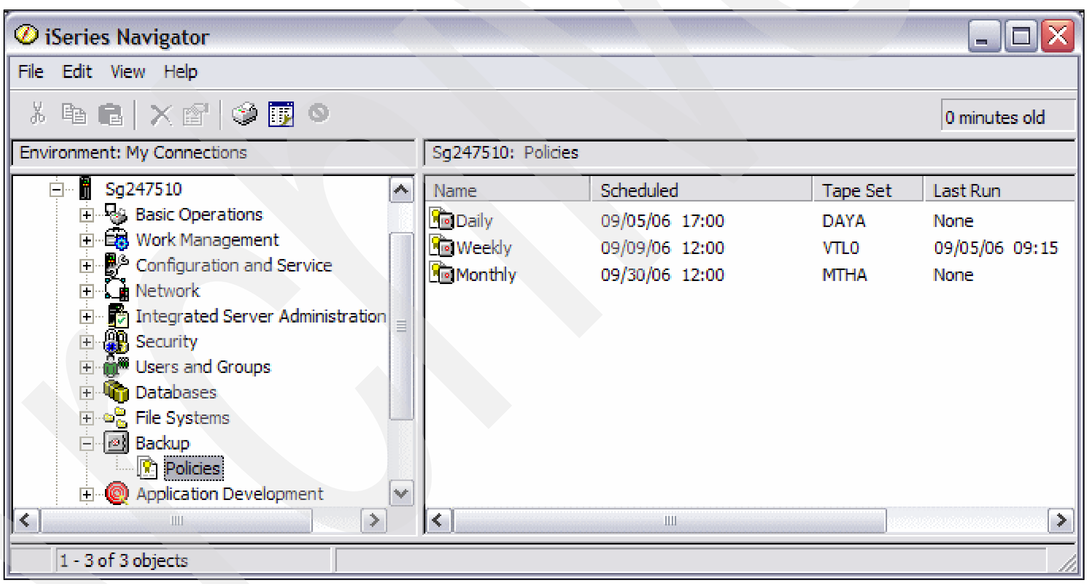



*Figure 5-64 iSeries Navigator: Backup Policies*

2. The Backup Policy General tab opens (Figure 5-65). You can specify to enable backup schedule and notification for backup. In the Run backups using schedule field, select **Yes**. In the Notify operator prior to backups field, select **Yes, send message**.

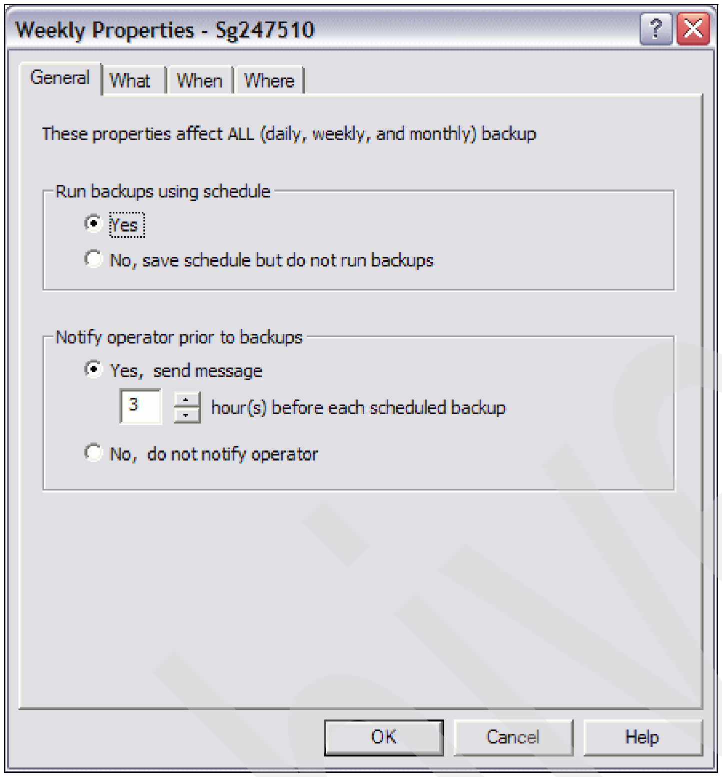



*Figure 5-65 iSeries Navigator Weekly Properties: General tab*

3. Open the **What** tab. You can select what you want to save. Figure 5-66 shows an example to back up all user libraries.

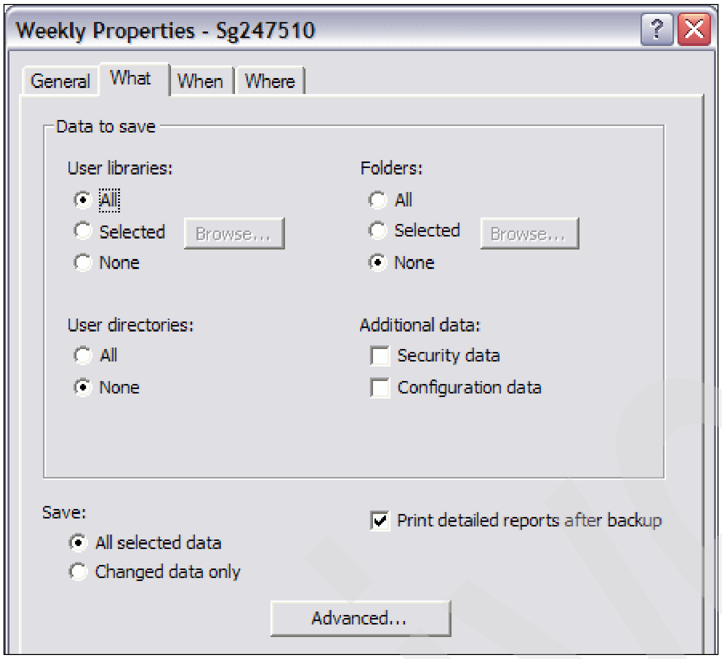



*Figure 5-66 iSeries Navigator Weekly Properties: What tab*

4. Open the **When** tab. You can specify when Daily, Weekly or Monthly backup occurs. You can specify the day of the week and time. See Figure 5-67.

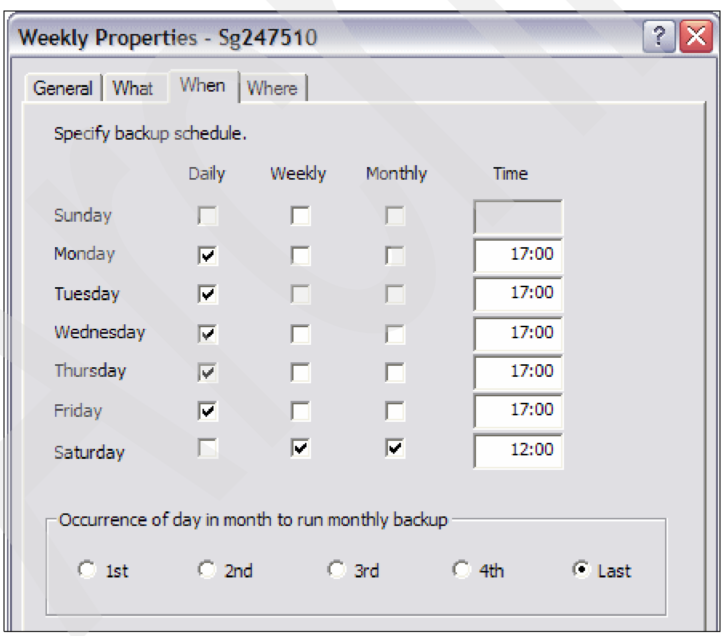



*Figure 5-67 iSeries Navigator Weekly Properties: When tab*

5. Open the **Where** tab. You can specify where you want to save to. You can specify tape drives and tape sets to save. Figure 5-68 is an example of how to use TAPMLB02 as tape library and VTL0XX as tape medias.

Tape sets are specified with the first four letters for tape label.

Click **OK**.

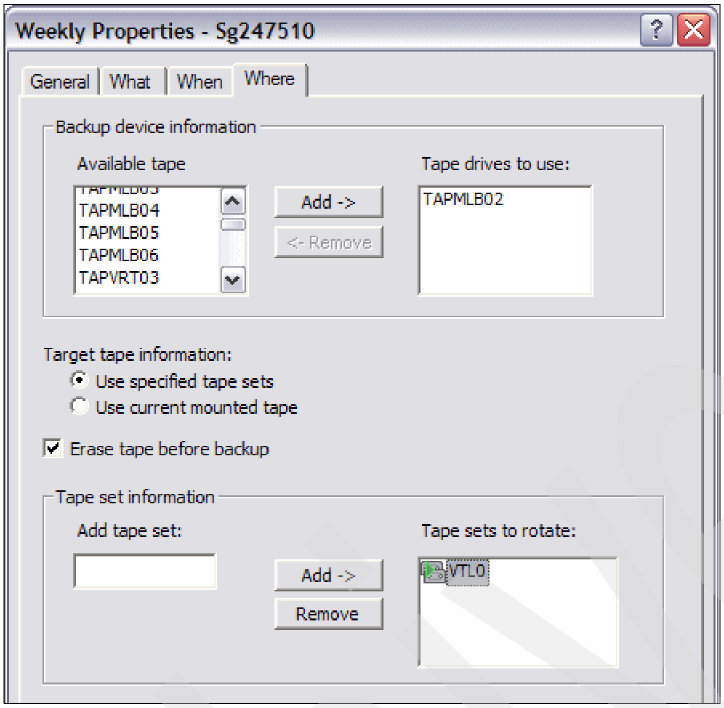



*Figure 5-68 iSeries Navigator Weekly Properties: Where tab*

The backup jobs are scheduled. Figure 5-69 shows the scheduled backup jobs on Work with Job Schedule Entries (WRKJOBSCDE) command.

```
      Work with Job Schedule Entries

Type options, press Enter.
  2=Change   3=Hold   4=Remove   5=Display details   6=Release
  8=Work with last submission    10=Submit immediately

                                                                Next
                      -----Schedule------              Recovery  Submit
Opt  Job          Status  Date       Time      Frequency   Action    Date
     QEZBKMGFRI    SCD    *FRI       14:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKMGMON    SCD    *MON       14:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKMGSAT    SCD    *SAT       09:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKMGTHU    SCD    *THU       14:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKMGTUE    SCD    *TUE       14:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKMGWED    SCD    *WED       14:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKTMFRI    SCD    *FRI       17:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKTMMON    SCD    *MON       17:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKTMSAT    SCD    *SAT       12:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKTMTHU    SCD    *THU       17:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKTMTUE    SCD    *TUE       17:00:00  *WEEKLY     *NOSBM    XX/XX/XX
     QEZBKTMWED    SCD    *WED       17:00:00  *WEEKLY     *NOSBM    XX/XX/XX
```

*Figure 5-69 iSeries Navigator backup example: WRKJOBSCDE*

## 5.6 Administrative setting

You have some additional settings for the administration of IBM Virtualization Engine TS7510. *Save Configuration* protects you from the system failure of 3954 Model CV5. You can have an *Administrative User* to secure your IBM Virtualization Engine TS7510. The *CallHome* setting automatically notifies system failure via e-mail.

### 5.6.1 Save Configuration

After your IBM Virtualization Engine TS7510 configuration is complete, you should save your IBM Virtualization Engine TS7510 system configuration to a secure location on another machine. To do this, highlight your IBM Virtualization Engine TS7510 server and select **Tools** → **Save Configuration**, as shown in Figure 5-70.

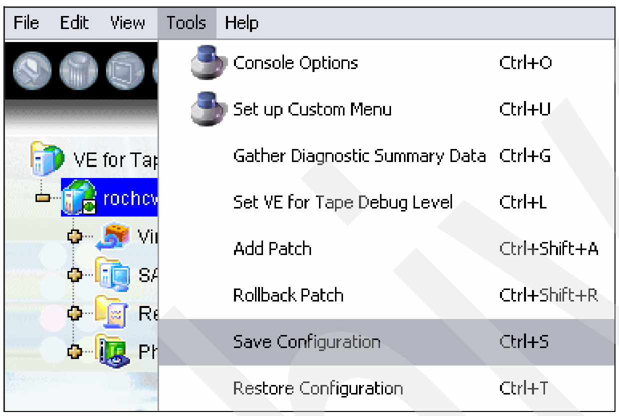



*Figure 5-70 Save Configuration Tool*

> **Note:** The configuration is saved as binary local file. You should re-save your configuration every time you change it, including every time you add, change, or delete a client or resource. If saving becomes very frequent, consider using the Auto Save function, as described in 5.6.2, "Auto Save".

### 5.6.2 Auto Save

You should have saved your system configuration to a secure location on a different computer after your IBM Virtualization Engine TS7510 installation/configuration was completed.

For consistent protection, you can set your system to automatically replicate your system configuration to another server on a regular basis. Auto Save takes a point-in-time snapshot of the TS7510 Virtualization Engine configuration, including all virtual tape libraries, virtual tape drives, virtual tapes, clients, client assignments, replication configuration, failover configuration, and so on.

To set Auto Save, perform the following steps:

1. Right-click your IBM Virtualization Engine TS7510 server and select **Properties**.
2. Select the **Auto Save Config** tab and enter information about the replication. See Figure 5-71 for an example.

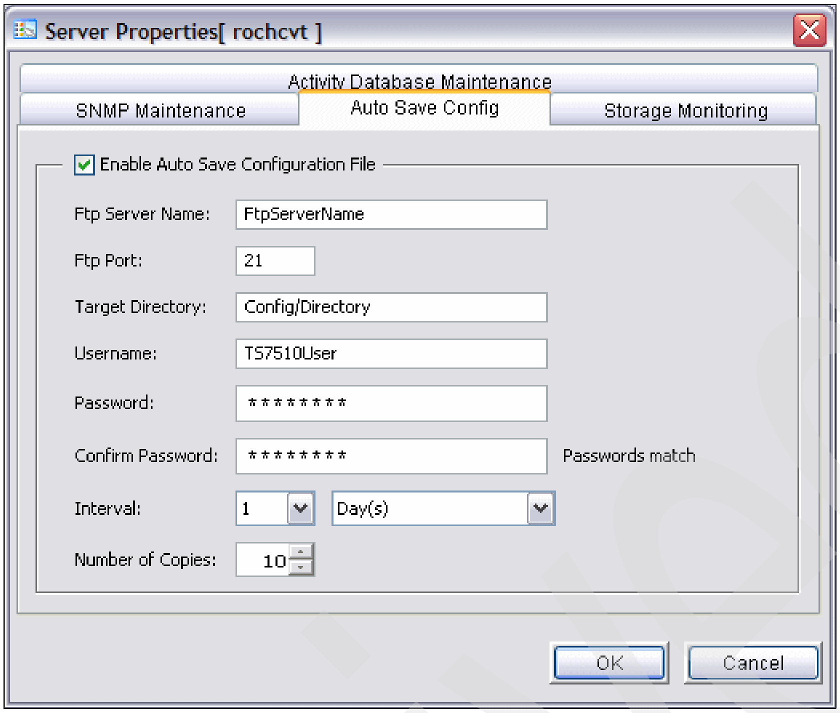



*Figure 5-71 Auto Save Config Property*

**Note:** The target server must have an FTP server installed and enabled. The specified Username must have read/write access to the Target Directory.

In the Interval field, determine how often to replicate the configuration. Depending on how frequently you make configuration changes to TS7510 Virtualization Engine, set the interval accordingly.

In the Number of Copies field, enter the maximum copies to keep. The oldest copy will be deleted as each new copy is added.

## 5.6.3 Administrative User

Only the tape administrator can add or delete a IBM Virtualization Engine TS7510 administrator or change an administrator's password. There are two types of administrators:

- *TS7510 Virtualization Engine Administrators* are authorized for client authentication and Virtualization Engine for Tape Console access.
- *TS7510 Virtualization Engine Read-Only Users* are only permitted to view information in the Virtualization Engine for Tape Console. They are not authorized to make changes and they are not authorized for client authentication.

1. Right-click the server and select **Administrators**.

   The TS7510 Virtualization Engine User/Administrator Management window opens. See Figure 5-72. You can see the administrative users registered now.

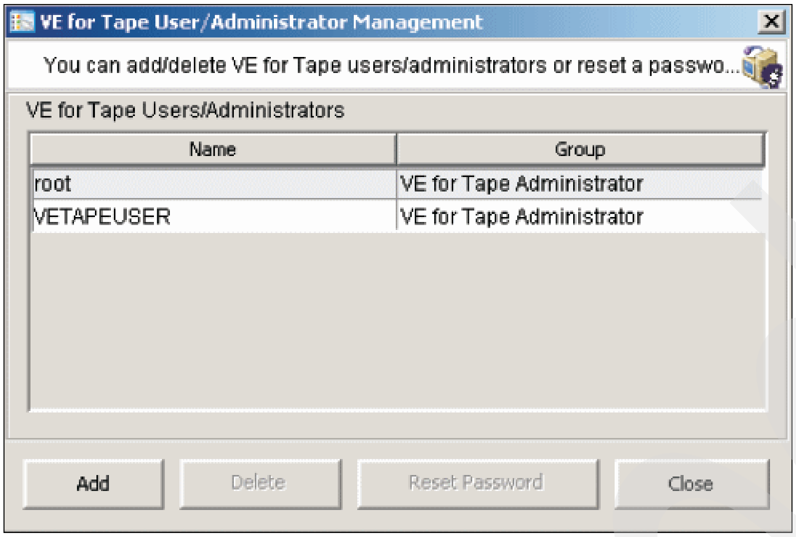



*Figure 5-72 User/Administrator Management*

2. Enter the Administrator Name and Password. Select the appropriate Group. See Figure 5-73.

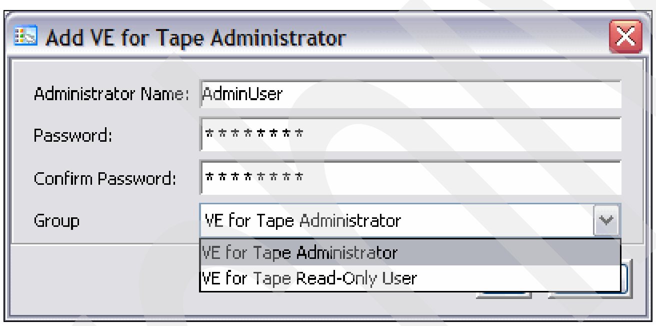



*Figure 5-73 Adding an administrator*

## 5.6.4 CallHome

CallHome is a unique customer support utility that proactively identifies and diagnoses potential system or component failures and automatically notifies system administrators via e-mail.

Using preconfigured scripts (called *triggers*), CallHome monitors a set of predefined, critical system components (SCSI drive errors, offline device, and so on). With its open architecture, administrators can easily register new elements to be monitored by these scripts.

When an error is triggered, CallHome captures the appropriate information, and a snapshot of the TS7510 Virtualization Engine appliance's current configuration and environment, and creates an entry in the TS7510 Virtualization Engine event log. With CallHome, system administrators are provided with the ability to take corrective measures more quickly, increasing service uptime and IT efficiency.

Complete the following steps to configure CallHome:

1. In the Management Console, right-click your IBM Virtualization Engine TS7510 server and select **Options** → **Enable CallHome**.
2. Enter the following information for your CallHome configuration, as shown in Figure 5-74.

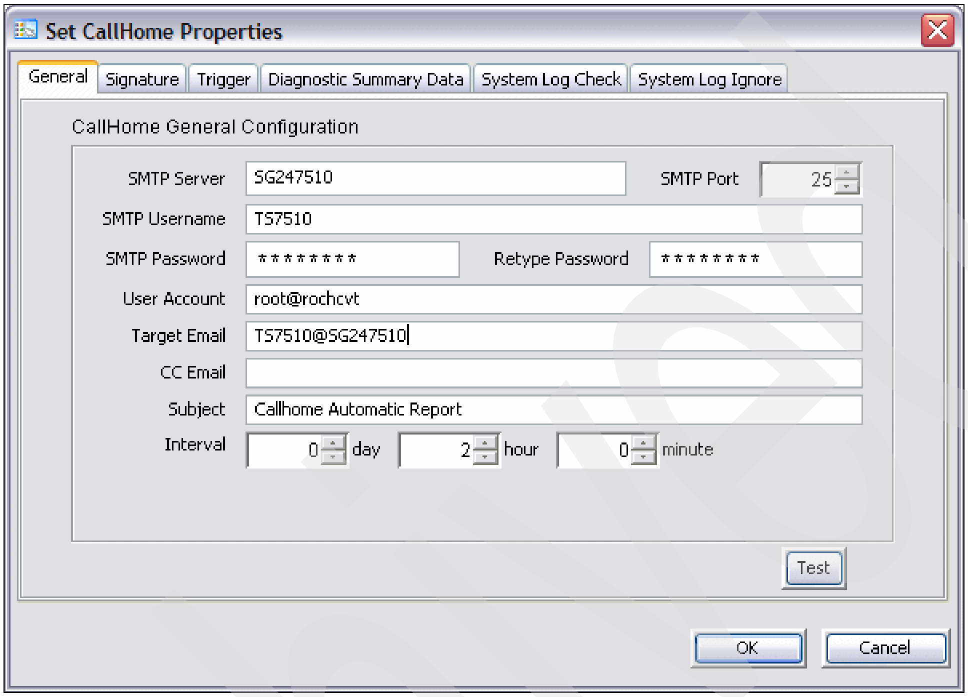



*Figure 5-74 Set CallHome Properties: General settings*

   – *SMTP Server*: Specify the mail server that CallHome should use to send out notification e-mails.
   – *SMTP Port*: Specify the mail server port that CallHome should use.
   – *SMTP Username/Password*: Specify the user account that will be used by CallHome to log in to the mail server.
   – *User Account*: Specify the e-mail account that will be used in the “From” field of e-mails sent by CallHome. Use a semi-colon (;) to separate e-mail accounts.
   – *Target Email*: Specify the e-mail address of the account that will receive e-mails from CallHome. This will be used in the “To” field of e-mails sent by CallHome. Use a semi-colon (;) to separate e-mail accounts.
   – *CC Email*: Specify any other e-mail accounts that should receive e-mails from CallHome.
   – *Subject*: Specify the text that should appear on the subject line.
   – *Interval*: Specify the time period between each activation of CallHome.

3. From the Signature tab, enter the contact information that should appear in each CallHome e-mail.
4. From the Diagnostic Summary Data tab, select the components that will be included in the diagnostic summary file. Each diagnostic summary file contains technical information about your server, such as server messages and a snapshot of your server’s current configuration and environment. It is useful for your technical support team to help solve system problems. See Figure 5-75.

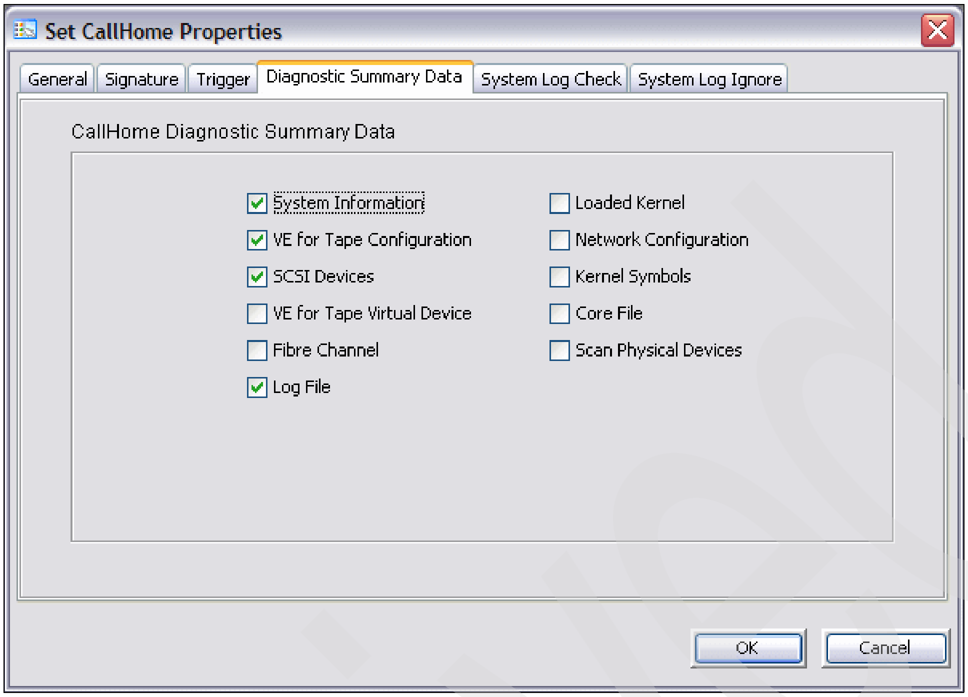



*Figure 5-75   Set CallHome Properties: Diagnostic Summary Data*

5. From the Trigger tab, set the triggers that will cause CallHome to send an e-mail. See Figure 5-76. Triggers are the scripts/programs that perform various types of error checking when CallHome activates. Default triggers are explained in *IBM TapeSystem Virtualization Engine for Tape Console Help* or *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769 (Chapter 9, "CallHome").

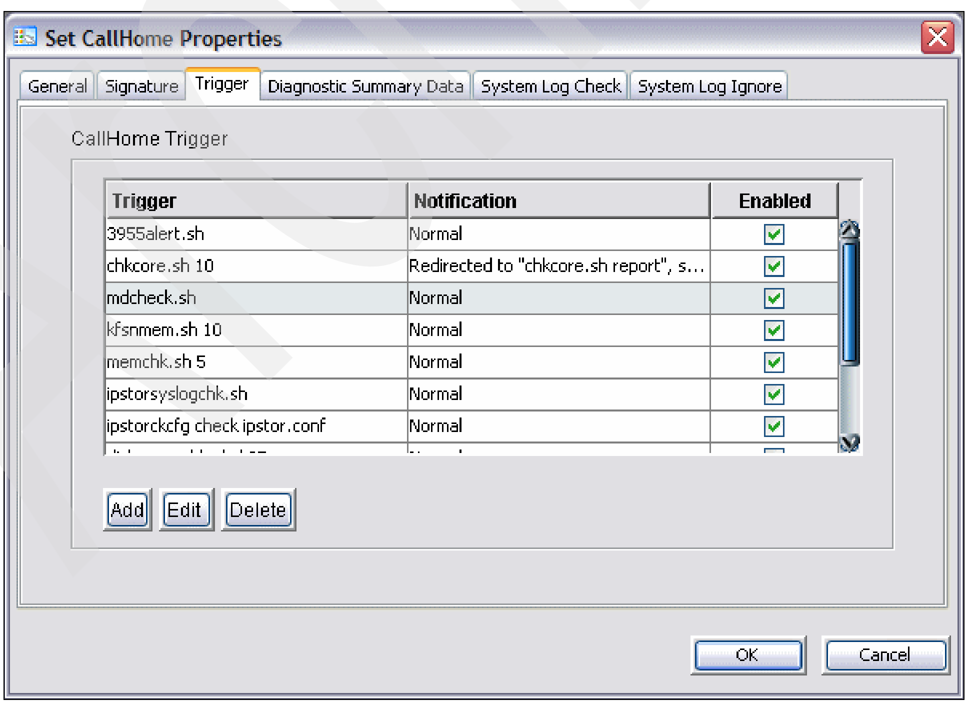



*Figure 5-76   Set CallHome Properties: Trigger*

6. From the System Log Check tab, indicate the terms that should be tracked in the system log by CallHome. See Figure 5-77. The system log records important events or errors that occur in the system, including those generated by IBM Virtualization Engine TS7510.

   Also, from the System Log Ignore tab, indicate the terms that should not be tracked by CallHome. This tab allows you to exclude system log entries that were included by the previous tab. You can enter terms to ignore, thereby eliminating entries that will cause CallHome to send out e-mail reports. Each line is a regular expression. The regular expression rules follow the pattern for AWK (a standard UNIX® utility).

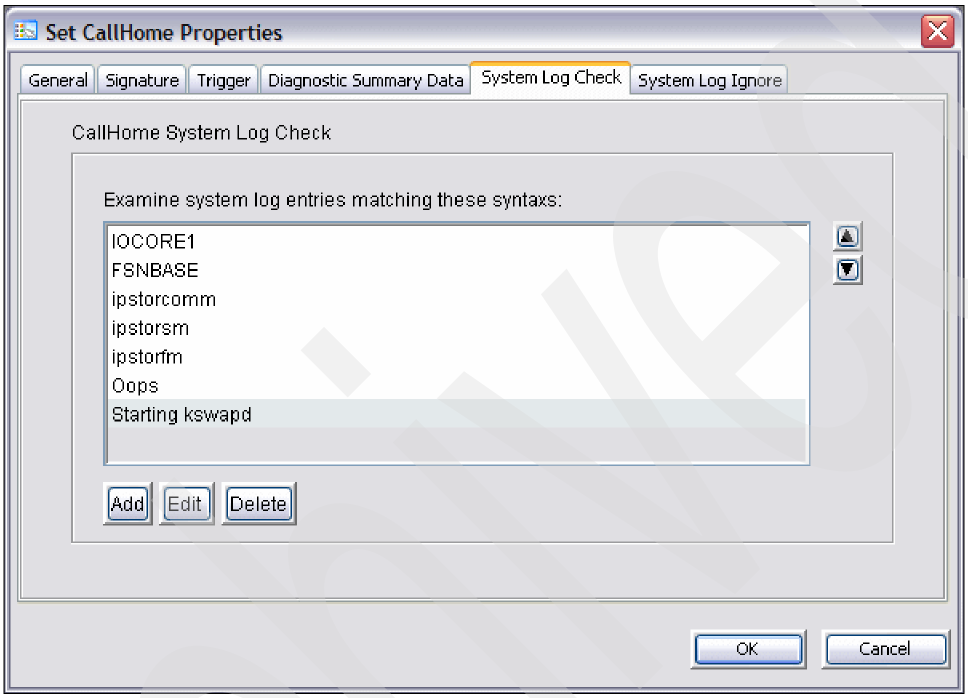



*Figure 5-77 Set CallHome Properties: System Log Check*

## 5.7 IBM Virtualization Engine TS7510 power on/off procedure

This section provides the summary of information for powering on/off all components of the IBM Virtualization Engine TS7510. The details of power on/off procedure are provided in Appendix C, “TS7510 Power Off/Power On procedures”, *IBM Virtualization Engine TS7510 Hardware Installation, Setup, and Problem Determination Guide*, GC26-7766.

### 5.7.1 Power off procedure

The following list summarizes the steps to power off the various components of the IBM Virtualization Engine TS7510.

1. Check the 3955 Model SV5 Cache Controller and 3955 Model SX5 Cache Module front controls and indicators. See Figure 5-78.

   Open the front door to the 3952-F05 base frame and ensure that all drive fault lights on all 3955 Model SV5 Cache Controllers and 3955 Model SX5 Cache Modules are off. If any fault lights are on, correct the problem before continuing. Never turn the power off if any fault light is on.

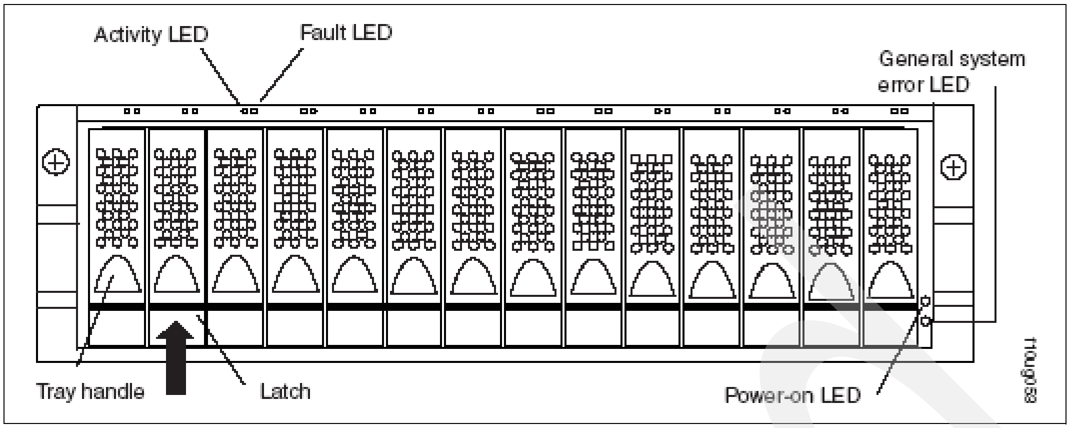



*Figure 5-78 TS7510 Cache Module and Cache Controller front controls and indicators*

2. Stop customer I/O to the IBM Virtualization Engine TS7510.

   I/O activity from servers attached to the IBM Virtualization Engine TS7510 3954 Model CV5 in the 3952-F05 frame must be stopped prior to shutting off the power to the IBM Virtualization Engine TS7510 system.

3. Suspend failover through the console for a failover/failback 3954 Model CV5 pair.

   If you have two 3954 Model CV5s installed, from the Virtualization Engine for Tape Console, right-click the 3954 Model CV5 server. For each failover partner, select **Failover** → **Suspend Failover**, as shown in Figure 5-79.

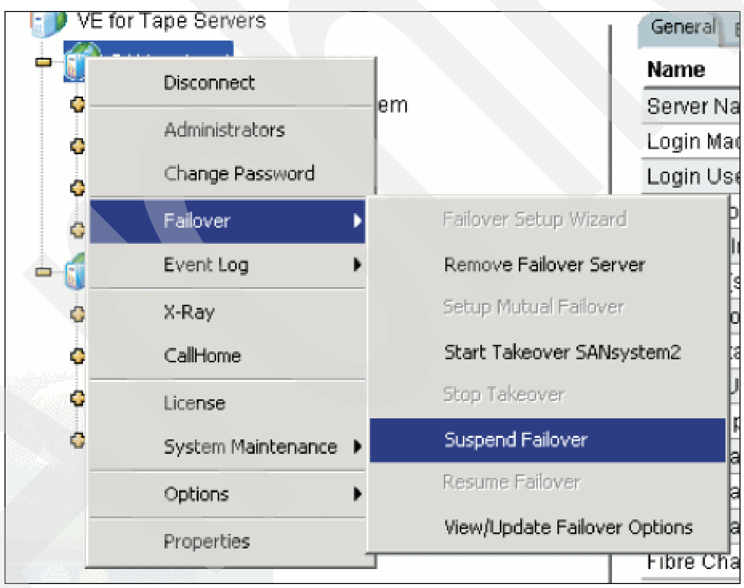



*Figure 5-79 Suspending failover from the Virtualization Engine console*

4. Shut down each 3954 Model CV5 through the console.

   a. From the Virtualization Engine for Tape Console, left-click the 3954 Model CV5 server you want to power off. Select **System Maintenance** → **System Shutdown** for each 3954 Model CV5, as shown in Figure 5-80.

   b. The dialog box for confirmation opens, click **Yes**.

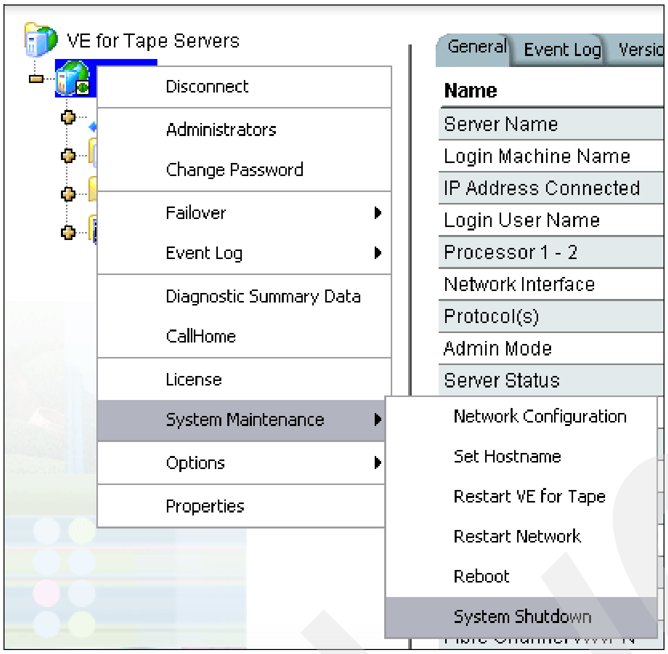



*Figure 5-80 Halting the 3954 Model CV5 from the Virtualization Engine for Tape Console*

5. Power off the 3955-SV5 Cache Controller, the 3955-SX5 Cache Module, or power off both.
   - Turn off both power supply switches on the back of the 3955-SV5 Cache Controllers.
   - If applicable, turn off the power switches on the back of all 3955-SX5 Cache Modules in the base frame and the expansion frame.

**Attention:** Except in an emergency, never turn off the power to a 3955 Model SX5 Cache Module or 3955 Model SV5 Cache Controller if any fault LEDs are lit. Correct the fault before you turn off the power using the proper troubleshooting or servicing procedure. This ensures that the 3955 Model SX5 Cache Module and 3955 Model SV5 Cache Controller will start correctly later.

- Power off the 3955 Model SV5 Cache Controller before you power off any of the 3955 Model SX5 Cache Modules. Turn off both power supply switches on the back of the 3955 Model SV5 Cache Controller.
- The 3955 Model SV5 Cache Controller cannot communicate with the failed drives. This in turn might cause the array or logical drive to be placed in a failed state.

**Important:** The 3955 Model SX5 Cache Modules and 3955 Model SV5 Cache Controllers are designed to run continuously. Turn off power to the 3955 Model SX5 Cache Modules and 3955 Model SV5 Cache Controllers only if:

- Instructions in a hardware or software procedure require that you turn off the power.
- An IBM technical service support representative instructs you to turn off the power.
- A power outage or emergency situation occurs.

## 5.7.2 Power on procedure

The following steps summarize the process that you must follow to turn on power to the IBM Virtualization Engine TS7510 system.

Verify that the following conditions exist:

- All communication and power cables are plugged into the back of the units, and all power cables are connected to an AC power outlet.
- Both switches on the back of the 3955 Model SV5 Cache Controller and 3955 Model SX5 Cache Module are turned off.
- All Serial Advanced Technology Attachment (SATA) drives are located securely in place in the drive slots of the 3955 Model SV5 Cache Controller and 3955 Model SX5 Cache Module drive expansion chassis.

Then perform the following steps:

1. Power on the 3955 Model SX5 Cache Controller.

   Power on all 3955 Model SX5 Cache Modules by pressing both toggle switches on the back of each module.

   Ensure that all green lights on the 3955 Model SX5 Cache Modules are flashing.

2. Power on the 3955 Model SV5 Cache Module.

   > **Attention:** After you have turned off the power to all 3955 Model SX5 Cache Modules, wait for 30 seconds. Failure to do so might cause the initialization of the 3955 Model SX5 Cache Module and the communication between the 3955 Model SX5 Cache Module and the 3955 Model SV5 Cache Controllers to fail.

   From the back of both 3955 Model SV5 Cache Controllers, turn on the power by pressing both toggle switches.

3. Power on the 3954 Model CV5s.

   Power on the 3954 Model CV5 by pressing the white recessed button on the front panel.

   If applicable, resume failover from the Virtualization Engine for Tape Console for a failover-failback 3954 Model CV5 pair. From the customer's Virtualization Engine for Tape Console screen, right-click the IBM Virtualization Engine TS7510 server you want to power on. For each failover partner, select **Failover**, then **Resume Failover**.

4. Check the IBM Virtualization Engine TS7510 cache indicator LEDs.

   Ensure that all LED controls and indicators on the 3955 Model SV5 Cache Controller and 3955 Model SX5 Cache Module are operating correctly.

# 6

# i5/OS, BRMS, and TS7510 in action examples

This chapter provides a base set of examples of how to set up i5/OS and licensed program Backup Recovery and Media Services (BRMS) for iSeries to use the IBM TS7510 virtual tape library. Because the TS7510 appears to i5/OS and BRMS as a tape library and associated library tape devices, we focus primarily on the BRMS interfaces and functions with the TS7510 rather than the i5/OS command interface.

We start with a first example using iSeries Navigator interfaces, rather than i5/OS and BRMS command interfaces. Many screen captures are included and the process is not as difficult as it may first appear because of the number of screens shown.

We then show two examples, based upon the environments discussed in 3.9, “Examples of using TS7510 with i5/OS” on page 44.

The i5/OS command interface requires significantly more *manual processes* to efficiently manage a tape library device, effectively use its capabilities, and track saved data, compared to using the BRMS interfaces. BRMS makes backup and recovery much easier to set up and actually perform recovery, if that becomes necessary.

> **Restriction:** The iSeries Navigator and the i5/OS BRMS command interfaces are not 100% identical in function. There are a few functions that are restricted to one or the other interfaces. For example:
>
> - The Initialize BRMS (INZBRM) command must be used at least once. There is no corresponding interface to this function under iSeries Navigator. Over time, as you use BRMS, there can be times when you must use INZBRM after its initial use.
> - Reclamation (condensing tape data onto less tape volumes) can be requested only using the iSeries Navigator interface.

# 6.1 Basic information

We start with the complete set of steps showing how to get BRMS up and running with the TS7510. This first example contains significant BRMS information, relative to TS7510 usage information. If you already are very familiar with setting up BRMS in general, you may want to skip this first example. We include this example for those less familiar with BRMS to minimize the need to refer to other BRMS documentation to get you up and running with BRMS using the TS7510. You can simply follow the steps and adjust them to your own environment and you will have a backup process up and running quickly.

In our step-by-step instructions, we also supply some informational text so that you know what the different options might result in when we can only show a few of the options. Our setup is only an example and you do not have to select the options we take. However, we provide advice for the do and don'ts.

When our example backup is defined, we switch over to the i5/OS 5250 environment to execute the backup and then restore one library. We do that to show that you can use the iSeries Navigator and the i5/OS command interfaces interchangeably. You select the one you find most convenient.

After the TS7510 is set up and operational, the *virtual library and its virtual devices* need to report in to the i5/OS so that i5/OS can *detect* what kind of tape library it has to communicate with. This has to be done as device descriptions in the i5/OS partition have to be created. If the TS7510 does not show up as the tape library you set it up for, you have to vary off (make unavailable) and vary on (make available) with STATUS (*RESTART) specified for the corresponding i5/OS controller description object, which represents the hardware controller (Fibre Channel card) the TS7510 is connected to.

When performing this action sequence, make sure that you do not disconnect other hardware in the system that sits under the same controller card. The controller card is a computer system in its own. It has to be IPLed or rebooted, that is, restart its control program. In i5/OS, this is "varyoff then varyon with reset."

**Important:** In general, any change to any tape-related hardware connected to i5/OS may need to have its IOP control program rebooted (reset). This could be including changes in model type, replacing a tape drive, and so on.

If you are not sure how your system is configured, consult your local IBM System i hardware experts or call IBM service if you need assistance. Resetting the Fibre Channel controllership can be one of the following System i hardware features: Features #2756, #5704, or #5761.

## 6.1.1 Base BRMS concepts and terms

This section briefly describes some of the common BRMS terms and how sometimes the same word mentioned in the iSeries Navigator interface is slightly different from the BRMS i5/OS command interface.

**Media** A tape cartridge (volume) that will hold the saved data.

**Media identifier** A name given to a physical piece of media.

**Media class** A logical grouping of media with similar physical, logical, or both of these characteristics (for example, density)

**Control group** A group of items (for example, libraries or stream files) to back up as well as the attributes associated with how to back them up. iSeries Navigator references these control groups as *policies*.

**Policies** A set of defaults that are commonly used (for example, device or media class). Generally used defaults are in the BRMS system policy. Backup-related defaults are in the BRMS backup policy.

These terms are used throughout the examples that follow in this chapter.

## 6.2 Example 1: A simple library backup setup

In our first and detailed example, we are backing up a large number of small or even empty libraries. This is where you probably will see a great performance boost using an IBM TS7510, because the TS7510 does not need to perform mechanical stops and starts as a real tape drive may have to do because of the frequency with which i5/OS has to switch between objects. The Linear Tape-Open (LTO) technology is designed for streaming big blocks of data where the tape drive can write continuously at rated speed. There are sections in this book that describe the tape technology, starting from 1.2, “Short history of tape technologies” on page 2.

In this chapter, we focus on using BRMS while sometimes showing you both i5/OS BRMS commands and the iSeries Navigator BRMS interfaces. In order to use the iSeries Navigator BRMS interfaces, you must have first installed BRMS as a plug-in to iSeries Navigator.

This book assumes that the reader is familiar with installing the BRMS plug-in and generally using BRMS interfaces through iSeries Navigator. However, just in case you have not used BRMS with iSeries Navigator, here is quick summary of how to install BRMS (or any other application set up to be an iSeries Navigator plug-in) as a plug-in.

1. After iSeries Navigator has been installed on your PC workstation and you have a connection to at least one i5/OS partition that has BRMS installed, right-click **My Connections** → **Install Options** → **Install Plug-ins**, as shown in Figure 6-1.
2. Select a system defined to your iSeries Navigator session. In our example, this can be Rchas08. Click **OK**.

   Assuming you have the i5/OS partition’s IP address in your PC Host Table or the partition’s host name is known in your network’s Domain Name Services (DNS) server, the iSeries Access for Windows selective install wizard starts and you must sign on to the i5/OS partition. After a few seconds, licensed programs, such as BRMS, that are set up to be an iSeries Navigator plug-in, are identified by your iSeries Navigator session and the list of plug-ins is presented to you. Follow the instructions in this window and any subsequent windows. When a progress window shows successful plug-in installation, you have new folder tree entries for the plug-ins in the left iSeries Navigator pane.

   You can see the BRMS plug-in folder for Rchas08 in Figure 6-1. The dashed red arrow represents a set of windows that we do not show.

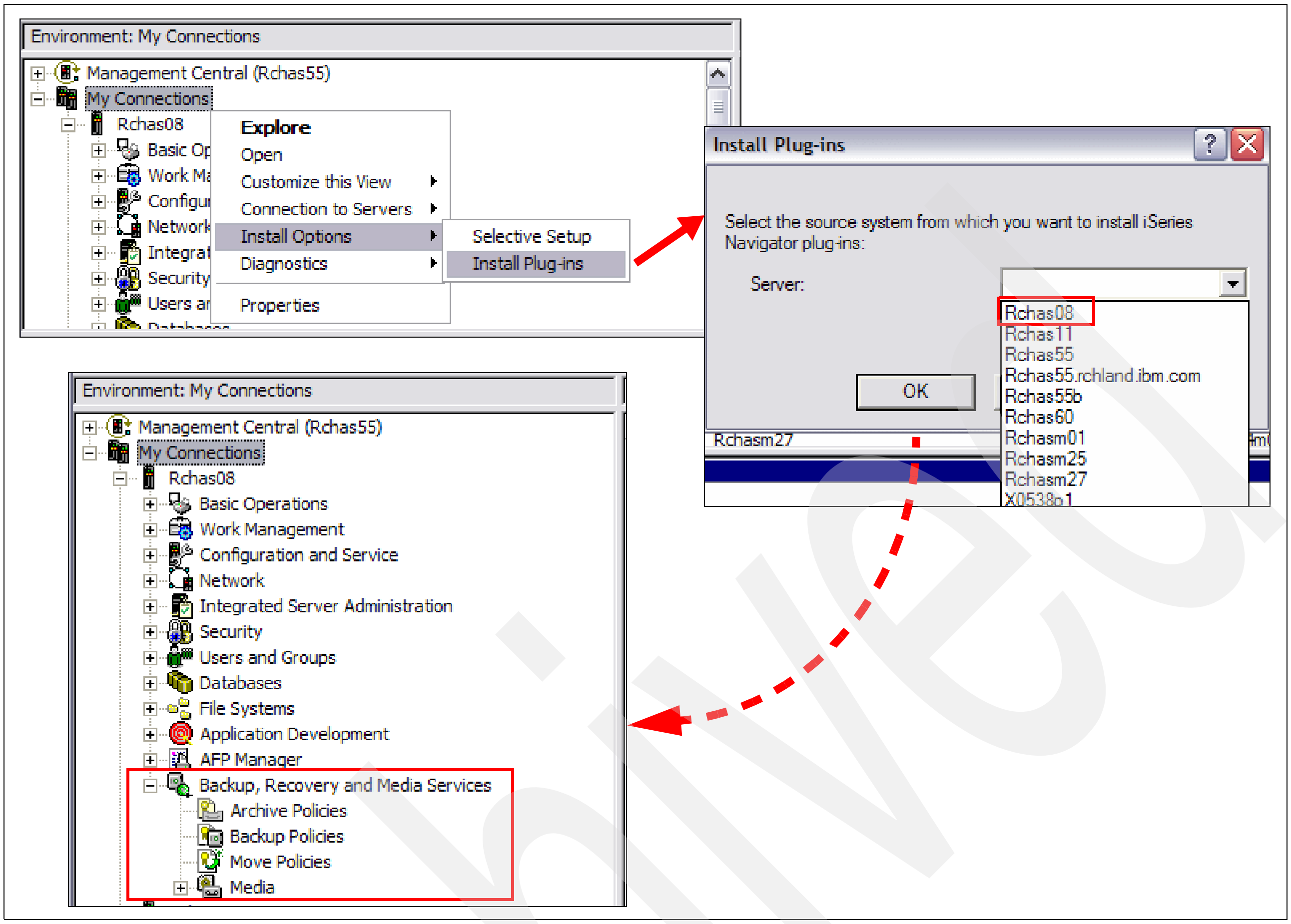



*Figure 6-1 Installing an iSeries Navigator plug-in*

## 6.2.1 Identifying virtual devices to BRMS

We assume that the 7510 tape library is visible from i5/OS and that you have created virtual tape volumes using the TS7510's Virtualization Engine for Tape Console as described in 5.4, "Setting up virtual tape library" on page 94.

You can use either the iSeries Navigator or the 5250 i5/OS command interfaces to manage the VTL devices and media. In this first step (identifying virtual devices to BRMS), we show examples using both interfaces.

### Using the iSeries Navigator interface

When using the iSeries Navigator interface:

1. From iSeries Navigator, drill down and expand **Configuration and Service** → **Hardware** → **Tape Devices** → **Tape Libraries** → ***TAPMLB19***, as shown in Figure 6-2.
2. Click **cartridges** to see what the TS7510 presents to i5/OS.

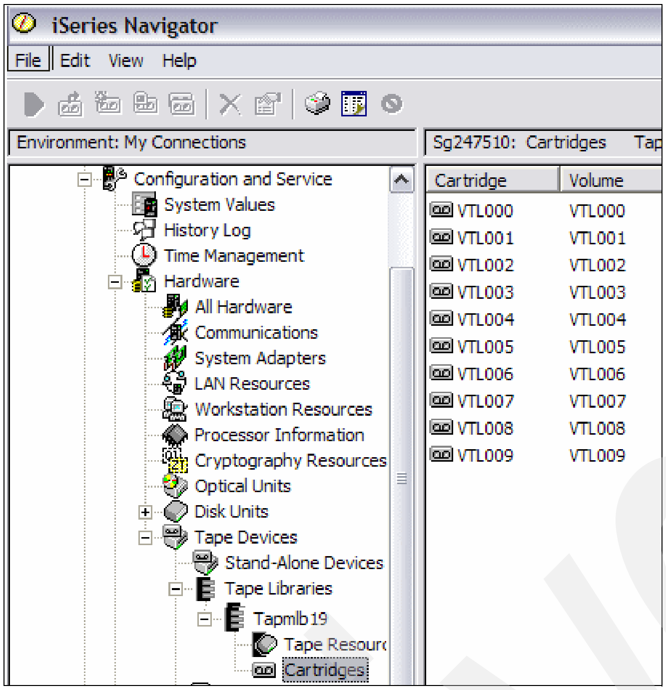



*Figure 6-2 iSeries Navigator - Cartridges*

## Using the i5/OS command interface

When using the i5/OS command interface:

1. From an i5/OS command line, enter the Work with Media Library Status (WRKMLBSTS) command. Our library is named TAPMLB19, therefore we type `WRKMLBSTS` *`TAPMLB19`*.

   The screen shown in Figure 6-3 is presented.

```
              Work with Media Library Status

Type options, press Enter.
  1=Vary on    2=Vary off    3=Reset resource       4=Allocate resource
  5=Allocate unprotected    6=Deallocate resource    8=Work with description

      Device/
Opt     Resource      Status                 Allocation
9     TAPMLB19      VARIED ON
        TAP14       OPERATIONAL            UNPROTECTED
        TAP15       OPERATIONAL            UNPROTECTED
        TAP16       OPERATIONAL            UNPROTECTED
```

*Figure 6-3 Work with Media Library Status example*

2. Use option **9** to show the tape volumes and their status.

   WRKMLBSTS shows all the tape cartridges currently known to the tape library (Figure 6-4).

**Note:** The tape volumes that we see are virtual, therefore i5/OS shows only the volumes the TS7510 reports.

Adding the volumes in the TS7510 has to be done from the Virtualization Engine for Tape Console.

```
                 Work with Tape Cartridges

Library Device:   TAPMLB19

     Cartridge   Volume      Media
Opt  ID          ID          Type        Status
     VTL000      VTL000      L2          Inserted
     VTL001      VTL001      L2          Inserted
     VTL002      VTL002      L2          Inserted
     VTL003      VTL003      L2          Mounted
     VTL004      VTL004      L2          Inserted
     VTL005      VTL005      L2          Inserted
     VTL006      VTL006      L2          Inserted
     VTL007      VTL007      L2          Inserted
     VTL008      VTL008      L2          Inserted
     VTL009      VTL008      L2          Inserted
```

*Figure 6-4 Work with Tape Cartridges*

### 6.2.2 Picking up new or changed devices in BRMS

To bind what the i5/OS knows about our new tape library and what BRMS also needs to know, run the Initialize BRMS command INZBRM *DEVICE, which not only picks up new devices, but also removes those that are no longer reported.

Type `INZBRM *DEVICE`, and press Enter.

When INZBRM *DEVICE is complete, we are ready for the next steps, to use the TS7510 devices.

- The IBM TS7510 is set up and is functional.
- The i5/OS has created device descriptions.
- BRMS has identified the virtual tape library and its virtual tape devices.

**Important:** INZBRM can only be issued in the 5250 i5/OS environment. INZBRM *DEVICE must be executed each time you make changes in your tape configuration.

### 6.2.3 Managing devices with BRMS

After BRMS has recognized our new virtual library configuration, we can start setting up our environment to satisfy our backup requirements and associated BRMS configuration.

Before doing anything else, we have to change some default names and values that BRMS created for us. This is not required, but we recommend it for ease of understanding.

1. From iSeries Navigator, expand **Backup, Recovery and Media Services**.
2. Right-click **Media** and select **Manage Devices**, as shown in Figure 6-5.

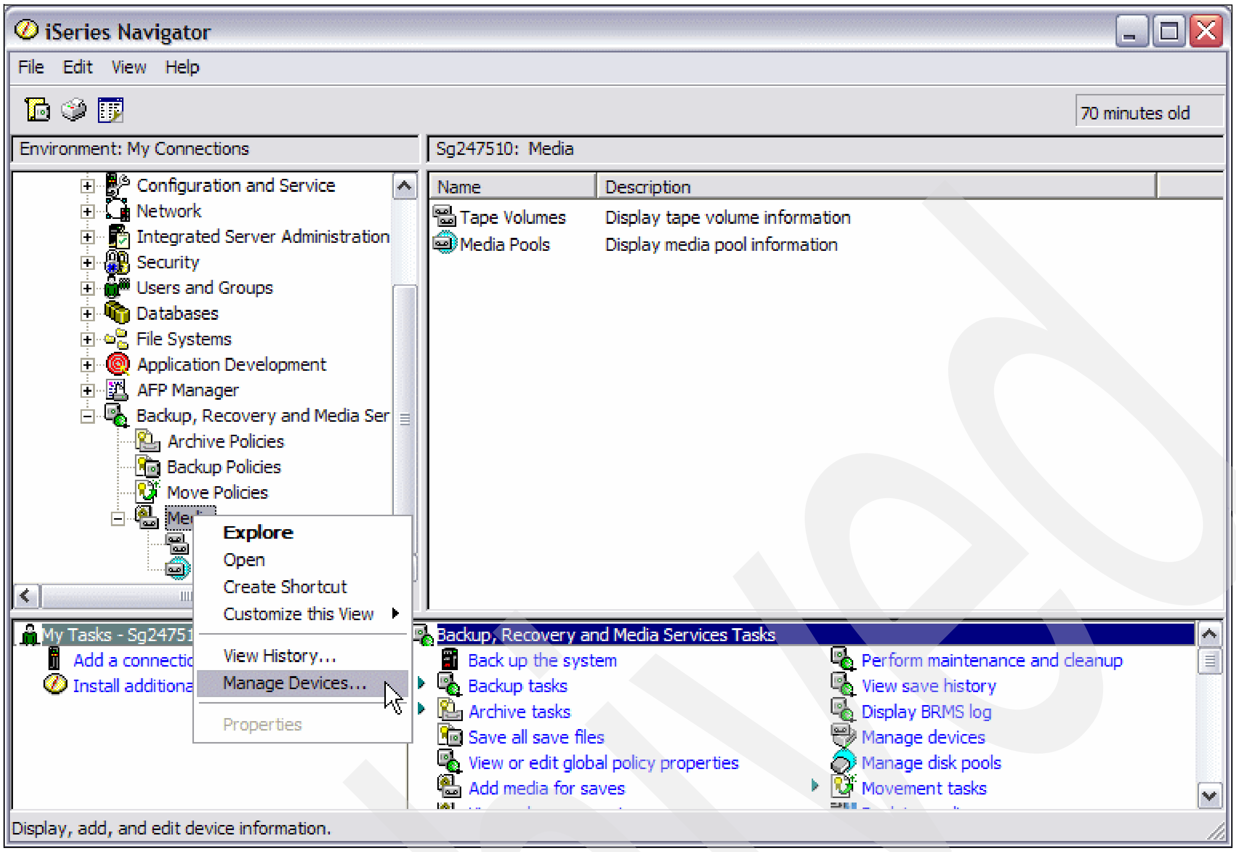



*Figure 6-5 iSeries Navigator - Manage Devices*

3. In the Manage Devices window (Figure 6-6), select your tape library and click **Edit**.

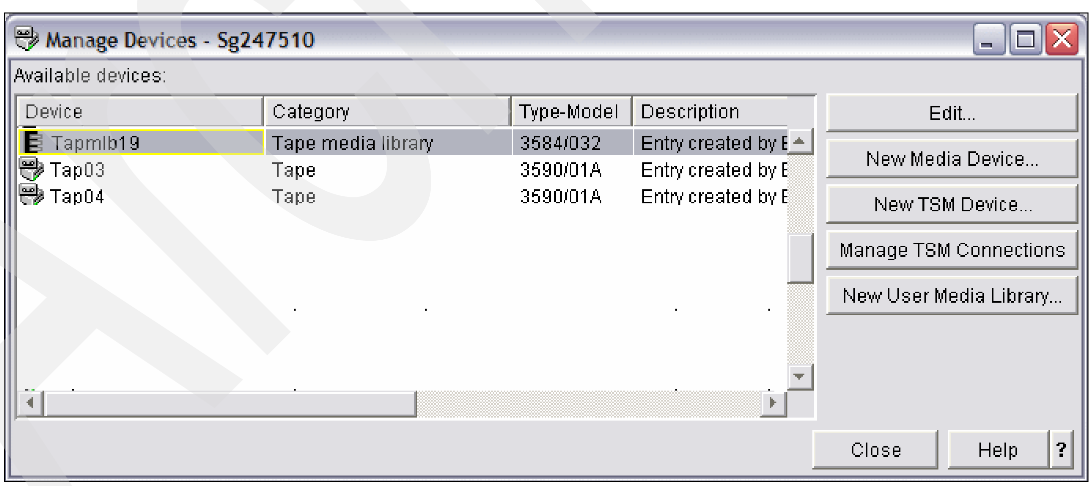



*Figure 6-6 Manage Devices*

Note the real 3590 class tape devices also attached to our system.

Edit device: There are three tabs in the Edit Device window.

4. **General**: Under General (Figure 6-7), the only thing required is changing the text “Entry created by auto-configuration” to something more meaningful.

   We typed `Virtual LTO tape library TS7510`.

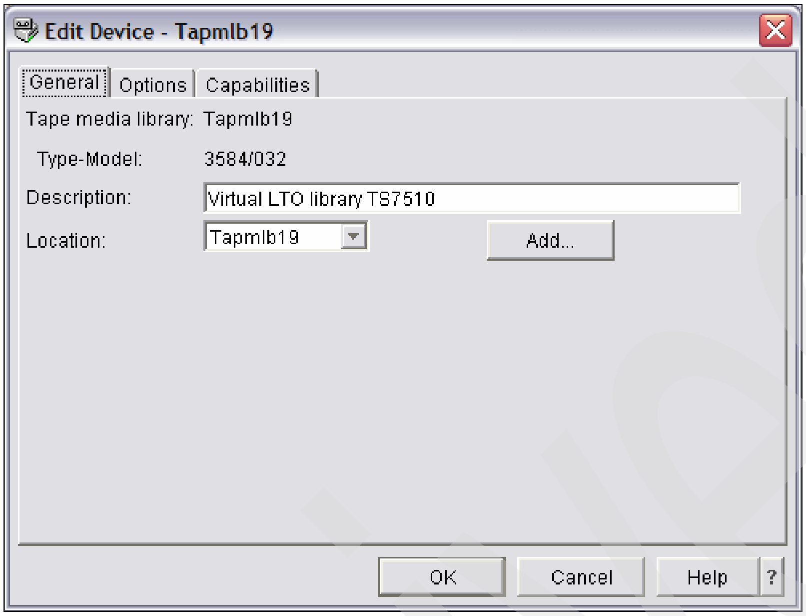



*Figure 6-7 Edit Device - General*

5. **Options**: Under Options, there is nothing to change.

> **Note:** Those familiar with the i5/OS virtual tape concept (available as a standard function in i5/OS V5R4) know that it is not exactly emulating a tape library although it essentially functions as one. The virtual tape support emulates tape drives with an Automatic Cartridge Loader (ACL). As it is virtual, there can be no operator to change a tape cartridge once it has filled up. That has to be done by the program.
>
> To know there is a need for a tape mount, the End of Reel (EOR) signal indication has to be indicated in a message to the system operator message queue (QSYSOPR). Therefore, in that setup the “Send message when ready for next volume” check box has to be selected. However, we do not do this here. Keep the default as deselected here as shown in Figure 6-8.

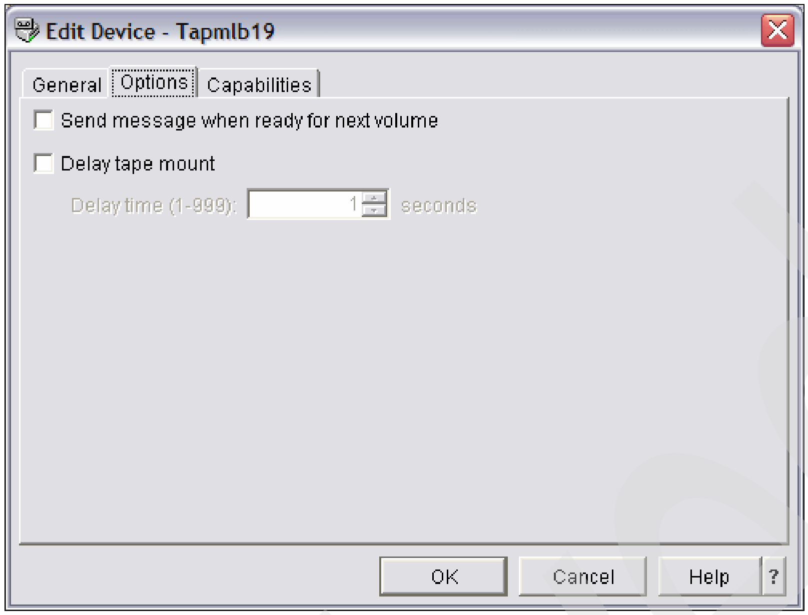


*Figure 6-8 Edit Device - Options*

6. Click **Capabilities**.

   **Capabilities**: Under Capabilities, there are Use optimum block size and Compaction (Figure 6-9 on page 139).

   These concepts have to be evaluated from a virtual tape compared to a real tape viewpoint, though they both are oriented to boosting performance and packing more information into a given physical space.

   This IBM Redbook is about implementing IBM TS7510 attached to i5/OS. You have to understand a little more on how the TS7510 works differently from a real IBM 3584 tape library.

   The IBM 3584 does everything via its hardware. The backup job does not have to worry about what a real tape library can or cannot do. When the real 3584 presents itself to i5/OS, device descriptions are automatically created to match the configuration information detected. From then on, the backup job only references those device descriptions and the i5/OS simply writes the data to the device. The receiving hardware decides how the data should be physically organized on the media.

   Because the IBM TS7510 is actually a set of disks controlled by a Linux-based operating system, software has to do some things rather than real tape hardware. Data that has to be compacted in the TS7510 has to go into a program and come out the other end. Computer programs require CPU power and memory. And rarely does the software run dedicated to performing only one function. That is, the software frequently has to share system resources with other functions that are going on.

   When the same operation is executed by hardware, there is a chip that does nothing else but the operation it was designed for, over and over. The physical tape drive does only this one function. Contrast this to a function such as compression or compaction that, in our case, is done by software within the TS7510. With the current implementation, this compression or compaction function performed by the TS7510 is not, in general, as fast as it would be if done by hardware.

Under specific conditions, where several jobs on the same i5/OS partition or multiple partitions or operating systems are all asking the same *virtual tape hardware and software configuration* to do work at the same time, overall throughput might suffer significantly.

Compaction increases the processing and memory requirements. Therefore, the recommendation is: If you frequently have many write operation requests being requested to the same *virtual device, configuration*, do not use compression or compaction with the TS7510.

### Optimum block size

Using the i5/OS command help text for Optimum block size:

- It is a hardware function and the optimum block size supported by the device is used for `save` commands. If the block size used is larger than a block size that is supported by all device types then:
  - Performance might improve.
  - The tape file that is created is only compatible with a device that supports the block size used. Commands such as duplicate tape (DUPTAP) and duplicate media using BRM (DUPMEDBRM) do not duplicate files unless the files are being duplicated to a device which supports the same block size that was used.
  - The value for the Data Compression (DTACPR) parameter is ignored.

Here is what the iSeries Navigator help text says about the same subject:

- Select this option if you want this device to save data in the block size at which it performs best.
- A device writes data to a volume in blocks, with tiny gaps between the blocks to separate them. The amount of data that a device can write in one of these blocks is the block size. Certain newer devices have a choice between writing traditional sized blocks (32 KB) or large blocks (224 KB to 256 KB). The exact size of the large blocks varies between devices depending on buffer sizes and other parameters: The size that your device performs best with is the optimum block size.
- There is a certain amount of system resources used for sending a block of data to any tape device. Therefore, it is more efficient for the system to send larger blocks when possible. If you are doing a save that uses a lot of processor resource, you can significantly improve your save performance by using optimum blocks. However, you may have to continue using the default block size if you have to duplicate a volume to a new volume that does not support the larger block sizes.

### Compaction

Using the i5/OS command help text:

- Device data compaction is performed if the data is saved to tape and all devices specified on the Device (DEV) parameter support the compaction feature.
- If *DEV is specified on both the Data compression (DTACPR) parameter and the Data compaction (COMPACT) parameter, only device data compaction is performed if device data compaction is supported on the device. Otherwise, data compression is performed if supported on the device.
- If *YES is specified on the Data compression (DTACPR) parameter and *DEV is specified on the Data compaction (COMPACT) parameter, both device data compaction and device data compression are performed if supported on the device.

Using the iSeries Navigator help text:

- Select this option if you want this device to compact the data that is backed up to it. Compaction occurs when data is compressed by your storage device. It increases the apparent capacity of your media by encoding the data to use less space. The data is compressed and decompressed automatically each time the data is read or written and is transparent to applications.

> **Note:** This option is not available for virtual devices directly controlled by the i5/OS. However, a virtual tape library, for example IBM TS7510, is treated as any other tape library.

While a specific customer environment might have special considerations, we generally recommend selecting Use optimum block size and leaving Compaction as deselected.

7. Make no changes on the Capabilities tab as optimum block size has been selected by default.

   Click **OK** and the device description looks a bit better.

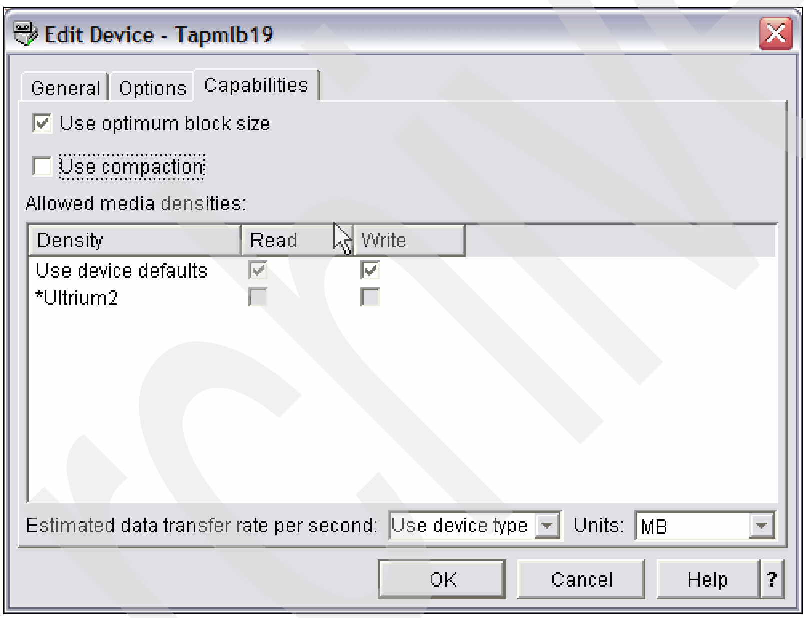



*Figure 6-9 Edit Device - Capabilities*

Although this entire section contains much information, we really made only one change: The description text shown in Figure 6-7 on page 136.

## 6.2.4 Managing locations

To manage locations, perform the following steps:

1. In iSeries Navigator, expand **Backup, Recovery and Media Services**. Right-click **Move policies** and select **Manage locations**, as shown in Figure 6-10.

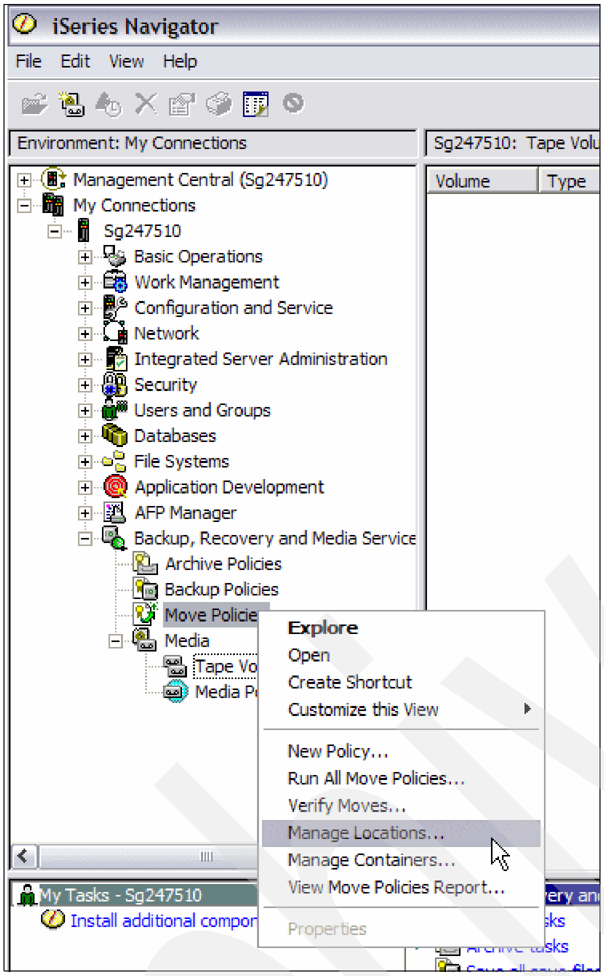



Figure 6-10 iSeries Navigator - Manage Locations

2. In the window shown in Figure 6-11, select your tape library. Click **Edit**.

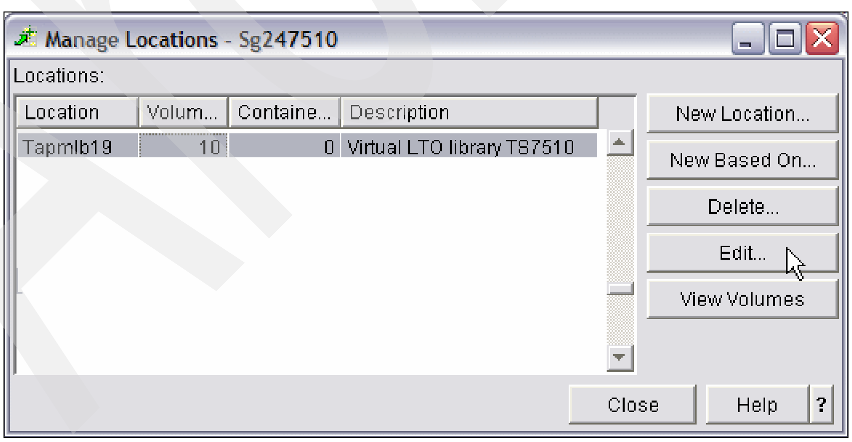



Figure 6-11 Manage Locations

3. You get the window shown in Figure 6-12. Change the text to your requirement.

> **Important:** These editorial changes may seem to add little or no value to your backups. However, remember the only reason we save data is that there might be a need to restore it. Murphy's law tells us that what may go wrong, does go wrong. Therefore, you should make setting up your backup (and recovery) process, including how to backup your data and how to recover it, as crisp and clear as possible. Meaningful text helps a lot, especially for those who do not know these procedures by heart.

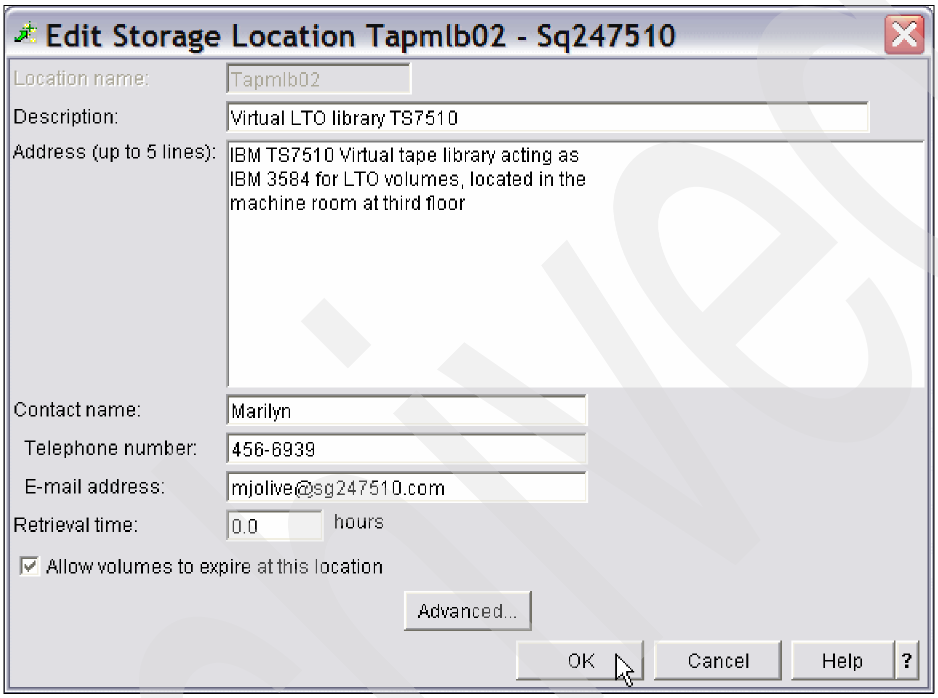



*Figure 6-12 Edit Storage Location*

4. Enter your own text into the Description, Address, Contact name, E-mail address, and retrieval time fields. We do not show Advanced capabilities in this book. When done with all your editing, click **OK**.
5. This returns you to the Manage Locations window shown in Figure 6-13. Next, we want to see what volumes there are in that tape library.

> **Note:** The volumes we find were created using the TS7510 Virtual Tape Console. Remember this is virtual. No one can physically stick any cartridges into a virtual library.

6. Click **View volumes**.

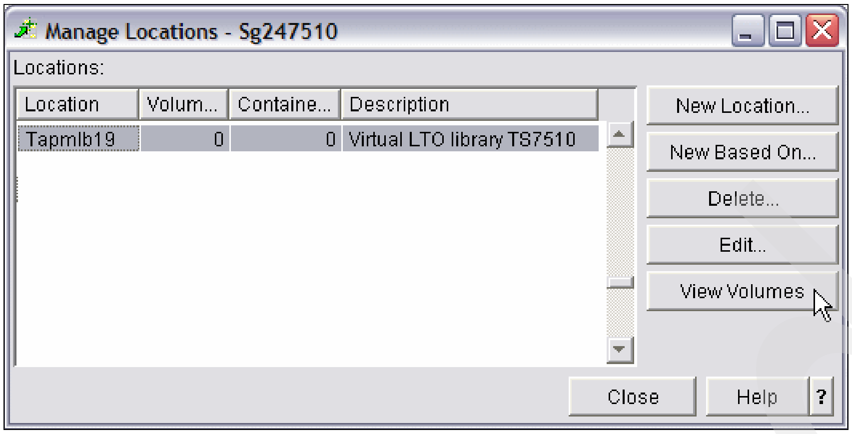



*Figure 6-13 Manage Locations*

7. You might see an error message window similar to the one shown in Figure 6-14.

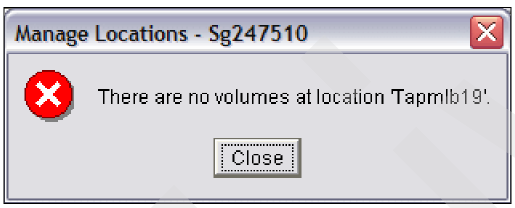



*Figure 6-14 Manage Locations - No volumes*

The error pop-up is posted because we are looking at the volumes from a BRMS viewpoint. In the BRMS inventory, there are no tapes.

We have to add volumes to BRMS. But first we must create a media pool so that BRMS knows where to stick them.

Our virtual IBM TS7510 library acts and behaves exactly the same as a real IBM 3584 library. The virtual volumes are bit by bit exactly the same as their physical counterparts. Display their content, and you cannot tell the difference. For instance, both use the same density. In a normal BRMS environment, you often want to have all cartridges of the same type in one pool. That makes it easier to handle, for instance, scratch volumes. You only have to look in one place. For the apparent reason that you cannot mount physical volumes in a virtual library and vice versa, although from an application perspective they have exactly the same characteristics. Therefore, we have to distinguish between physical and virtual cartridges. We do that by placing them in separate media pools.

The easiest way to create a media pool for our virtual volumes is simply to copy an existing media pool using the same media type.

Find and select one that corresponds to your requirement.

8. Right-click **a suitable Media Pool** and select **New Based on**, as shown in Figure 6-15.

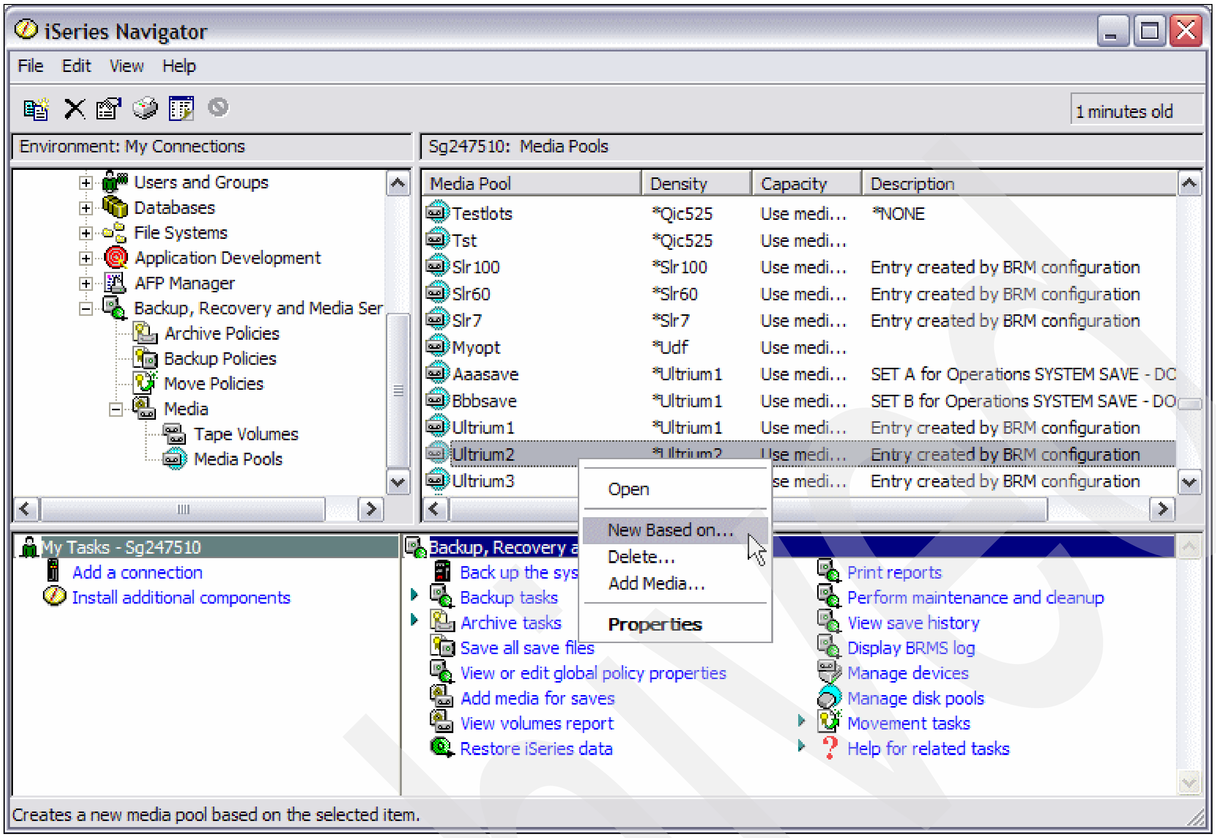



*Figure 6-15 iSeries Navigator - Add Media Based on*

This opens a wizard.

9. In the window shown in Figure 6-16, specify a media pool name and description text that are meaningful to you. Note the selected Use media format and Share media across systems. In this IBM Redbook, we do not cover BRMS multiple system support, but selecting here is acceptable. Click **OK**.

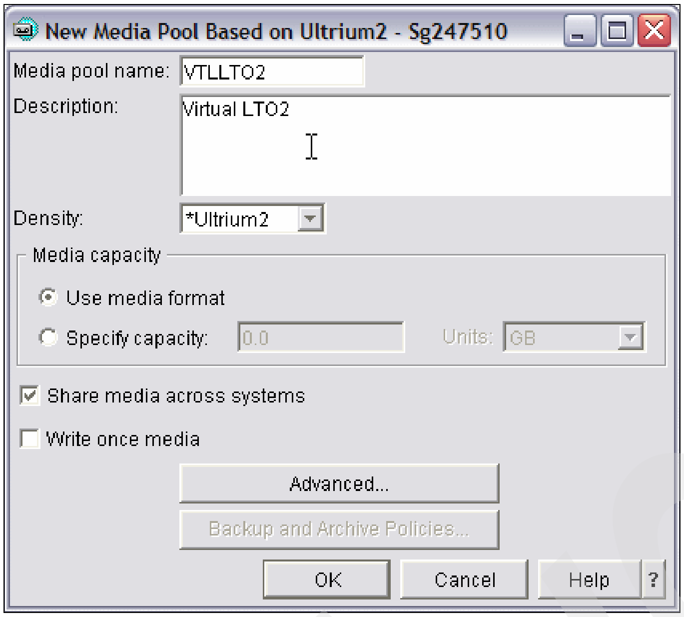



*Figure 6-16 New Media Pool Based on*

10. You might have to refresh the screen to see your newly created media pool.
11. Right-click your newly created Media pool name and select **Add Media**, as shown in Figure 6-17.

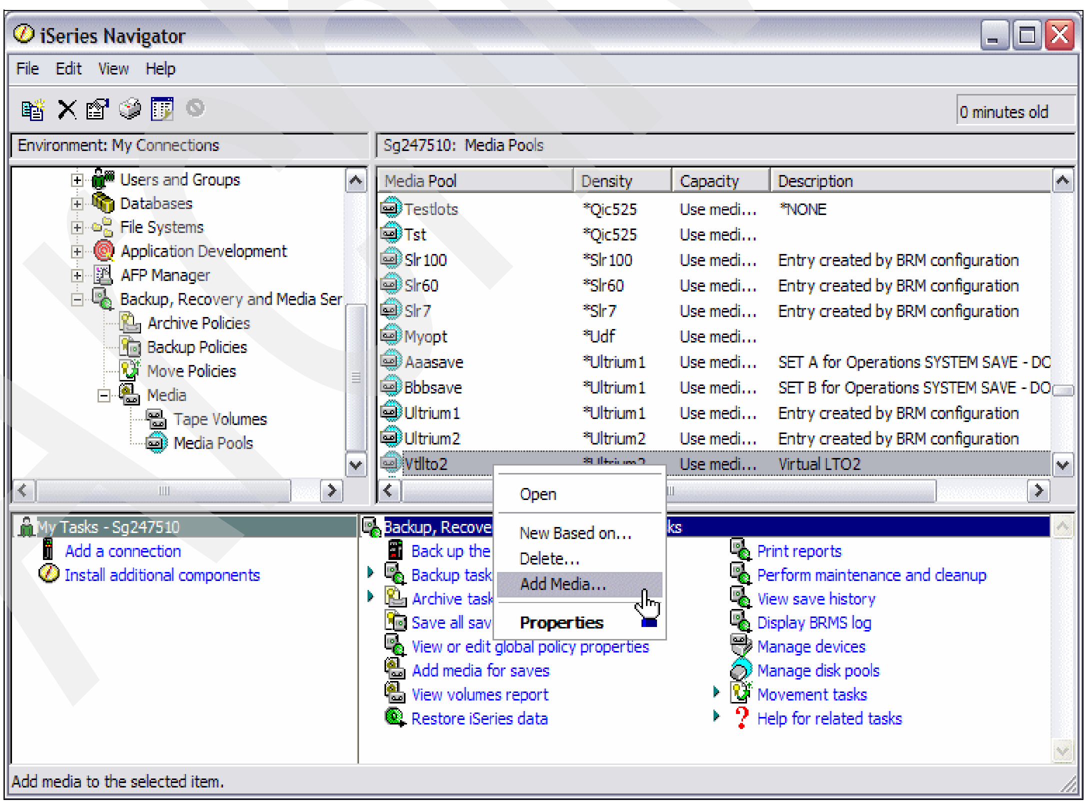



*Figure 6-17 iSeries Navigator - Add Media*

12. This opens the first Add Media wizard window shown in Figure 6-18. Click **Next**.

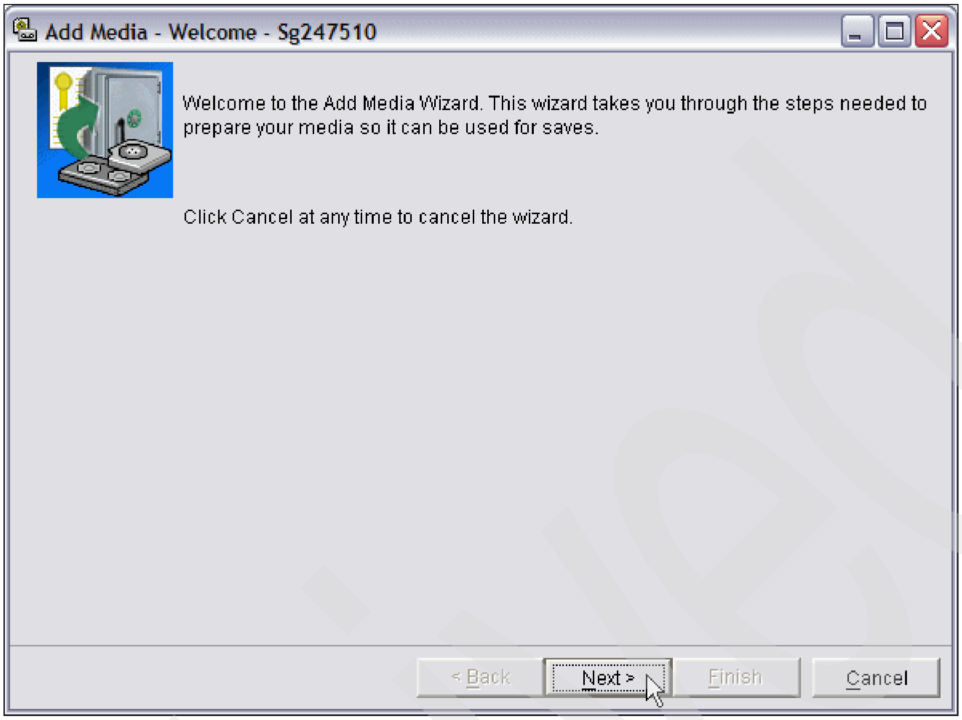



*Figure 6-18 Add Media - Welcome*

13. In the next window (Figure 6-19):

   a. Select **Yes** if it is not already selected by default.
   b. Click the down arrow in the Media library field to find your media library. Select it.
   c. Click **Next**.

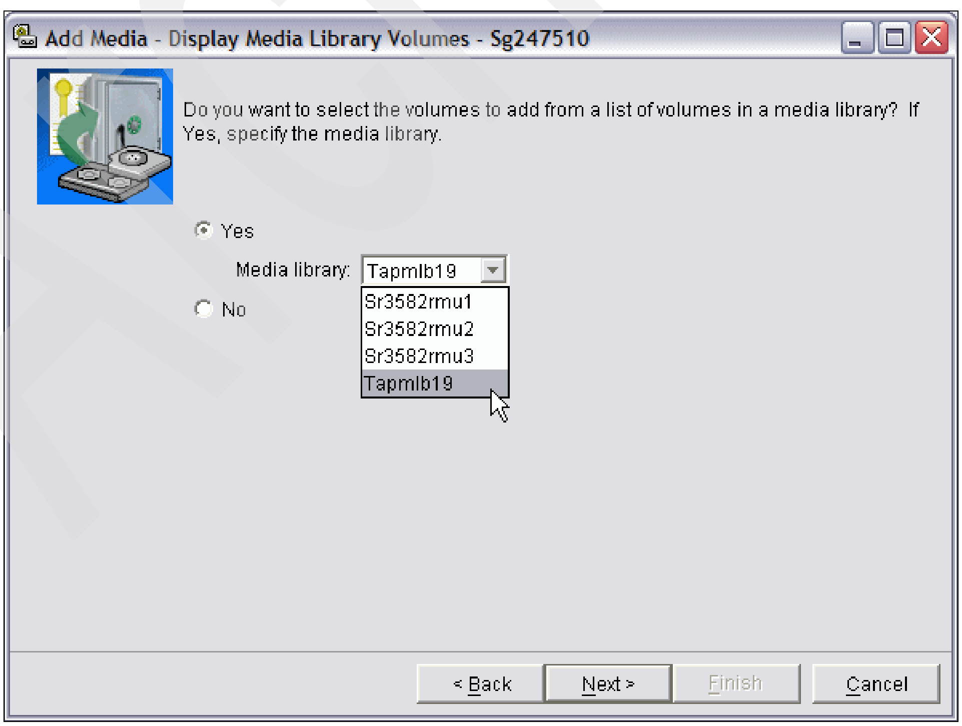



*Figure 6-19 Add Media - Display Media Library Volumes*

14.In the next window (Figure 6-20) select which Category you want to have presented.

We selected the option **All inserted volumes**.

> **Note:** If the process of adding volumes fails for some reason, next time you return to this wizard window, you might find that there are fewer inserted volumes. This is because there are several software operations being performed when adding a volume. One is changing volume status from Inserted to Available or even Mounted. Depending on where the error occurred, some of those operation were successfully completed and the result might have been a status change.

Click **Next**.


*Figure 6-20 Add Media - Specify Media Library Category*

15.The Add Media - Select Media Library Volumes window opens. In this window, select whatever volumes you find best for your requirements: one, select one or all, as we have done in our example in Figure 6-21. Click **Next**.

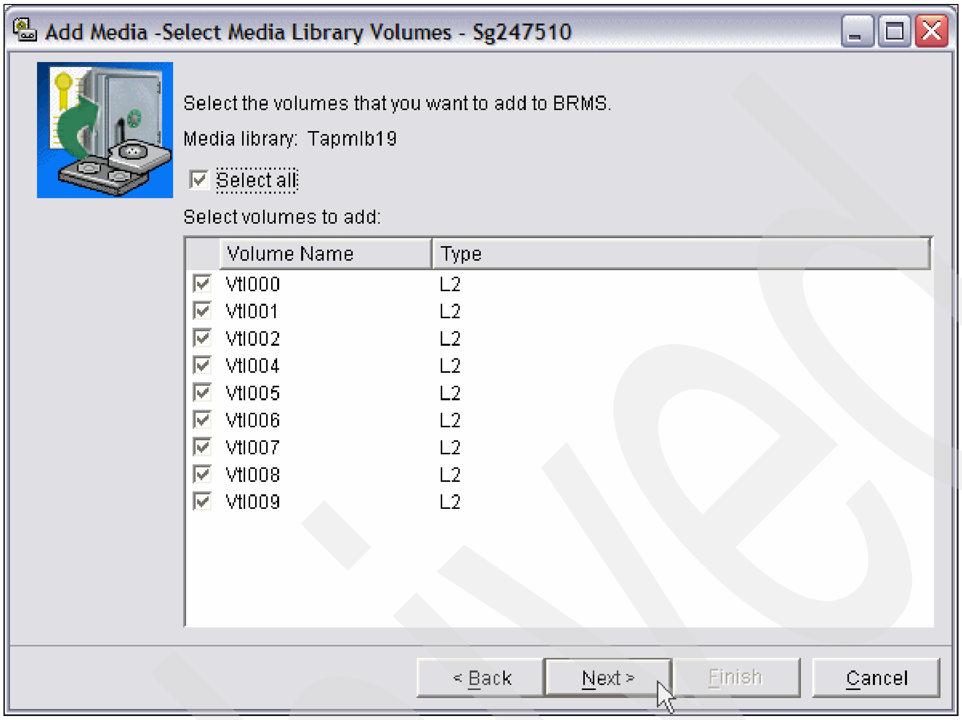



*Figure 6-21 Add Media - Select Media Library Volumes*

16.Now you must decide if you want to initialize the selected volumes. Our virtual volumes are “right out of the box” as we just created them. Because we want to use them now, we have to initialize them.

> **Attention:** Regardless of whether they are virtual or real, all tape volumes must be initialized before they can be used. i5/OS thinks it is communicating with a real tape configuration. You have to initialize a volume only once.

Select the volumes you want initialized (we selected all of them in our example as shown in Figure 6-22). Click **Next**.

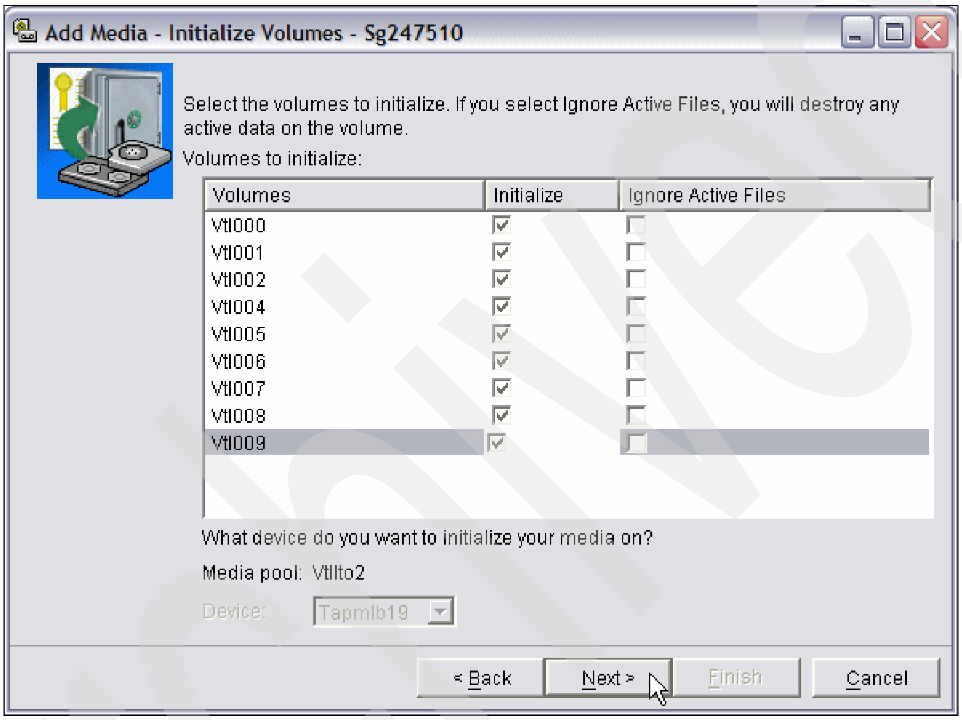



*Figure 6-22 Add Media - Initialize Volumes*

17.After you click Next, you get a summary window, such as the one shown in Figure 6-23. Review the summary information and make changes if you want. You can use the Back button if you want to make changes using previous wizard windows.

Before starting, you see a window that sums up your selections. You can go back and change things or continue.

When satisfied with your settings, click **Finish** to start the initialization process.

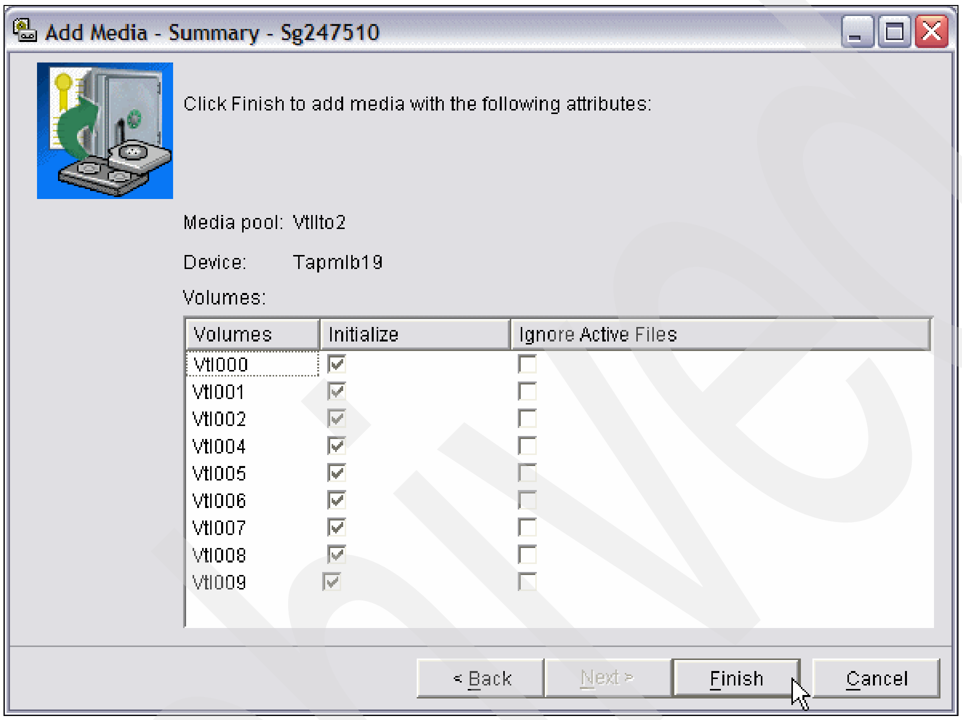



*Figure 6-23 Add Media - Summary*

During the initialization process, you see a progress status window similar to Figure 6-24.

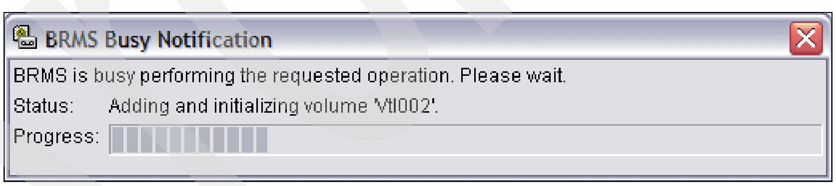



*Figure 6-24 BRMS Busy Notification*

When finished, you are ready to do some more changes to get ready to use the initialized volumes.

## 6.2.5 Changing what you see in the iSeries Navigator

The iSeries Navigator uses a standard setup that you might want to change.

An example could be what is presented when looking at media.

If you are working in an environment with many systems connected, you might not be interested in media belonging to other systems or media of types that you do not need in your daily operation. You can change the standard setup.

## What type of media do I want to see?

The iSeries Navigator has an Include function (F11). You use that to *subtract* or *add* information you want presented in the iSeries Navigator window.

1. Right click **Tape Volumes**, and select **Customize this View** → **Include**, as shown in Figure 6-25.

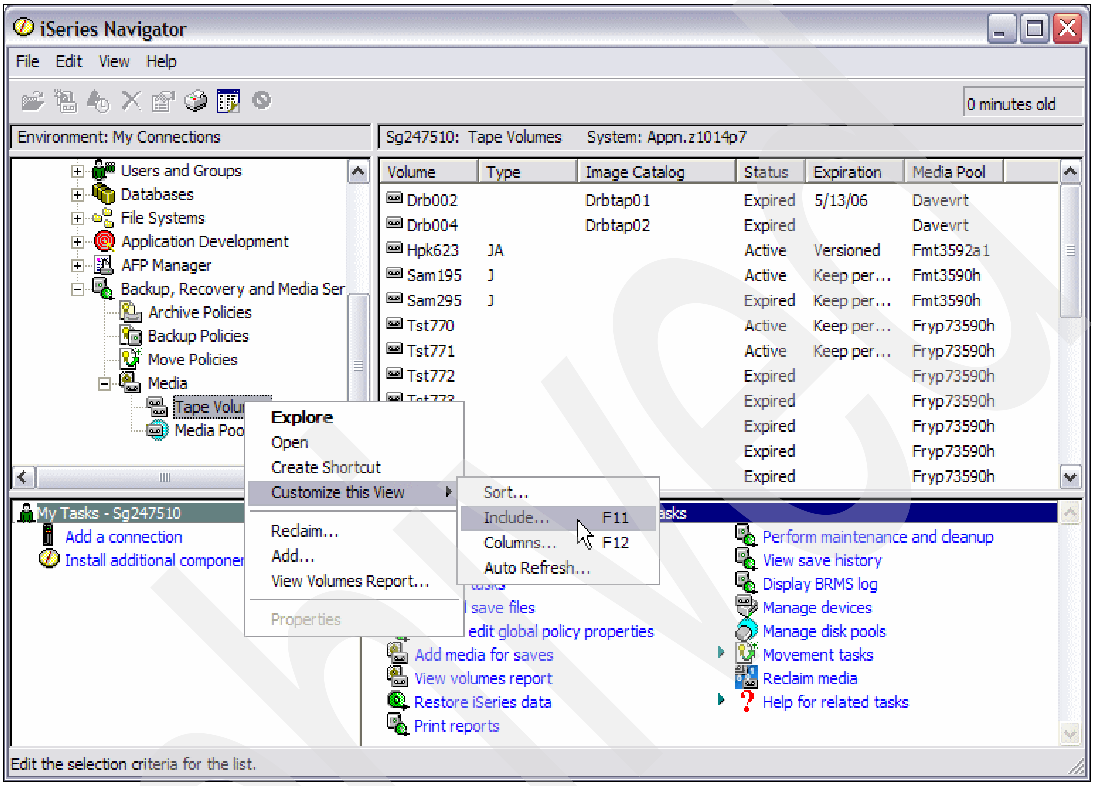



*Figure 6-25 iSeries Navigator - Customize Tape Volumes Include*

2. You get a window like the one shown in Figure 6-26 to consider and perhaps change the information shown in the window.

   In this example, we are primarily interested in our new virtual tape volumes and that we named VTL000 through VTL010.

   In our example, we entered `vtl*` into the Volume field. We left all other field values unchanged. Click **OK**.

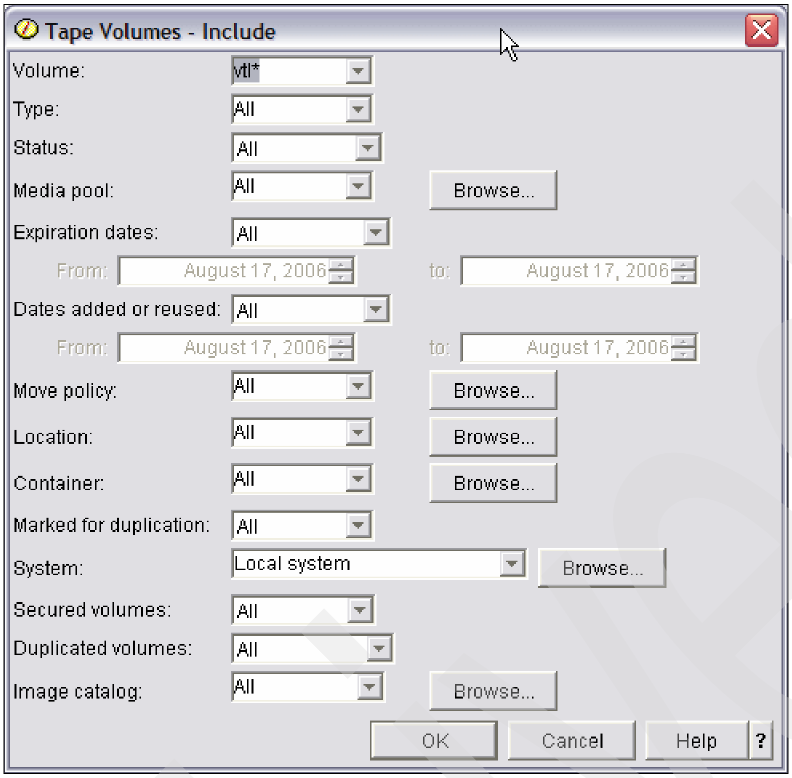



*Figure 6-26 Tape Volumes - Include*

In our Include example, our window now looks like the one shown in Figure 6-27, showing volumes whose names begin with vtl.

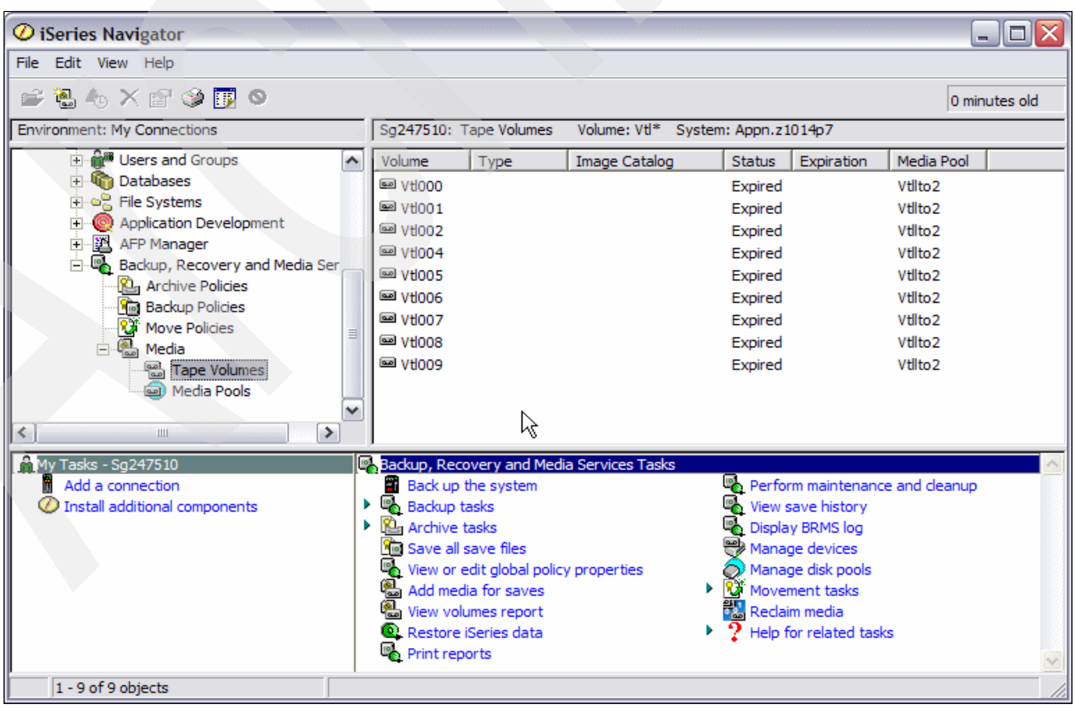



*Figure 6-27 iSeries Navigator - Customize Tape Volume Include result*

## What detail information do I want to see?

Similarly, as in the previous step, we customize how the columns of data are presented.

1. Right click **Tape volumes** → **Customize this view**, select **Columns** (F12), as shown in Figure 6-28.

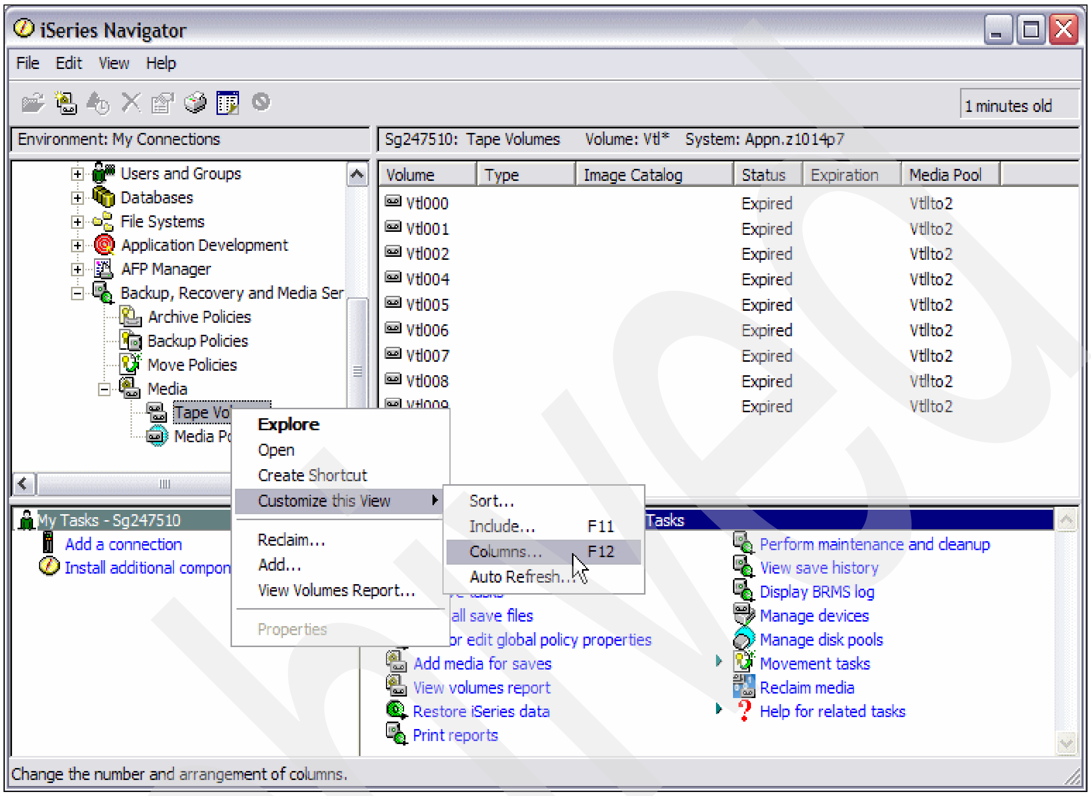



*Figure 6-28 iSeries Navigator - Customize Tape Volume Columns*

2. You can then look at the various column fields already being shown (Figure 6-29). You can remove them, add new columns, and even reorder the columns of information.

   Typically the useful columns of information you should want to see include:

   – Volume
   – Location
   – Status
   – Media pool
   – Expiration date
   – Marked for duplication
   – Duplicated to volume

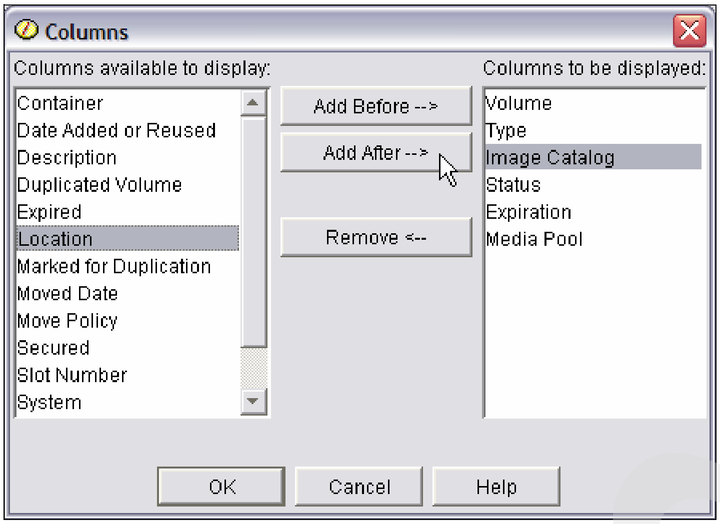



*Figure 6-29 Columns - Adding/Removing/Arranging*

Figure 6-30 shows an example of column changes.

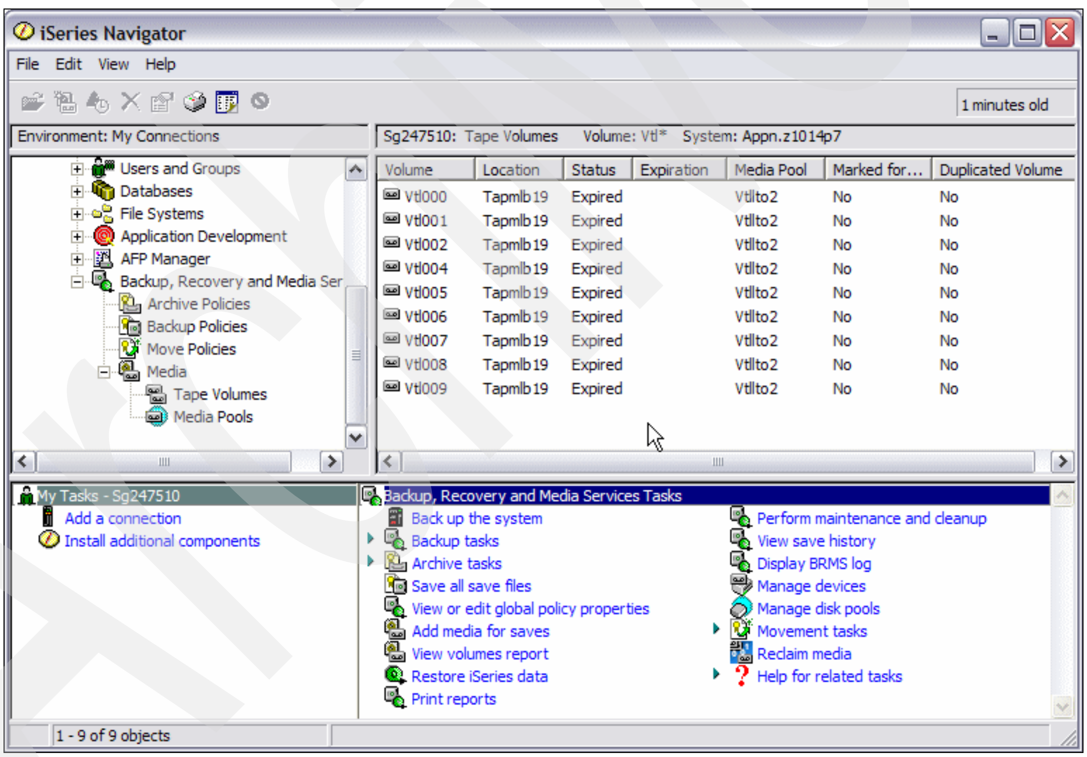



*Figure 6-30 iSeries Navigator - Customize Tape Volume Columns result*

## 6.2.6 Why is volume VTL003 missing?

You might have observed that earlier in this book, we created ten virtual volumes using the Virtualization Engine for Tape Console. For some reason, VTL003 never showed up in the rest of this example. Refer to Figure 6-21 on page 147.

Why is volume 3 missing?

Again we must think of the TS7510 as being a real physical tape library. Such libraries can hold many hundred tape volumes. When adding volumes, you stick them into an input/output (I/O) device, which is the normal transport mechanism for cartridges physically leaving or entering a tape library. You can also open its door, but that affects any physical tape robot functions in operation. All functions are stopped until the door is closed. This is to prevent accidents as the cartridge gripper device moves very fast.

In real life, you would *not manipulate the door latch*. You might stand the risk that the gripper thinks you are a tape device.

When operation returns to normal, the robot device has to locate every single tape cartridge in the whole tape library. It has to *re-calculate* who they are and where they are located. Were cartridges removed and new ones inserted? The tape robot device does not know until the inventory is complete. This could take some time.

In order to keep track of all this, every cartridge has a status: *available*, *mounted*, and (the one we are interested in) *inserted*.

When we ask BRMS to look up our new tape volumes, it asks the library device what new cartridges are there. This is not done by BRMS directly. The i5/OS does this through Media and Storage Extensions, which is i5/OS (5722-SS1) option 18. We still have to determine why VTL003 is *missing*.

A quick look using the i5/OS WRKMLBSTS BRMS command shows us. In a 5250 screen for WRKMLBSTS, we have already selected option **9**, which shows us the information in Figure 6-31.

```
Work with Tape Cartridges

Library Device:   TAPMLB19


     Cartridge   Volume      Media
Opt  ID          ID          Type        Status
     VTL000      VTL000      L2          Available
     VTL001      VTL001      L2          Available
     VTL002      VTL002      L2          Available
     VTL003      VTL003      L2          Mounted
     VTL004      VTL004      L2          Available
     VTL005      VTL005      L2          Available
     VTL006      VTL006      L2          Available
     VTL007      VTL007      L2          Available
     VTL008      VTL008      L2          Available
     VTL009      VTL009      L2          Available
```

*Figure 6-31 Work with Tape Cartridges*

For some reason, someone had mounted virtual tape volume VTL003 into a virtual tape drive, so it had the status *MOUNTED. Although this volume is not used in our example, and thus was never initialized, it never came up as a candidate for add because BRMS asked for those that were *INSERTED.

We added all the other virtual volumes earlier, therefore they are fully usable and in Available status.

Although already sitting in a tape drive, VTL003 may or may not be usable. We do not know, because it does not yet *belong to BRMS*. Therefore, we must first add it to BRMS and, to be on the safe side, also initialize it. The following section shows how to do this.

## 6.2.7 Adding a single virtual volume to BRMS

To add a single virtual volume to BRMS:

1. Open **Backup, Recovery and Media Services** in the iSeries Navigator. Right-click **Tape volumes**, and select **Add**, as shown in Figure 6-32.

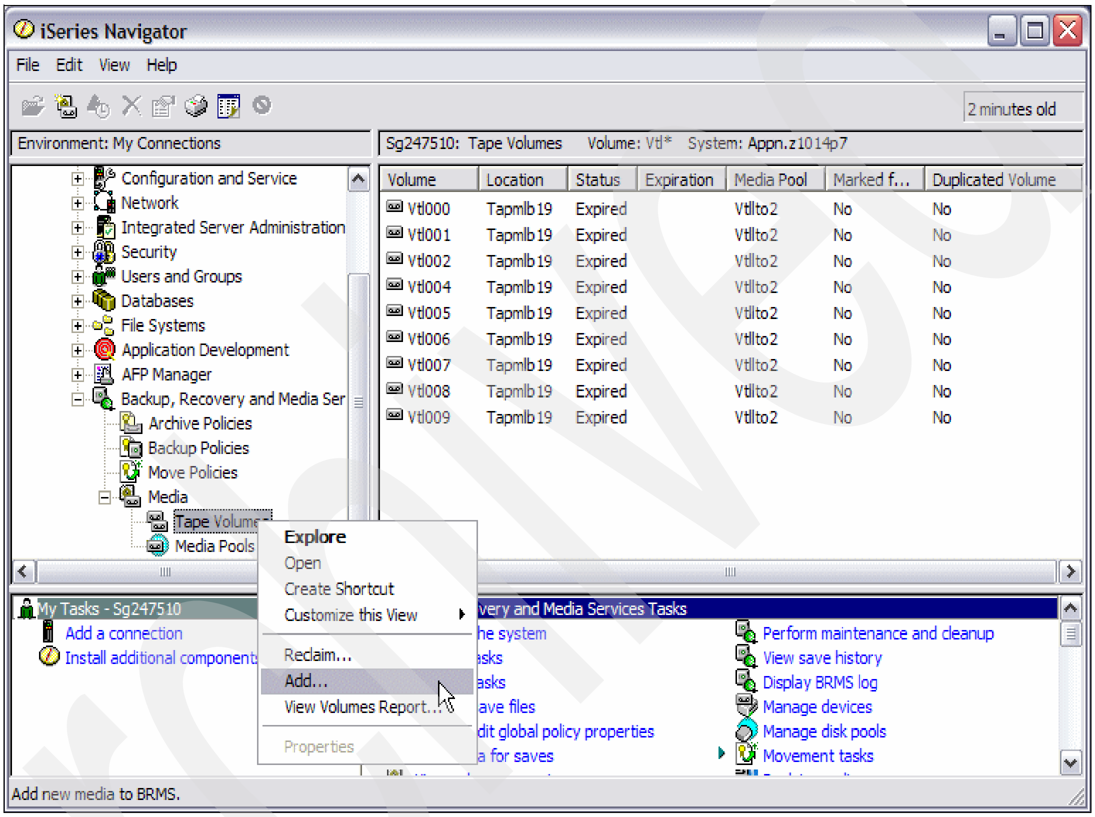



*Figure 6-32 iSeries Navigator - Add Tape Volumes*

2. The Add media wizard is presented (Figure 6-33). Click **Next**.

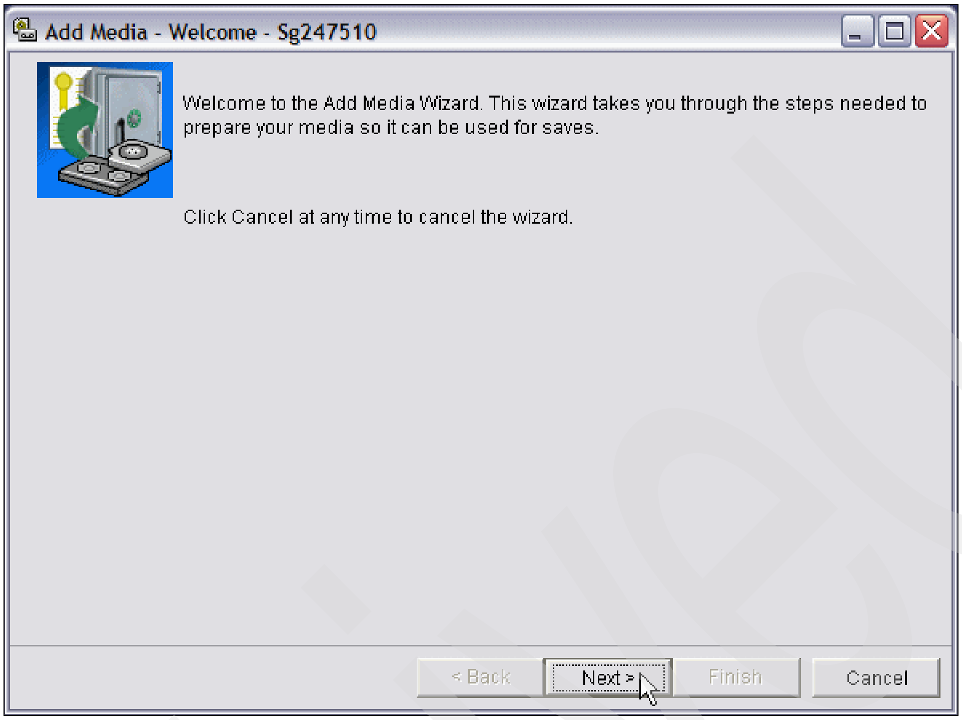



*Figure 6-33 Add Media - Welcome*

We place this missing volume into the same media pool with the other vtlnnn volumes.

3. Select the media pool that you created earlier (Figure 6-34). In our example, this is media pool **vtllt02**.

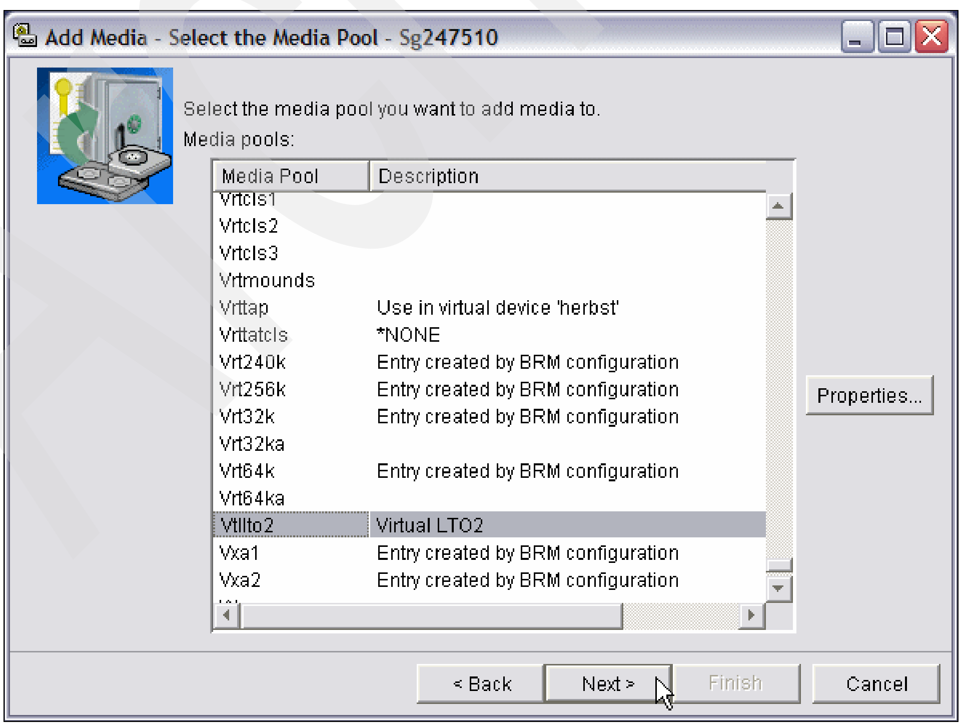



*Figure 6-34 Add Media - Select the Media Pool*

**Note:** You can add a volume in either of two ways:

- Specify a volume name or a volume name prefix to see a list of possible volume names to list.
- Specify that the library device itself is to display all the volumes it knows about. You can select from the list presented. Depending upon how many volumes you might have already defined, the list could be quite long.

In the following steps, we specify that we are going to specify the volume name itself.

Click **Next**.

4. The window shown in Figure 6-35 opens. Because we are adding a single tape volume, we select **No** and click **Next**.


*Figure 6-35 Add Media - Display Media Library Volumes*

5. Read the wizard text shown in Figure 6-36. Type the volume name to be added. Click **Add**.

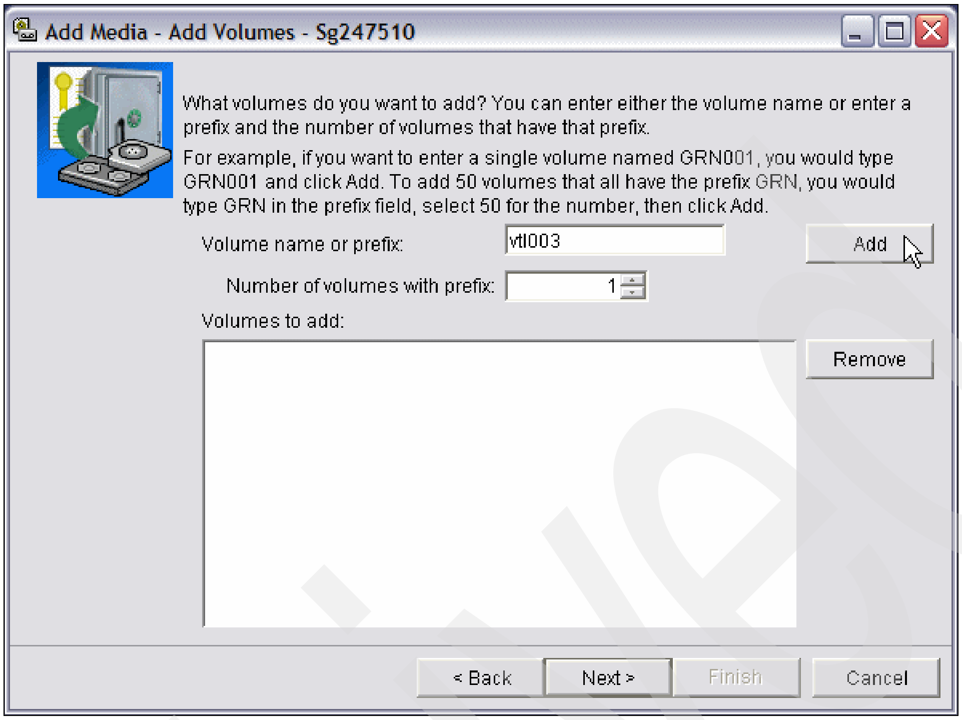



*Figure 6-36 Add Media - Add Volumes*

6. When all volumes have been added, click **Next**, as shown in Figure 6-37.

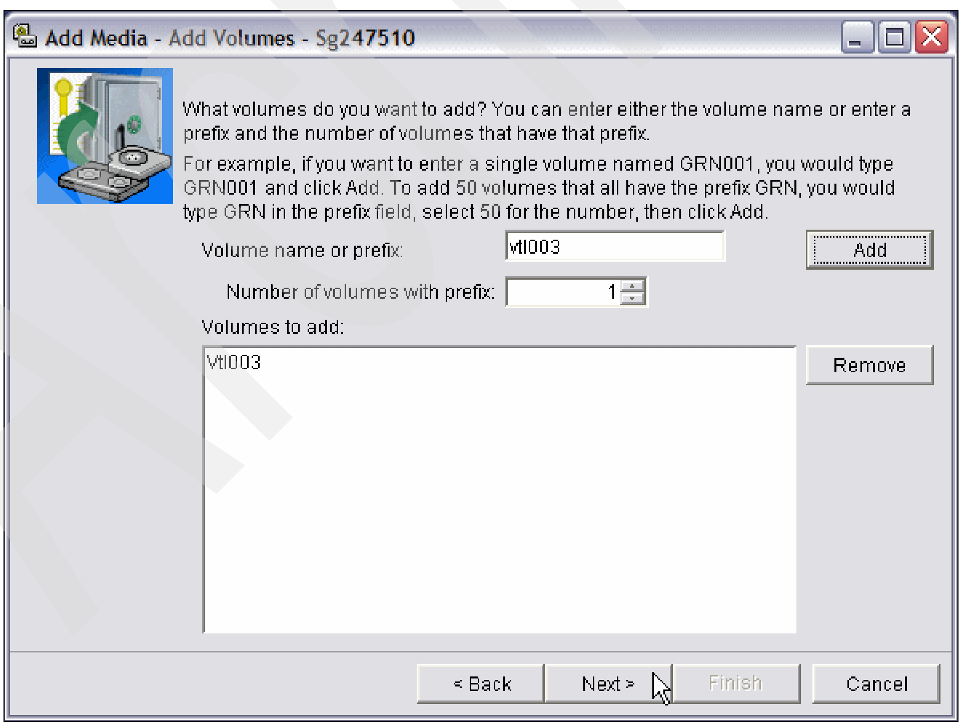



*Figure 6-37 Add Media - Add Single Volume*

7. In the next window (Figure 6-38), we must select an existing location or define a new location to which the virtual the tape volumes should be added to. Select the down arrow for Location and BRMS displays any tape libraries it has already sensed. You can refer to the sections starting from 6.2.1, “Identifying virtual devices to BRMS” on page 132, to see where location (tape library) Tapmb19 was identified.

   Select **TAPMLB19**. Click **Next**.

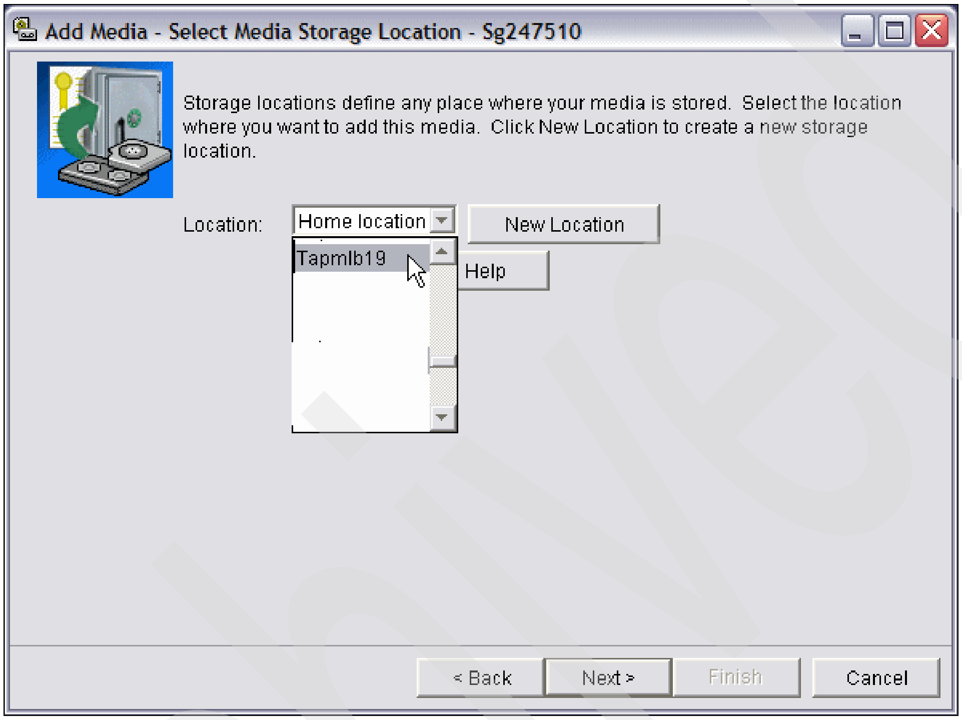



*Figure 6-38 Add Media - Select Storage Media Location*

8. The window shown in Figure 6-39 opens. After reviewing this window, click **Next**.


*Figure 6-39 Add Media - Select Media Storage Location (selected)*

9. The window shown in Figure 6-40 opens. Select the check box under Initialize to specify that the volume being added also has to be initialized. Select a device if required.

   Click **Next**.

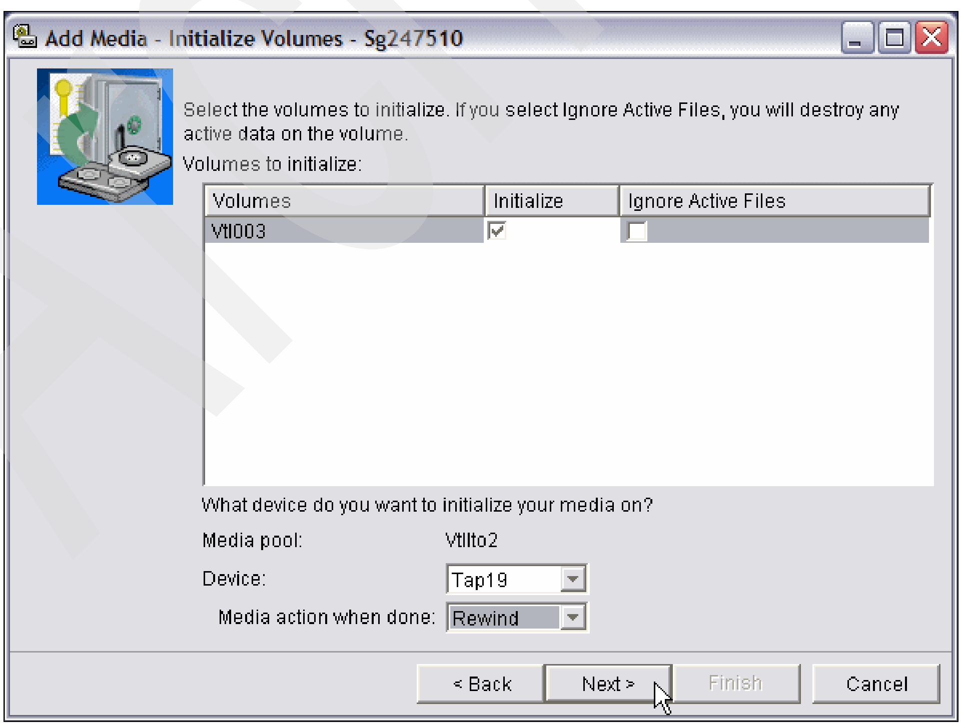



*Figure 6-40 Add Media - Initialize Volumes*

10. The Add Media Summary window shown in Figure 6-41 opens. Click **Finish** or click the **Back** button to change your options. Assuming that you clicked Next, the summary window shown in Figure 6-41 opens.

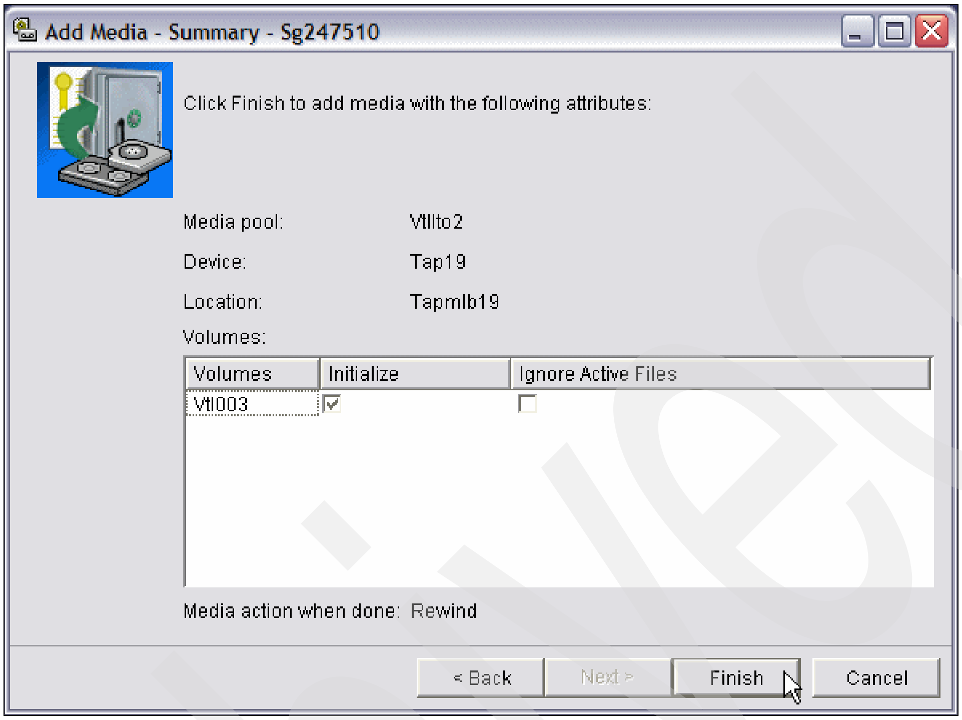



*Figure 6-41 Add Media - Summary*

After the progress window indicates that the add media has completed successfully, we are done adding our volume.

11. Press F5 to refresh the iSeries Navigator window and all of our volumes should be there (Figure 6-42).

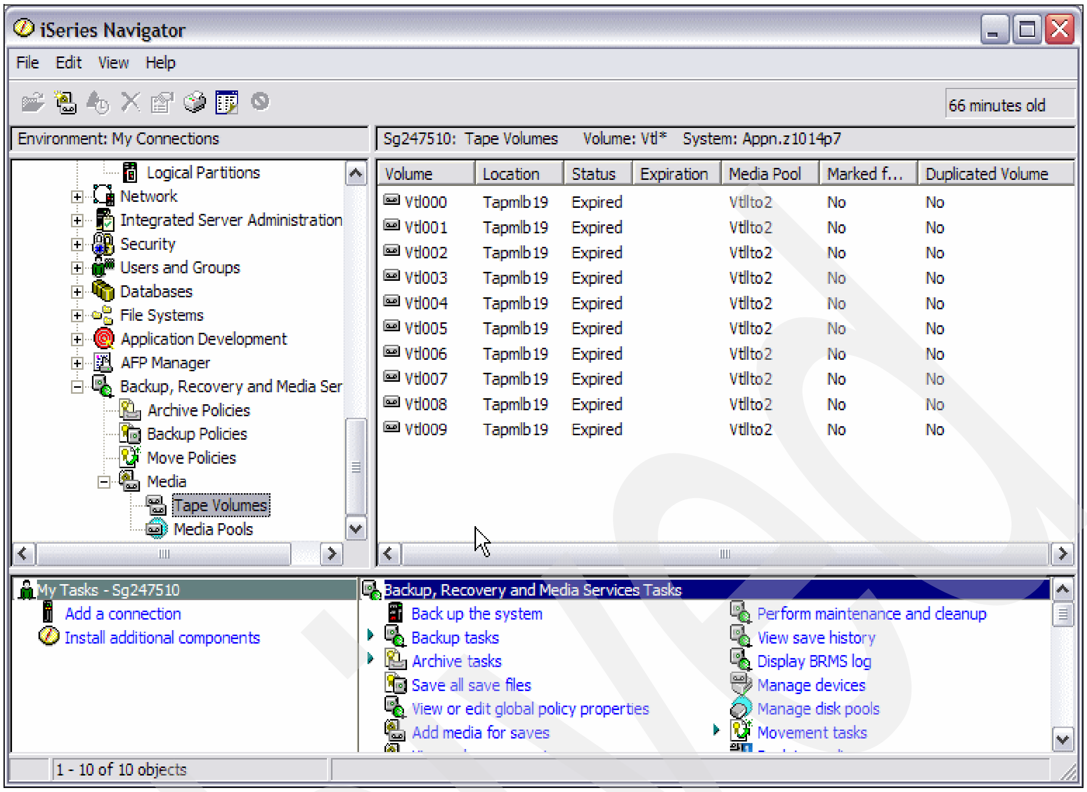



*Figure 6-42 iSeries Navigator - Tape Volumes*

## 6.3 Setting up and running the backup example

In this section, we continue to explain how to set up a simple backup to the TS710, using the iSeries Navigator and then run the backup.

We remind you that setting up the virtual tape environment using the TS7510 is almost exactly like setting up for a real tape library and its devices. The TS7510 reports into the operating system as any other tape library, therefore the user cannot tell the difference. Neither can the operating system. There is a library (some kind of robot device that manipulates tape volumes), there are tape drives, and there are policies that specify how to define, use, and manage this tape library environment.

As with any other tape library, the IBM TS7510 has to have tape drives and it has to be attached to the system reading and writing to it. To be able to write or read, there must also be tape volumes available. Therefore nothing is really different, up to a point.

Backing up to the TS7510 would not normally be considered a *highly available* environment. Putting the critical data required for recovery still requires *the data* be backed up to a physical tape media (volume). That volume can then be physically stored in a highly secure physical location.

Therefore, backing up to a virtual environment has one additional step for the critical data backup: Copying the data on virtual volumes to physical tape media. For some data, you need it physically stored “someplace else” than solely on the TS7510 or solely on any virtual tape “media.”

The role of BRMS is to specify what to back up, how much to back it up, where to write it, and then keep track of the result; in detail or at summary level. In our virtual tape scenario, BRMS is not, programmatically, made aware of any copy to physical tape done through the Virtualization Engine for Tape Console.

The obvious advantage is that these console tasks can be done from any workstation that has the Virtualization Engine for Tape Console program loaded and can physically connect to the TS7510.

BRMS is an application and as such it is totally independent of a system's or partition's physical setup. It knows nothing about resources, cabling, and so on. Thus, this chapter does not contain information about how to attach the real hardware to your system or about any TS7510 setup. In the context of this IBM Redbook, that information is contained in:

- Chapter 2, "Description and terminology of the TS7510" on page 15
- Chapter 4, "Hardware and software requirements" on page 47
- Chapter 5, "Installation and basic setup" on page 67

This chapter, and BRMS, assume that the partition hardware connections and the TS7510 are in working order.

As a result, almost all of the BRMS setup described in this chapter should be used by a supported tape library and its devices, virtual or real. Only the backup and recovery *policies* need to be adjusted.

The logic for BRMS support of the TS7510 remains basically the same as for a real tape library:

1. Take your backup.
2. Move the volumes to a secure place.
3. Bring them back for reuse when the volumes have expired.
4. Load the appropriate backup media when recovering.

With virtual tapes, however, there are a few *twists* to the real tape backup and recovery process:

1. Take your backup.
2. Copy the virtual volumes to real physical tapes.
3. Move the physical volumes to a secure place.
4. Let the virtual volumes expire for reuse some time after they have been copied to real media.
5. Bring the physical volumes back for reuse when they are expired.

In the remainder of this chapter, we show how to create a simple backup process or an application using the iSeries Navigator. You can do the same thing using the 5250 i5/OS commands, but it is much easier to do this using the iSeries Navigator BRMS plug-in interfaces.

A backup job normally writes data to tape volumes and when done there is nothing more to it other than that the objects backed up store information when and where they were saved to (unless you told the `backup` command not to store this information).

We used the i5/OS command Display Object Description (DSPOBJD) for the library OLIVER to show what i5/OS knows about an object, as shown in Example 6-1.

*Example 6-1 Display Object Description of library Oliver*

```
Object . . . . . . . : OLIVER        Attribute  . . . . . :   PROD
  Library  . . . . . : QSYS          Owner  . . . . . . . :   MARILYN
Library ASP device . : *SYSBAS       Library ASP group  . :   *SYSBAS
Type . . . . . . . . : *LIB          Primary group  . . . :   *NONE

Journaling information:
  Currently journaled  . . . . . . . . :   NO
Save/Restore information:
  Save date/time . . . . . . . . . . . :   07/24/06  14:52:28
  Restore date/time  . . . . . . . . . :   02/17/06  10:42:03
  Save command . . . . . . . . . . . . :   SAVLIB
  Device type  . . . . . . . . . . . . :   Tape
  Sequence number  . . . . . . . . . . :   1021
  Volumes  . . . . . . . . . . . . . . :   VOL770
  File label ID  . . . . . . . . . . . :   OLIVER
  Save format  . . . . . . . . . . . . :   Serial
```

Example 6-1 simply shows that the last save of library OLIVER was done to tape media with volume name VOL770. It also says which sequence number it got, which is important to know in case there are more saves on the same volume.

Now, if you are satisfied with only knowing when the last backup was done this is okay, but you have no idea if that tape volume still exists or where it is.

Furthermore, you do not know if there were previous backups taken. And if so, to what media. To what volume. If someone deleted the object, therefore it no longer can show you at least when the last backup was taken, what do you do then? Obviously, there is a need for some tool to keep track of your backups and this is where the BRMS capabilities can be used to your advantage.

The primary usage of BRMS is to keep track of every backup that you have made, therefore it has to know where all those tape volumes are, whether they are real, virtual, or save files.

Every volume has to exist in a location. If you do not place a volume in a specific location, BRMS stores them in a location called *HOME, which is an undefined, catch-all repository. If you have to go and make use of a volume, a meaningful BRMS location name makes an operator's life much more simpler.

This chapter provides information about setting up BRMS for taking virtual backups. They do exist, but you cannot move them around in the same way as though they exist on physical media. But you have to set up your environment as though you could move them. BRMS sees a volume as a volume, whether real or virtual. The same rules apply to both.

As we have previous stated in this chapter, virtual tape is identical to a physical tape. The layout is exactly the same, bit by bit. When virtual tape volumes are duplicated to real media, there is a one-to-one match. This means that the type of virtual tape media you select must match what the hardware in a real tape library can accept. For example, you cannot put an LTO cartridge into a Quarter Inch Cartridge (QIC) technology tape drive. It is the same with virtual media. If you have selected your virtual tape volume as an image of an LTO cartridge, you cannot copy that logical tape to a physical QIC drive. Their bitmap layouts are different.

The general rule is to keep everything as simple as possible. The process of recovering data should be kept simple and straightforward. We strongly encourage you to familiarize yourself with the BRMS application, preferably by signing up for formal education. Before you attend a class, it is useful to refer to the appropriate IBM publications for self-study.

You may also want to start up BRMS and try setting up and running a few example backups. Also, try to restore some of your backed up data.

Many environments have very well planned and tested backup processes, but often spend too little time testing and refining the recovery process.

Recovery is the most important task of all; if you are unable to restore, there is little point to taking backups. If you combine BRMS classes with some hands-on experience, you can immediately start asking questions and find it easier to follow the formal education lectures.

Listed here are links to IBM services and training sites:

- IBM Rochester AS/400 Solution Center

  `http://www-1.ibm.com/services/us/index.wss/offering/its/a1001549`

- Also visit the IBM Services site for your geography to determine whether there are local services available. The IBM Training Finder at:

  `http://www.ibm.com/products/finder/us/finders?pg=trfinder`

# 6.4 Setting up locations

If we were to set up our backup environment using 5250 emulation, we should start with creating for us the locations required, as that is the logical entry point. Everything with BRMS evolves around backups and they have to exist somewhere. Instead, by using the iSeries Navigator, we do not have to be quite as structured and can be more flexible. For example, we can create locations as we go along.

Of course, also by using the iSeries Navigator, you can create locations as separate tasks, which, by itself is a good idea. Having a picture diagram that gives an overview of your backed up data flow sequences, provides a very good understanding of the whole procedure. Even though we back up to virtual media, there remains a logical flow.

## 6.4.1 Why use locations?

Understanding locations is important because you need a clear picture about what to do with your backups after they have completed. BRMS must know where every volume is and they have to be at a location, whether real or virtual. Even volumes you have lost track of must have a home. You should, in fact, create a location called LOST (or an appropriate name). Tapes considered lost might show up again and if they contain vital data, you would not want to delete the information stored on such a volume just because you do not know where that volume is right now.

At this point, we assume that you have defined between which locations your backups should rotate, therefore we create the necessary locations as we go along.

If you want to create locations separately, expand **Backup, Recovery and Media Services**, right-click **Move policies** and select **Manage Locations**. Then follow the wizard windows.

> **Important:** Be aware that you only allow volumes to expire in a location that has a media library. If you allow expirations, for example, in a safe, you might get a mount message in the middle of the night saying: `Go take volume ABC123 out of the safe and mount it on device TAP123`.

## 6.4.2 Creating a sample backup of all xxx libraries

We are setting up a sample backup that only consists of saving all libraries starting with the “X” character. Those are libraries used for application testing and education. Normally, they do not contain much information. The people testing applications are told to clean up when testing is done, therefore normally most of them are empty or have a few small files. You could argue whether such information should be backed up at all. Maybe the actual test data is not of any value, but we take the position that we will save it on a daily basis. A lot of time can be saved if an environment can be quickly restored rather than having to rebuild it from scratch.

Fast tape drives perform very badly backing up such data because of the mechanical functions the tape drive has to perform (the tape drive drains its buffer before more data is loaded into it). Backing up to a virtual environment performs much better as there is no mechanics that have to go reverse. In fact, the LTO technology only outperforms virtual drives when it comes to backing up big files where it can constantly stream data to the tape. Any physical start/stop needed affects the throughput.

**Note:** For background information, Linear Tape-Open (LTO) is an open-format tape storage technology developed by Hewlett-Packard (HP), International Business Machines (IBM), and Certance. The term *open-format* means that users have access to multiple sources of storage media products that will be compatible. The high-capacity implementation of LTO technology is known as the LTO Ultrium format, or simply LTO Ultrium.

LTO technology generation 3 (LTO-3) has been available for several years. LTO-4 was announced in January 2007. Look for LTO-4 products to be announced during 2007.

We create a new backup policy by performing the following steps:

1. Expand **Backup, Recovery and Media Services** and click **Backup policies**, as shown in Figure 6-43.

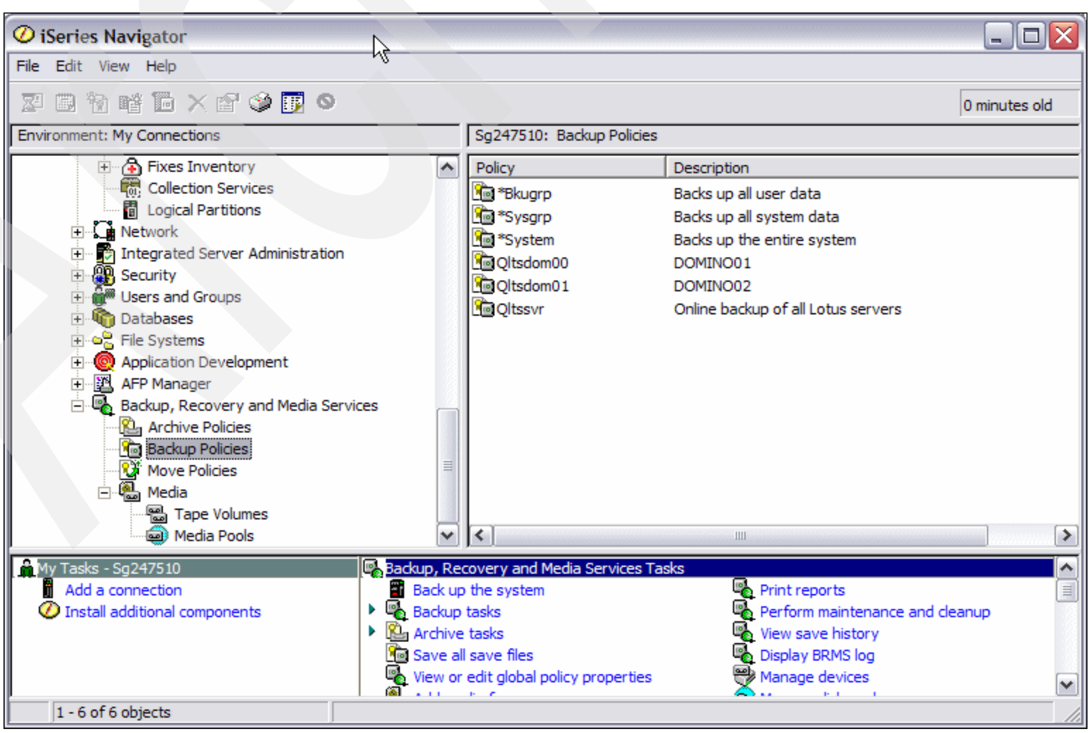



*Figure 6-43 iSeries Navigator - Backup Policies*

This opens all backup policies.

2. Right-click **Backup policies** and select **New Policy**, as shown in Figure 6-44.

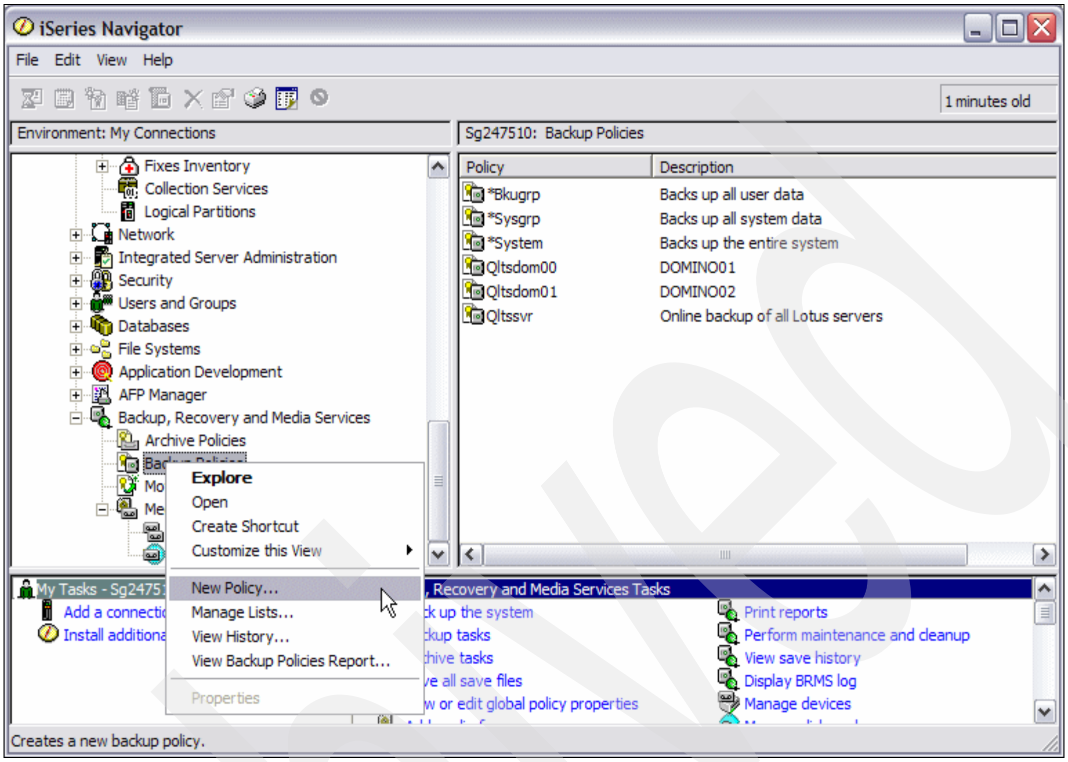



*Figure 6-44 iSeries Navigator - New Policy*

3. The welcome wizard window is presented (Figure 6-45). Click **Next**.

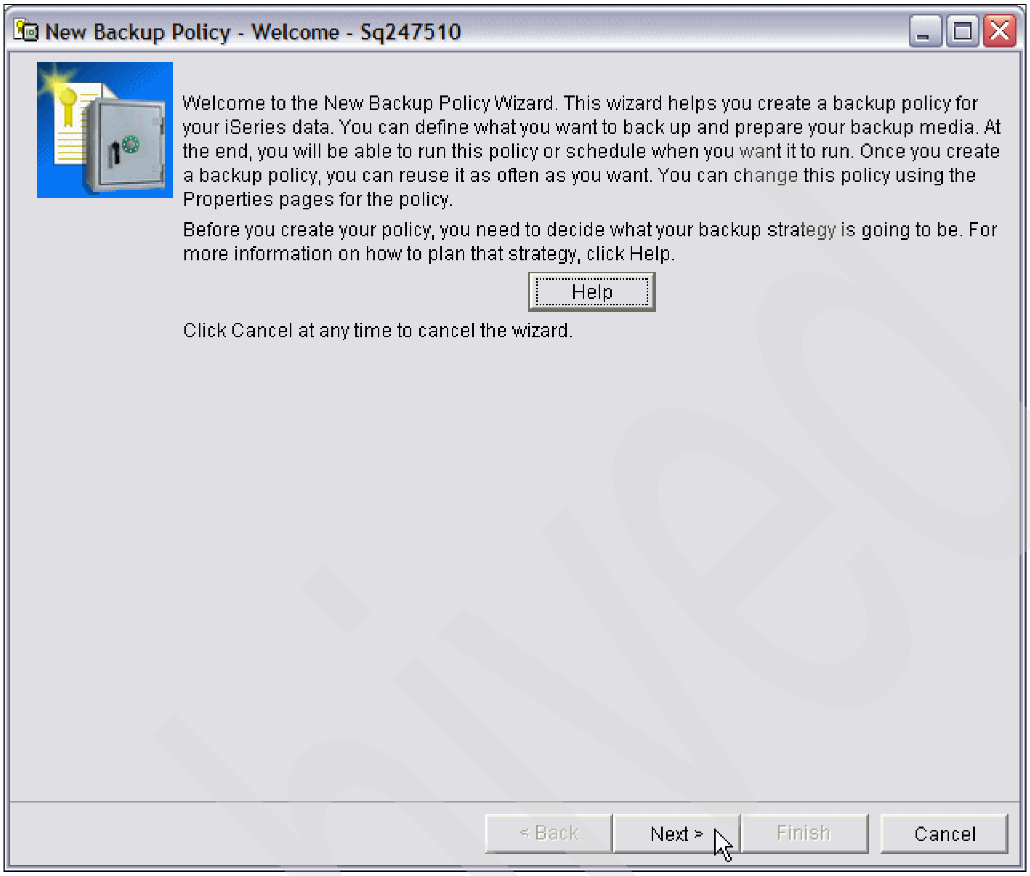



*Figure 6-45 New Backup Policy - Welcome*

4. First of all, we have to give our new backup policy a name and a meaningful text. The policy name should say something about what it does. Avoid names such as Mondayback or similar text, as you never know if this backup will run only on Mondays. In the window shown in Figure 6-46:
   a. Enter your backup policy name. We use `Xlibs`.
   b. Fill in a meaningful policy description.
   c. Click **Next**.

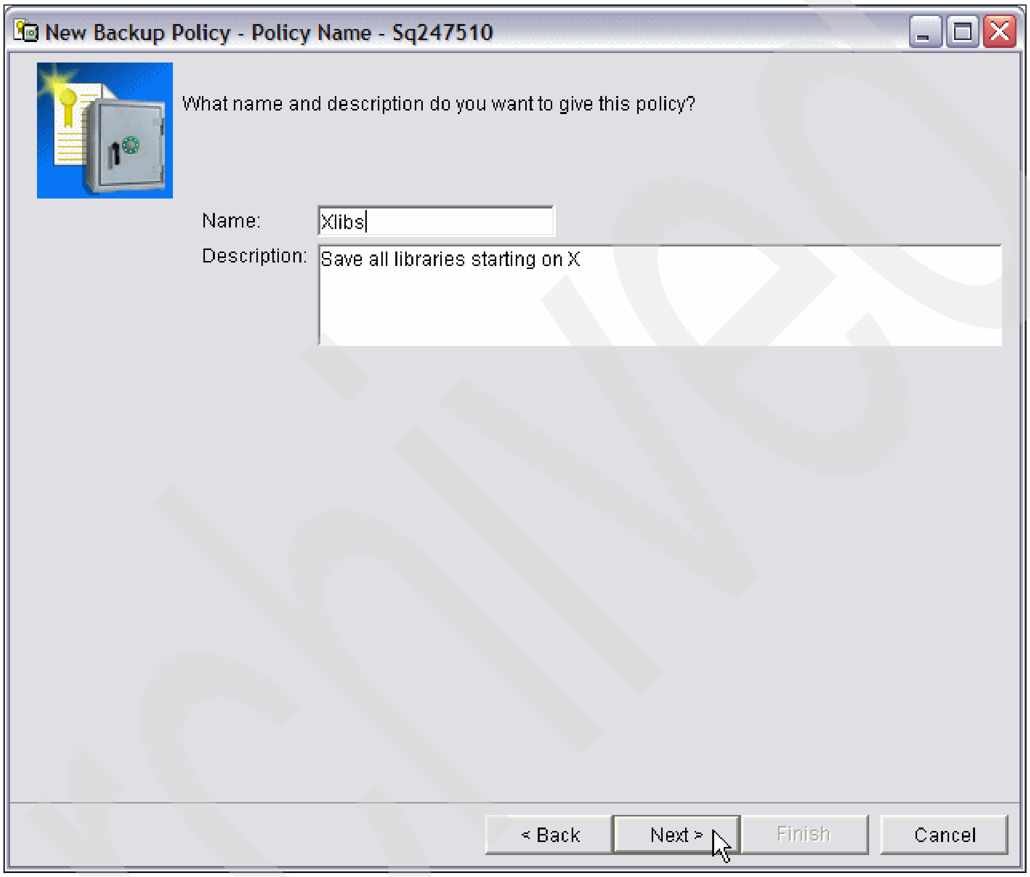



*Figure 6-46 New Backup Policy Name*

5. Now we have to decide everything that is to be backed up under this policy.

   In our example, we are going to back up all libraries whose name starts with “x.” To get to the window that let us specify this, select **Save Lotus server data or a customized set of objects**, as shown in Figure 6-47. Click **Next**.

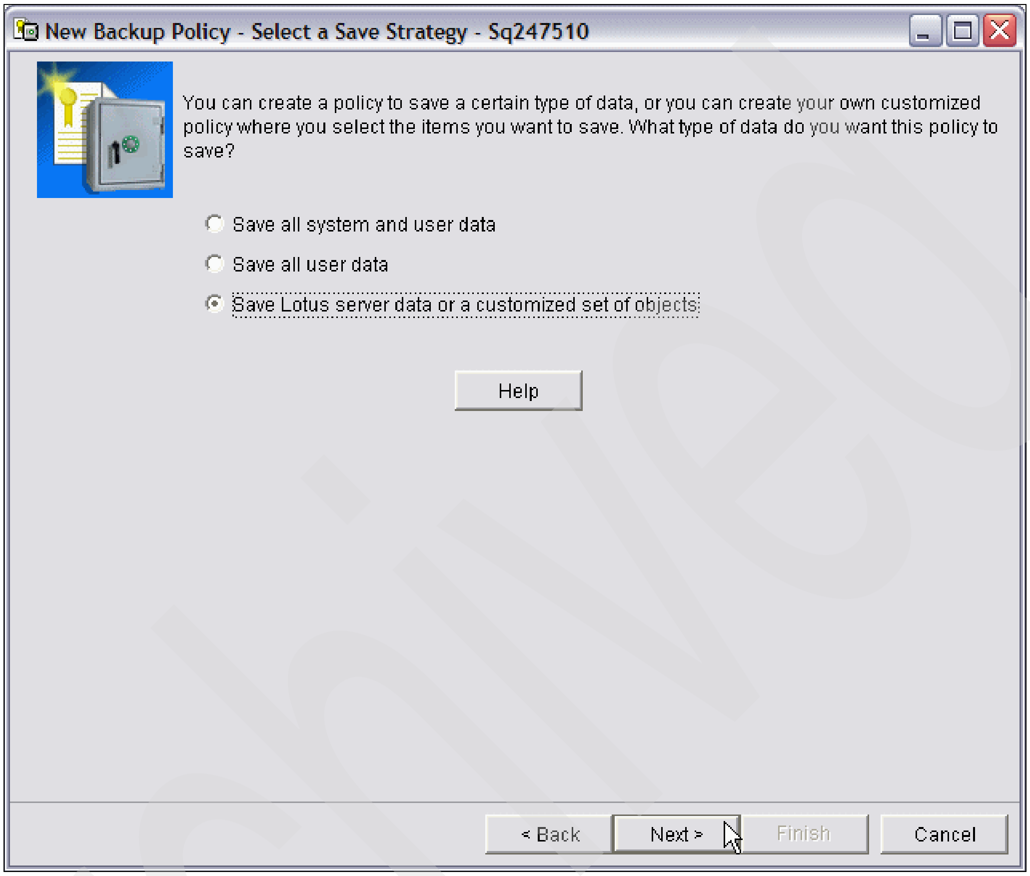



*Figure 6-47 New Backup Policy - Select a Save Strategy*

6. In the next window (Figure 6-48), we are asked what type of customized data do we want to save, IBM or user or both. We select **User data** and click **Next**.

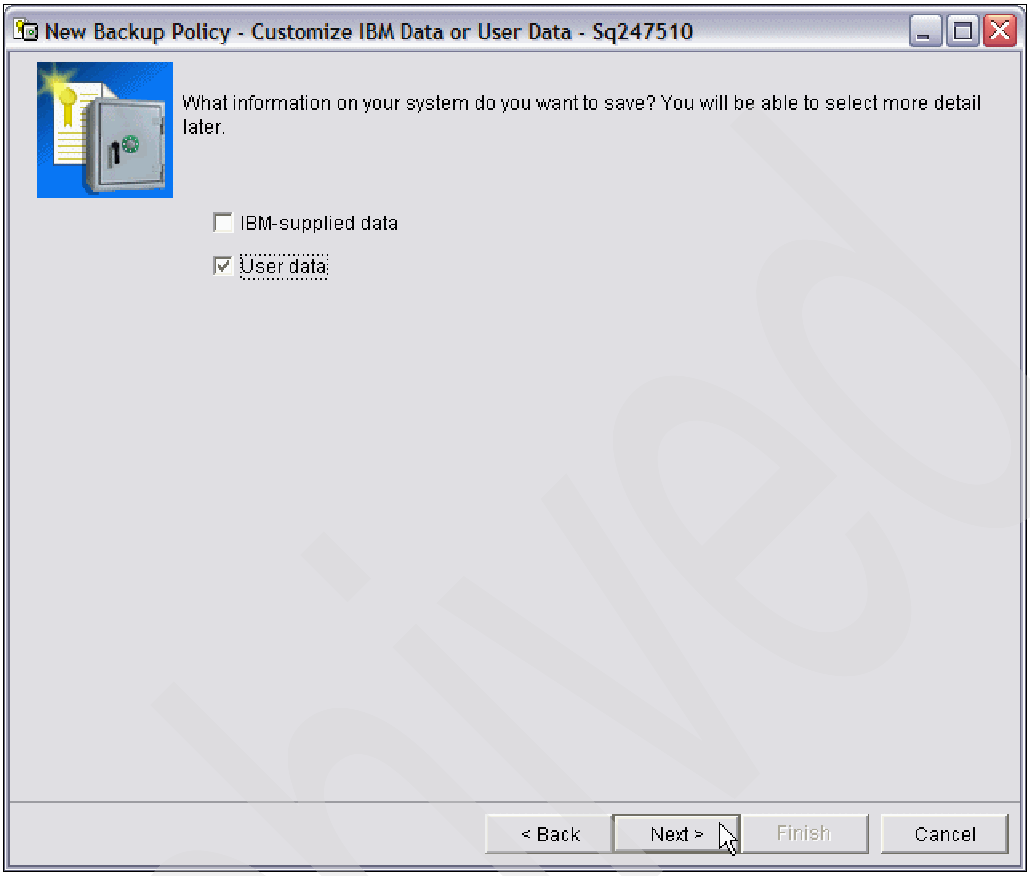



*Figure 6-48 New Backup Policy - Customize IBM Data or User Data*

7. We must specify which of our own data we want to save using the window shown in Figure 6-49.

   Choose **Select specific items to save** and click **Next**.

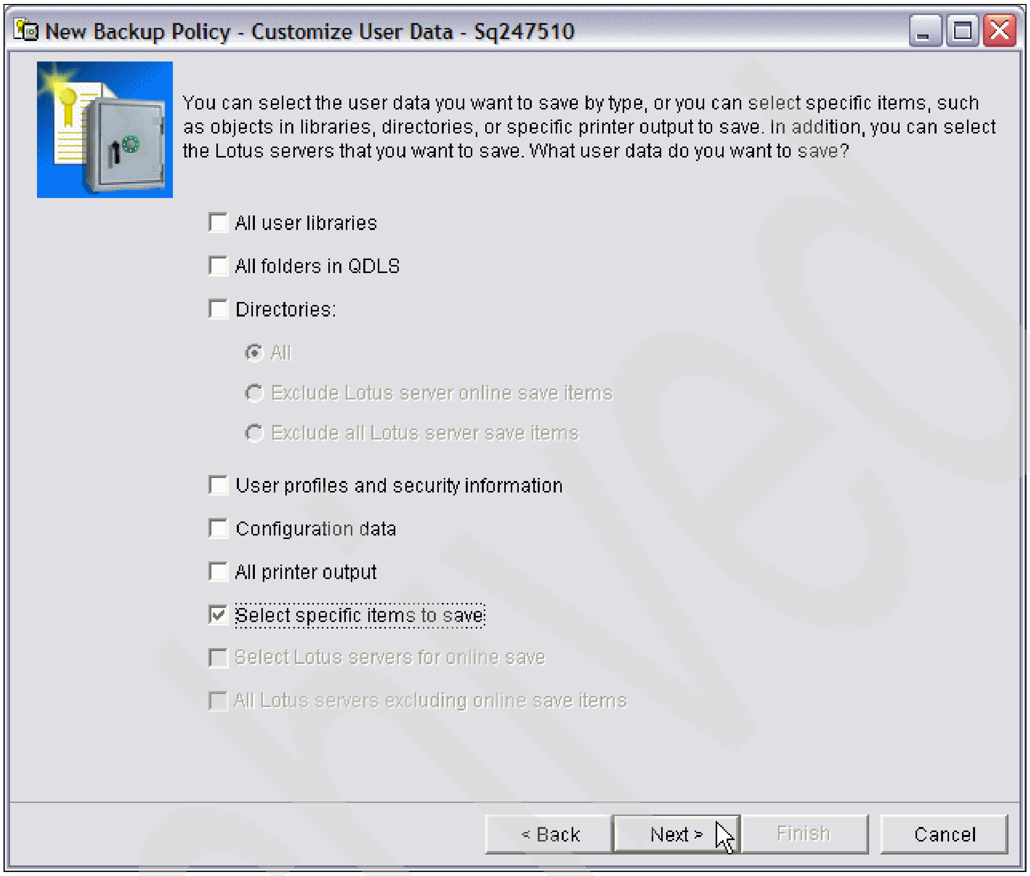



*Figure 6-49 New Backup Policy - Customize User Data*

8. As shown in Figure 6-50, this opens a graphical tree of all our i5/OS partition’s *data repositories* including libraries and Integrated File System directories (folders). We can select each of the repositories in the list and or the objects that will appear under each of the Select Lists, Specify Directories - all, and Select Printer Output buttons.

   In this example, we click the **Specify Generics** button.

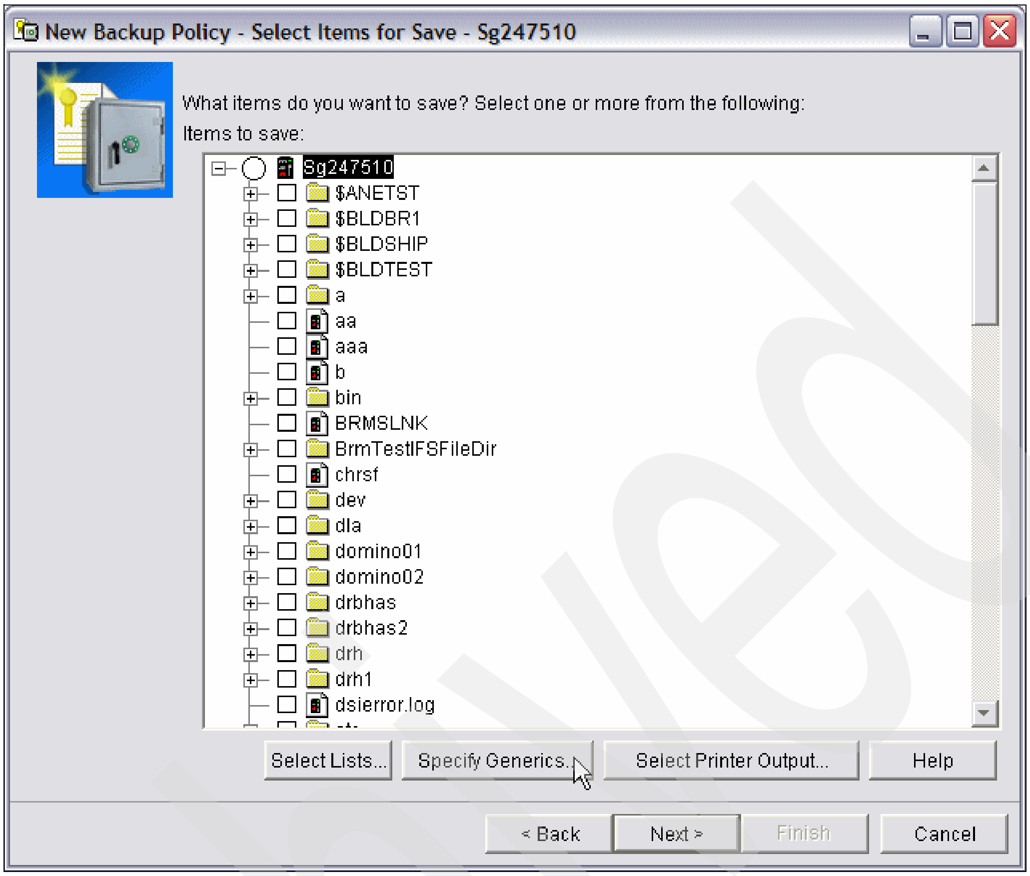


*Figure 6-50 New Backup Policy - Select Items for Save (Specify Generics)*

9. The window shown in Figure 6-51 opens. Because we are simply going to back up a list of library names with the same beginning name, we select **Libraries** and click **OK**.

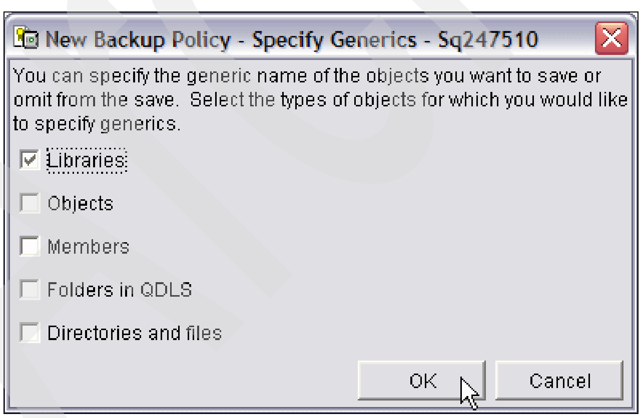


*Figure 6-51 New Backup Policy - Specify Generics*

10. This opens the Specify Generics for Libraries window shown in Figure 6-52.

    We enter X and click **Add**.

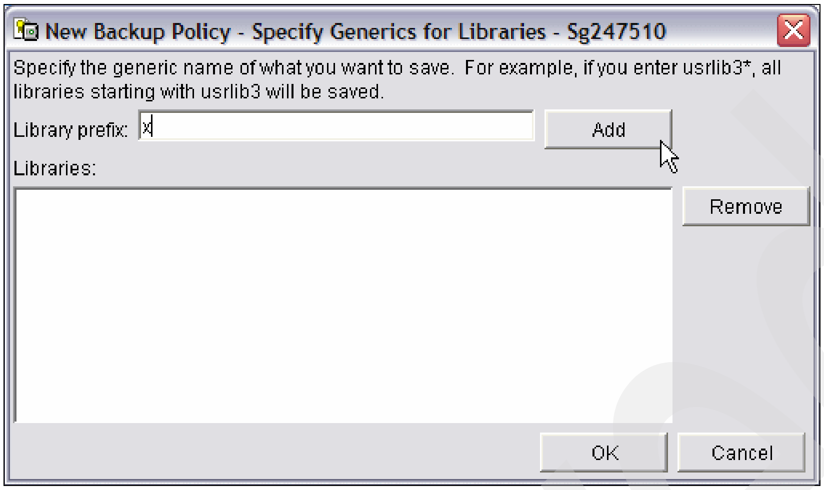



*Figure 6-52 New Backup Policy - Specify Generics for Libraries*

11. The window in Figure 6-53 shows X* entered in the Libraries list area.

    There is nothing more to specify. Click **OK**.

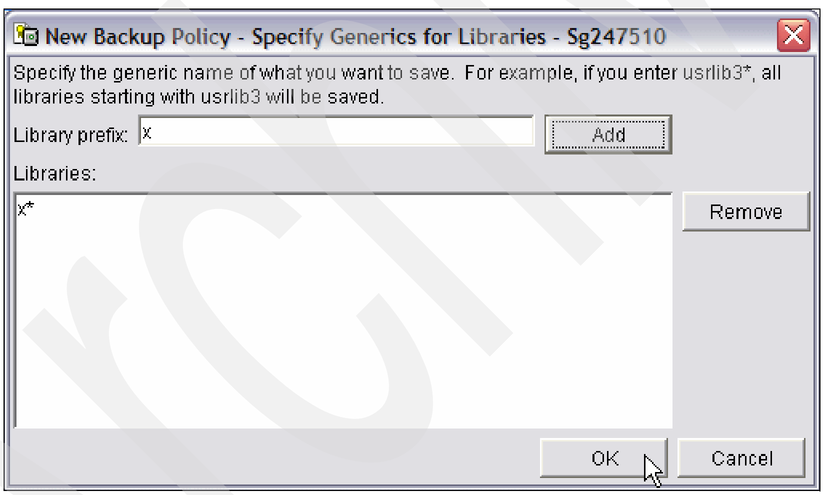



*Figure 6-53 New Backup Policy - Specify Generics for Libraries (filled in)*

12. We are back at the Select Items to Save window (Figure 6-54).

We have nothing more to specify. Click **Next**.

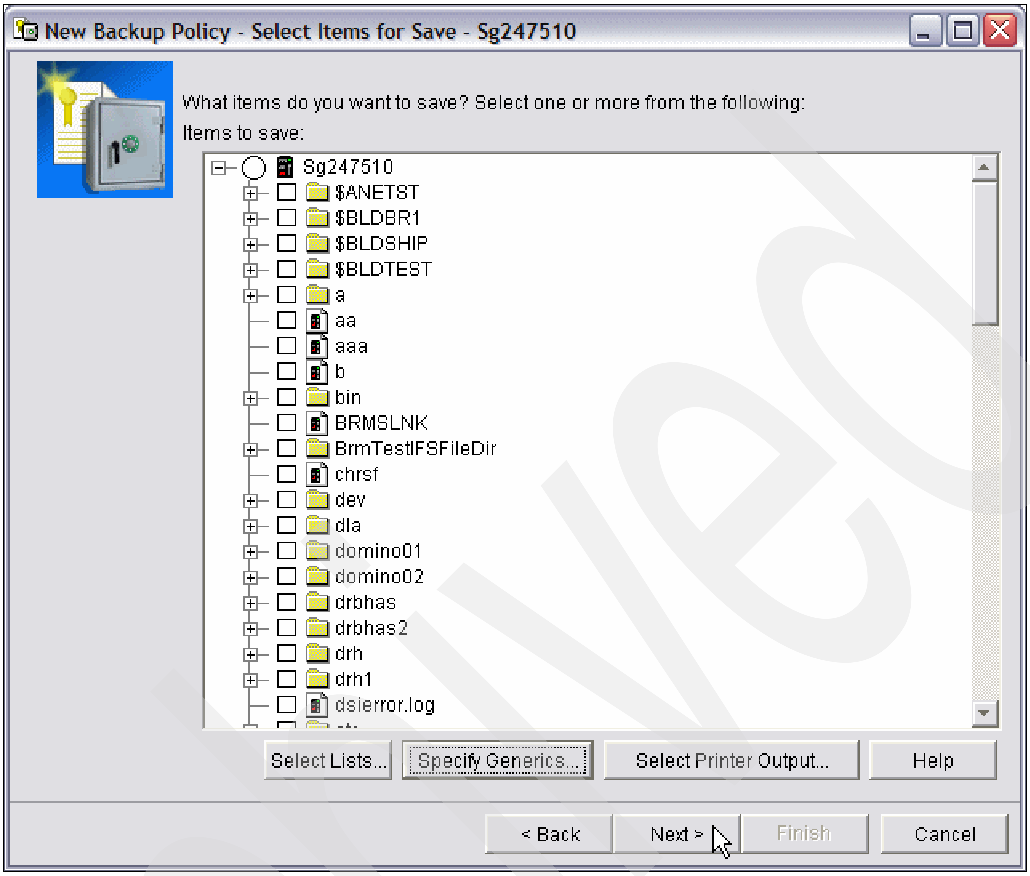



*Figure 6-54 New Backup Policy - Select Items for Save*

13. The next window is shown in Figure 6-55. This is the Save Order window. We review the the objects and folders previously selected in the order they will be saved. Review the window text. You can go back and make changes or continue.

Certain device configuration-based object may have to be varied off in order and other object types may require no one using them or some other action before they can be saved. In our simple library save example this does not apply.

Click **Next**.

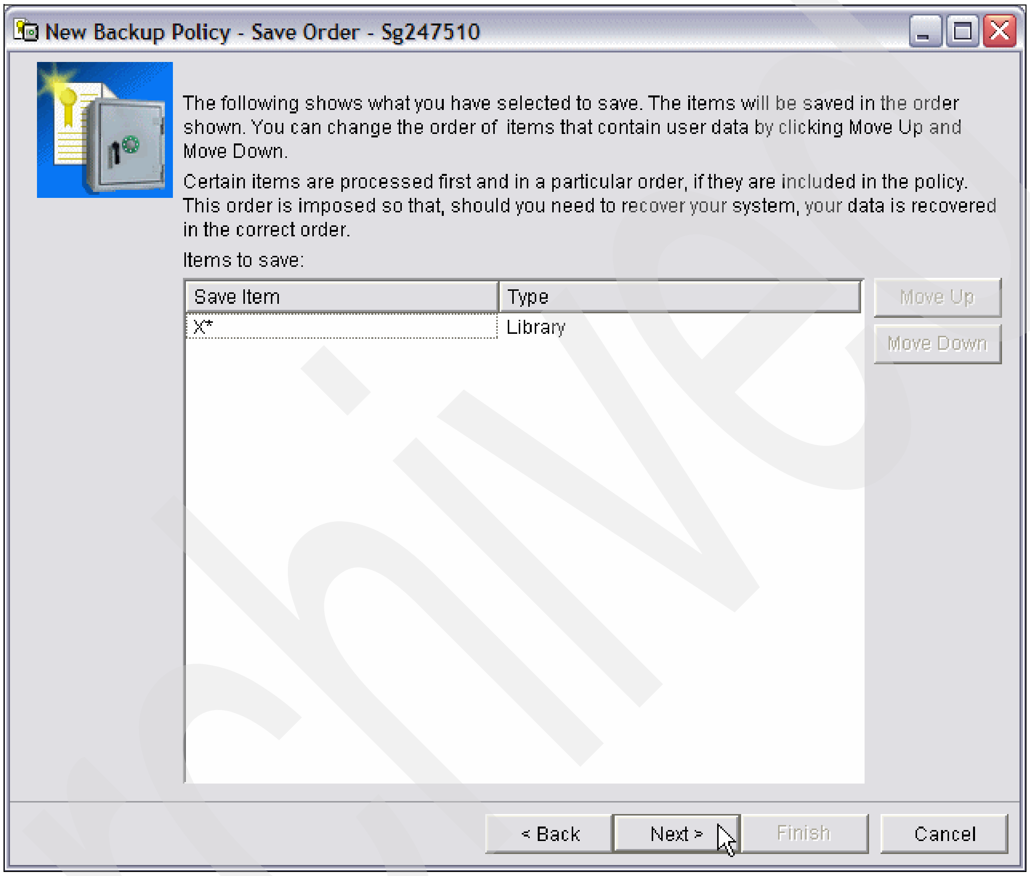



*Figure 6-55 New Backup Policy - Save Order*

14. The widow shown in Figure 6-56 opens.

In our library example, we select **No, leave user-defined file systems mounted**. You can click the Help button for more information. Click **Next**.

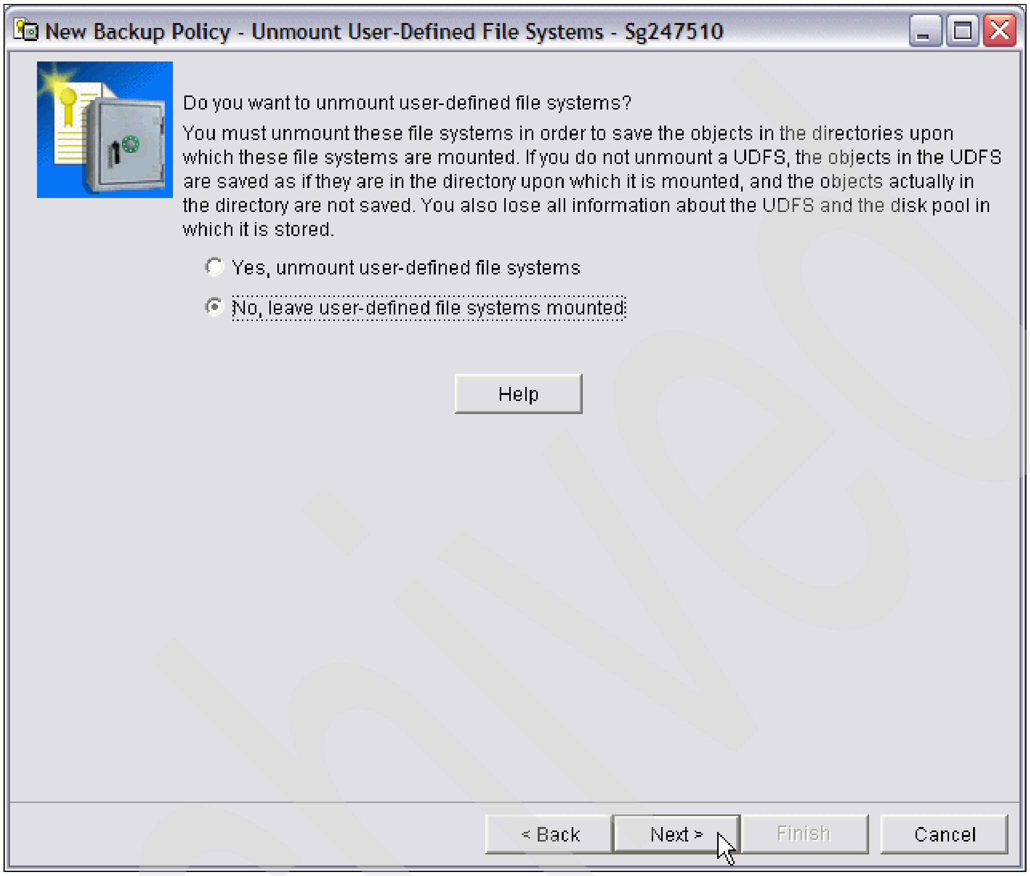



*Figure 6-56 New Backup Policy - Unmount User-Defined File System*

15. In the next window shown in Figure 6-57, there are several options. You have to carefully consider each of them.

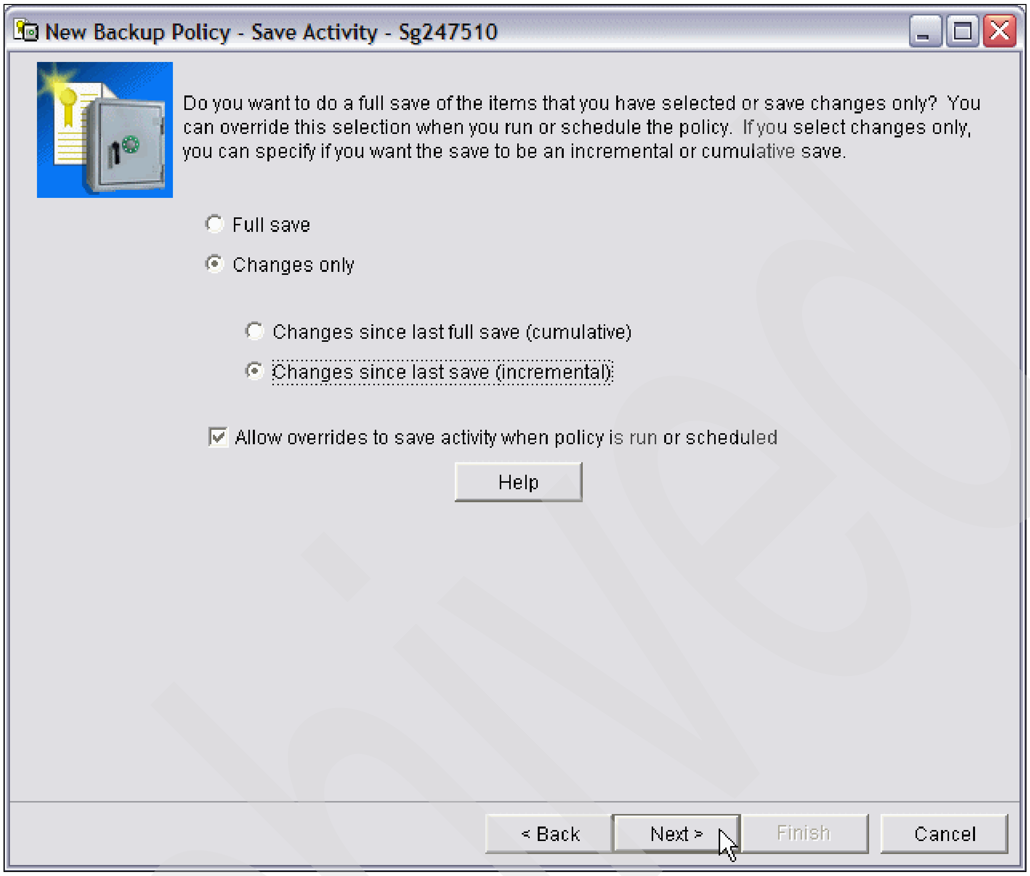



*Figure 6-57 New Backup Policy - Save Activity*

There can be many different approaches to setting up a backup. Consider the following before selecting or not selecting each option:

– You can define a policy that is totally transparent to what media it can be backed up to.

– You can have an objective to minimize backup (save) time.

– Your target can be fast recovery.

– You can set up a policy that saves *all the objects* and then have a related, but different policy that runs more frequently and that saves only changed objects since the last *full object* save.

– You can set up a simple backup policy so that no one has to read special instructions to perform such a task.

– You can set up a specialized policy that best utilizes the hardware configuration you want to use.

– There can be many other objectives or considerations for customizing a backup policy.

Consider using the Help button to review detail information regarding your choices. You make the choices you think works best for your objectives. Further discussion in this area is beyond the scope of this IBM Redbook.

In this example backup, we decided to take advantage of what the virtual tape library gives us. That is, in our example, we choose to save changes only, day by day with no cumulative saving. We do this because we can take advantage of the virtual tape save speed and not physical media handling, versus real physical tapes. There is little consideration on the *save side* between virtual versus real tapes. However, should we need to recover, we could end up with lots of real tape volume that have to be mounted, positioned, and read in exactly the right sequence. Using the virtual tape all volumes are available to be mounted and our backup and recovery management software, BRMS, ensures that the volumes are mounted and read in correct sequence.

A “changes only” backup requires a base full backup. This enables i5/OS to detect changes if you specify to save only changes. Therefore, we must first make an initial full backup. BRMS is smart enough to detect that, in our example, such an initial full backup does not exist. The first time the backup policy is run, a full backup will be performed, even though the policy specifies Changes only.

a. Select **Changes only**.

   Now consider whether we are going to save changes day by day or do we add them up (cumulative)? What is our philosophic approach to backups? Do we go for speed versus simplicity? Do we go for media transparency? You must answer for yourself.

   We are using BRMS as our save restore application, which makes it almost *transparent* to us, how the data is backed up. BRMS keeps track of our backups regardless of how they were taken. That is, we are assuming that you must initiate your backups under BRMS.

   To be more precise, BRMS stores every backup taken to its tapes. However, if you use an i5/OS Save Library (SAVLIB) command to the same volume managed by BRMS, you will see at which point in time a backup was taken and to which volume and sequence number. However, you do not see the save details maintained by BRMS. Note that there is no additional detailed information available for SAVLIB to any other volume not managed by BRMS.

   In the example backup, we use day by day changes as we have a virtual tape library that outperforms any physical library device when finding the data we are after. Recovering small portions of data spread around on a number of physical tape volumes is not productive. However, if there were only a few very large file objects to be saved, you might make different choices than we do in our example.

   See Appendix A, “Sizing and performance examples” on page 281, for some performance comparisons between the TS7510 and real high performance tape devices using a section of different save scenarios.

b. Select **Changes since last save (incremental)**.

c. The last consideration is whether our backup policy must run as defined or have some settings overridden at run time. We select **Allow overrides to save activity when policy is run or scheduled**. This allows us flexibility until we determine, after running the backup policy several times, whether we do or do not want to allow overrides.

d. Click **Next**.

16. This opens the Where to Save window shown in Figure 6-58. In our example, only one option applies: To media. Neither i5/OS or BRMS knows that this LTO tape library is, in fact, an IBM TS7510.

    Select **Save to media** and click **Next**. This leads to the Media Retention window shown in Figure 6-59 on page 181.

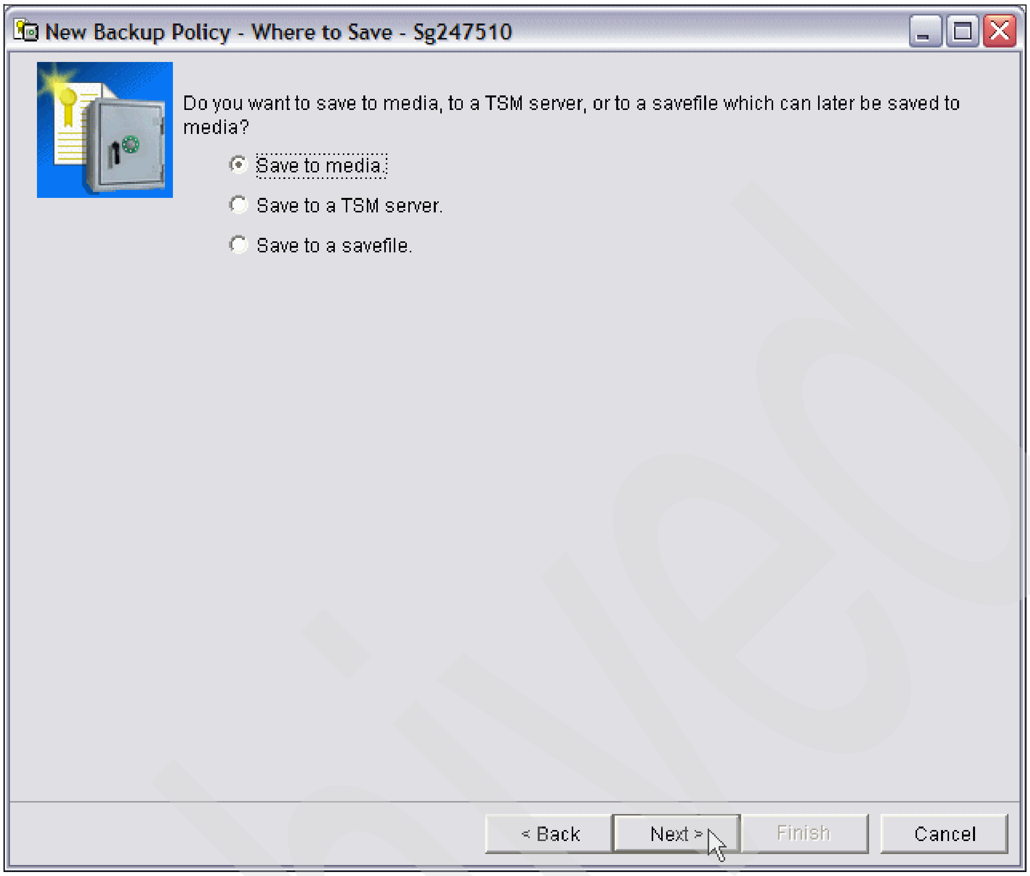



*Figure 6-58 New Backup Policy - Where to Save*

## Media retention periods

Determining media retention to a real tape or to a virtual tape volume requires that several things have to be considered. Most of the information in this topic applies to any real or virtual media used to hold backed up data. However, there will be some considerations discussed with the TS7510 in mind, later in this chapter.

If we select to always run full backups, there is only one thing to keep in mind and that is how old can our data be and still remain valid for recovery purposes?

For instance, is it of any interest to restore orders that are already shipped? In most case, no. Your business decides how long time to keep saved data for recovery.

There are, of course, other factors that come into play such as government laws, other legal requirements, the need for archiving several levels of backup, and more.

In our setup, we selected changes only. This means, in a worst case scenario, we will get a small backup of every library every day. Therefore, our data can be spread out over many volumes. Normally, however, the vast majority of objects are found in the full backup (most objects do not change very often). Therefore, we have to make sure that a full backup is always available for recovery.

Now what about the *pieces* saved every day? How long should they be kept? Of course, the answer is, until the next full backup is taken.

Let us assume that we run a full backup once a week. In theory, we only have to keep the changes for 7 days. To be on the safe side, however, we decide to keep saved data for 10 days. But what if the full backup fails or is not executed for some reason? Then we are in danger as we might get some daily backups overwritten and certainly, in such cases, there will be some updates missing.

If you know what files are affected, you might be fortunate to find these objects were again changed later on, therefore that first backup is not required; unless you have to recover to a specific date and time.

Again you might be lucky, but is also possible that you might not be.

Therefore, what has to be done to meet your business's retention time period requirements? In a book specifically on the general topic of backup and recovery, we make some generally applicable decisions. You, however, have to make your own decisions in this area.

Generally, you should keep daily changes so that they survive at least two full backups.

17. Enter whatever suits your requirements best in the window shown in Figure 6-59. We play it safe and go for keeping full backups for 35 days and changes for 16 days, assuming we will run full saves every week.

    We also select **Allow overrides to retention when policy is run or scheduled**. Click **Next**.

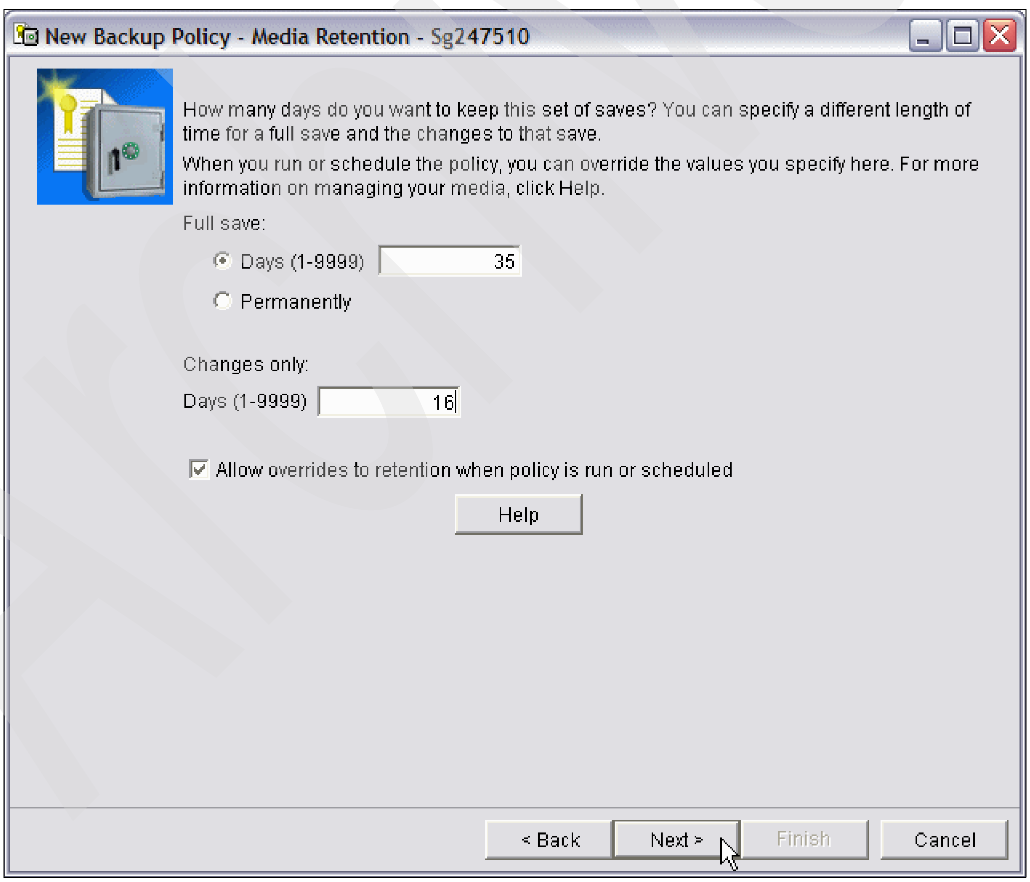



*Figure 6-59 New Backup Policy - Media Retention*

18. You have to select the media pool that your backup will use using the window shown in Figure 6-60.

Remember that BRMS does not know that we have a virtual tape library. It thinks it is a real one, therefore we make our selection from that viewpoint. As mentioned before, we have a specific media pool for our TS7510 to avoid our data ending up at different media.

We earlier created a media policy VTLLTO2.

Select **vtllt02**.Click **Next**.

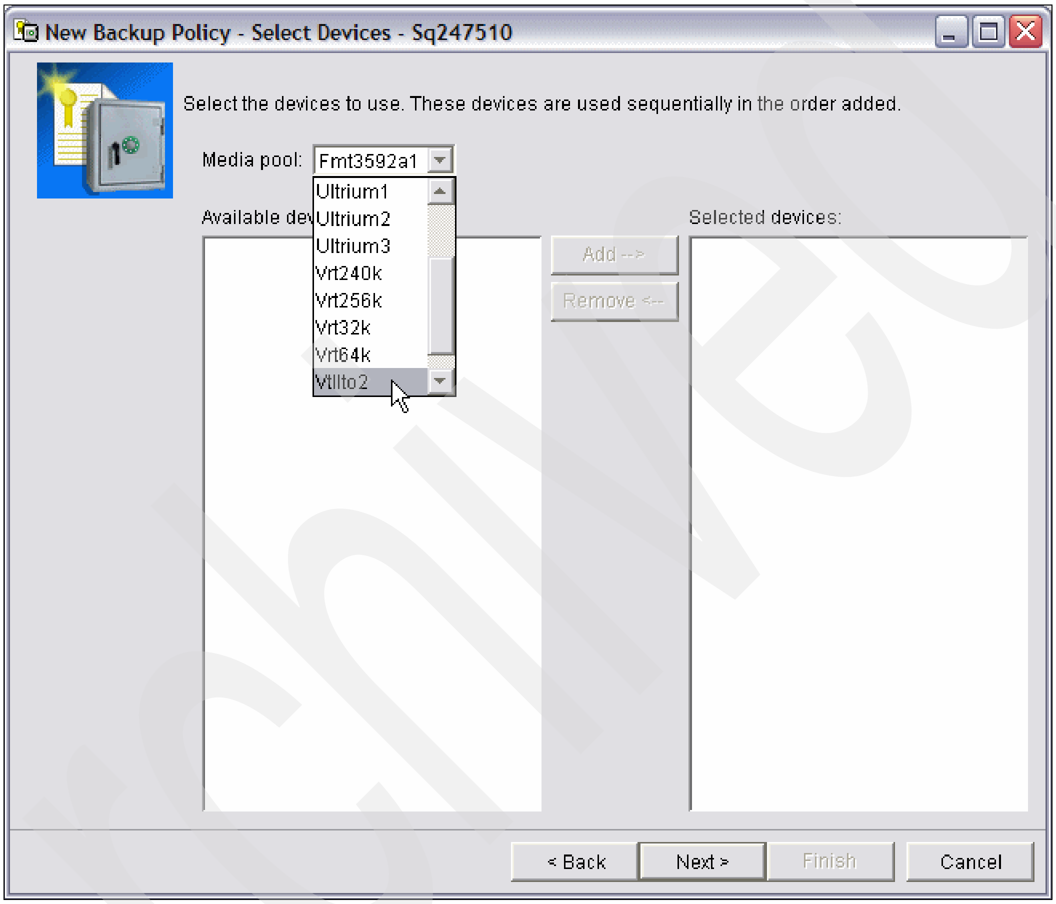



*Figure 6-60 New Backup Policy - Select Devices*

19. This opens the Select Drives window shown in Figure 6-61. Our library is TAPMLB19.

    Select **TAPMLB19**. Click **Add**.

    In your production mode environment, you might have more than one virtual tape library defined and you can specify more than one library.

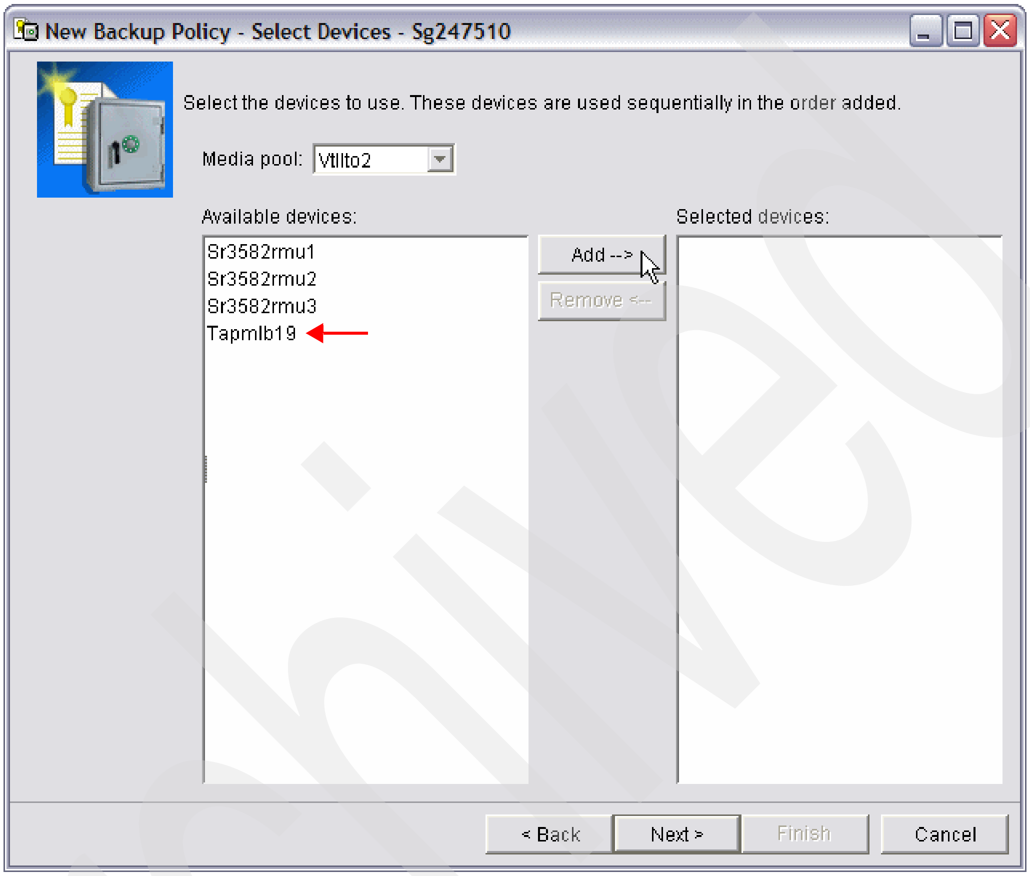



*Figure 6-61 New Backup Policy - Select Devices (adding)*

By checking what other tape libraries support LTO2, the list of libraries to select is shortened. As mentioned earlier, we have only one virtual library so we are satisfied by selecting tapmlb19.

Select **tapmlb19** and click **Add**.

20. This places tapmlb19 into the right side, Selected devices area, as shown in Figure 6-62. Click **Next**.

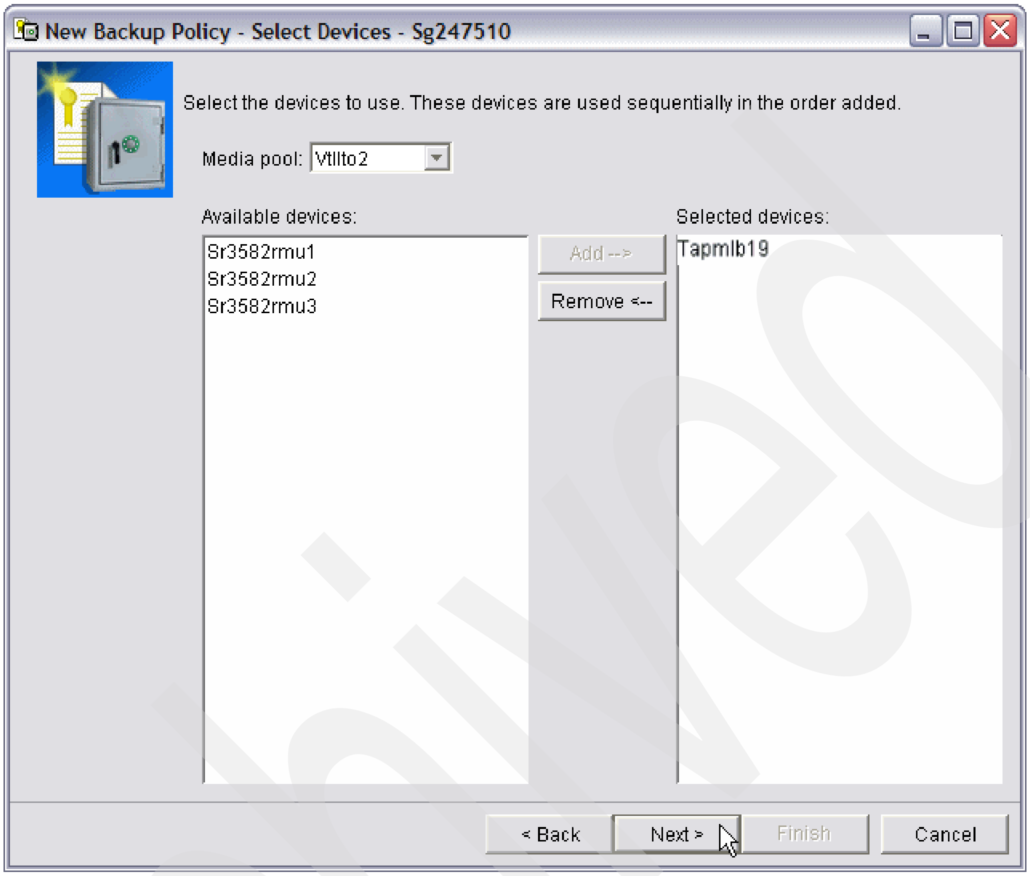



*Figure 6-62 New Backup Policy - Select Devices (selected)*

21. The next window (Figure 6-63) asks us if we want to duplicate our data or not. Read the text on the Duplicate Media window.

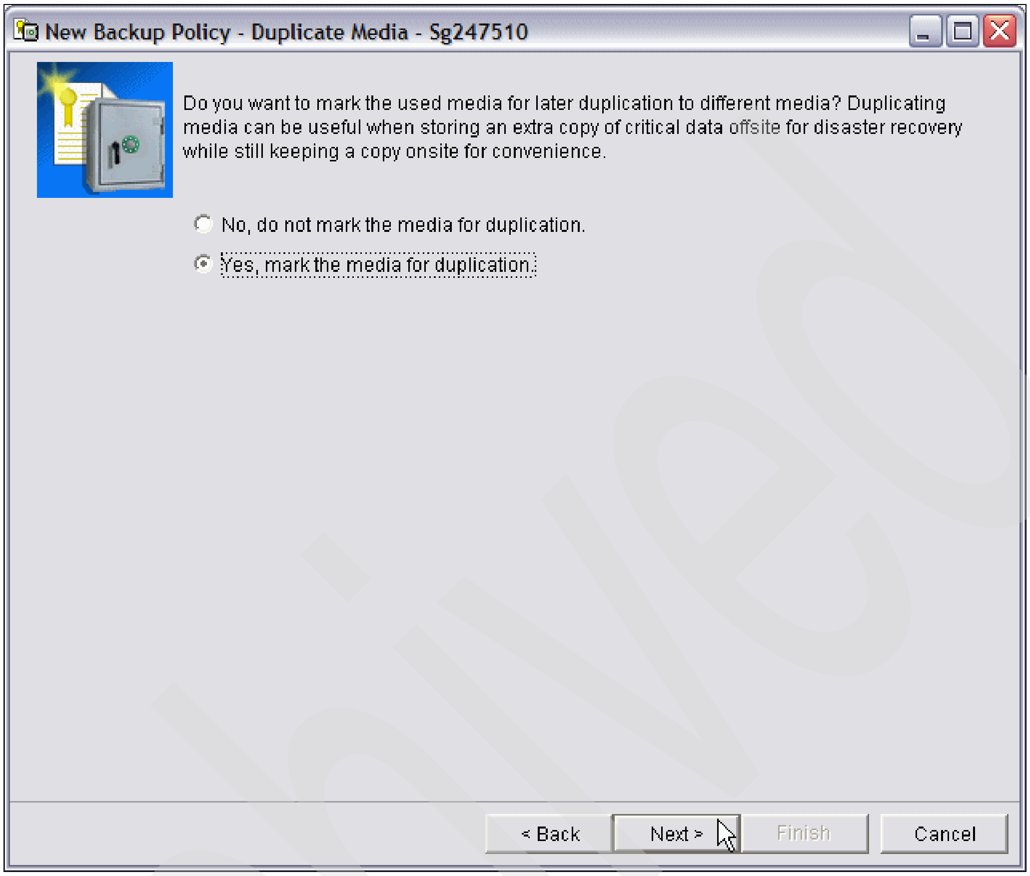



*Figure 6-63 New Backup Policy - Duplicate Media*

Again it is up to your judgement to decide how reliable you consider the TS7510 disk hardware compared to the impact of a disk problem exactly when you may have to recover your system.

History shows that the disk hardware and use of Redundant Array of Independent Disks (RAID) protection significantly minimizes the impact of a disk hardware problem on your business.

However, history also shows that the more disks you have, and the older they are, a disk failure will eventually occur.

RAID technology can handle most failure situations. However, you must decide what the risk is to your business, if a long outage occurs how does it affect you business.

Remember that a backup is only a copy of something. As long as the original data is intact, there is no problem if a backup no longer exists, unless you have to go back to a specific day and that backup is lost.

Another reason for duplicating the backups is that in the storage industry, virtual tape libraries are generally considered short time storage. The most obvious reason to go for a virtual backup concept is speed. The backup window will normally shrink. However, disk storage is a limited resource.

A recommendation would be to *not* keep data on disk backups any longer than required and make sure that the key data is duplicated to physical media as soon as possible.

You can also take the same approach as recommended for the i5/OS internal virtual tape support, which is to have virtual volumes active until they are copied to real media. Keep the backup data as active for a couple of days more in case a restore is required. Then return the volume for reuse. Refer to the IBM Redbook *i5/OS V5R4 Virtual Tape: A Guide to Planning and Implementation*, SG24-7164 (Section 6.4.1 “Location considerations in BRMS),” for information about how you might implement such a concept (it is achieved by moving virtual volumes between locations and making sure not one is left uncopied).

A lot of your decision making depends on how much disk space you have available in the TS7510 and how much backup data is consistently backed up to it.

We go for the *safe* way to enable the saved data and specify **Yes, mark the media for duplication**. Click **Next**.

22. This opens the Run Maintenance window shown in Figure 6-64.

Do we have to run BRMS maintenance each time we execute this backup? No.

Select **No, do not run maintenance after save**. Click **Next**.

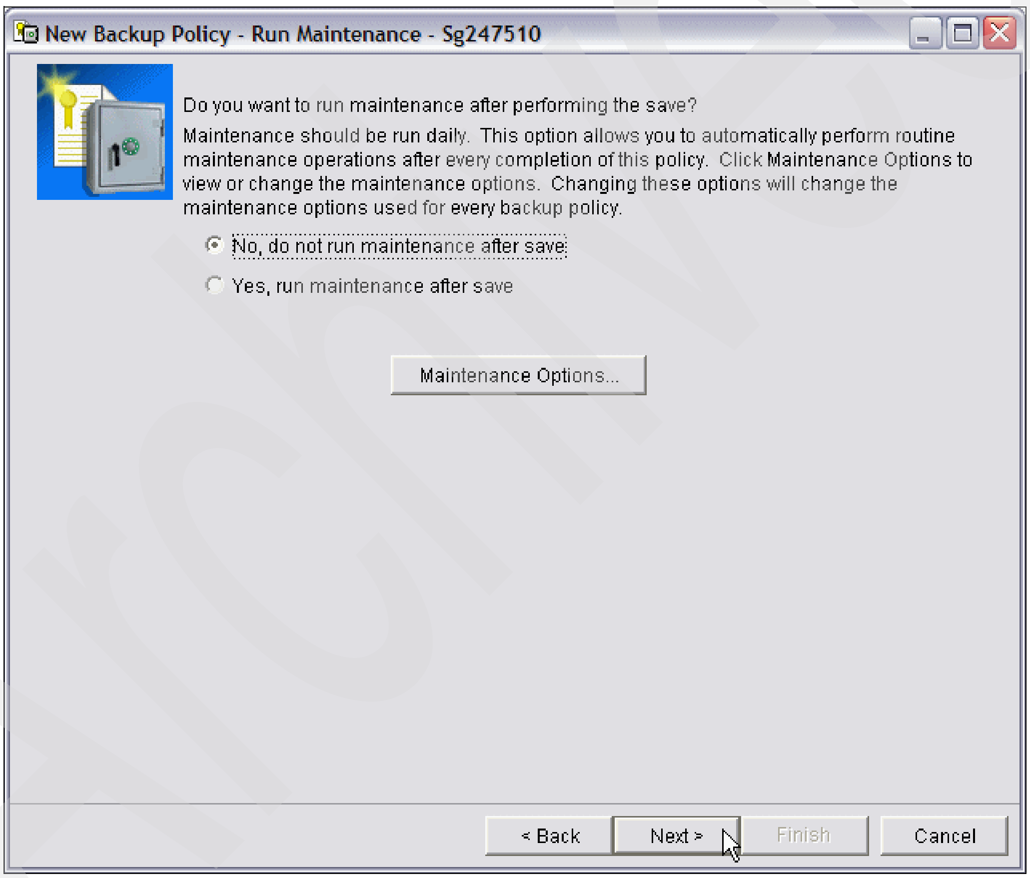



*Figure 6-64 New Backup Policy - Run Maintenance*

23. This opens the Add Media window shown in Figure 6-65.

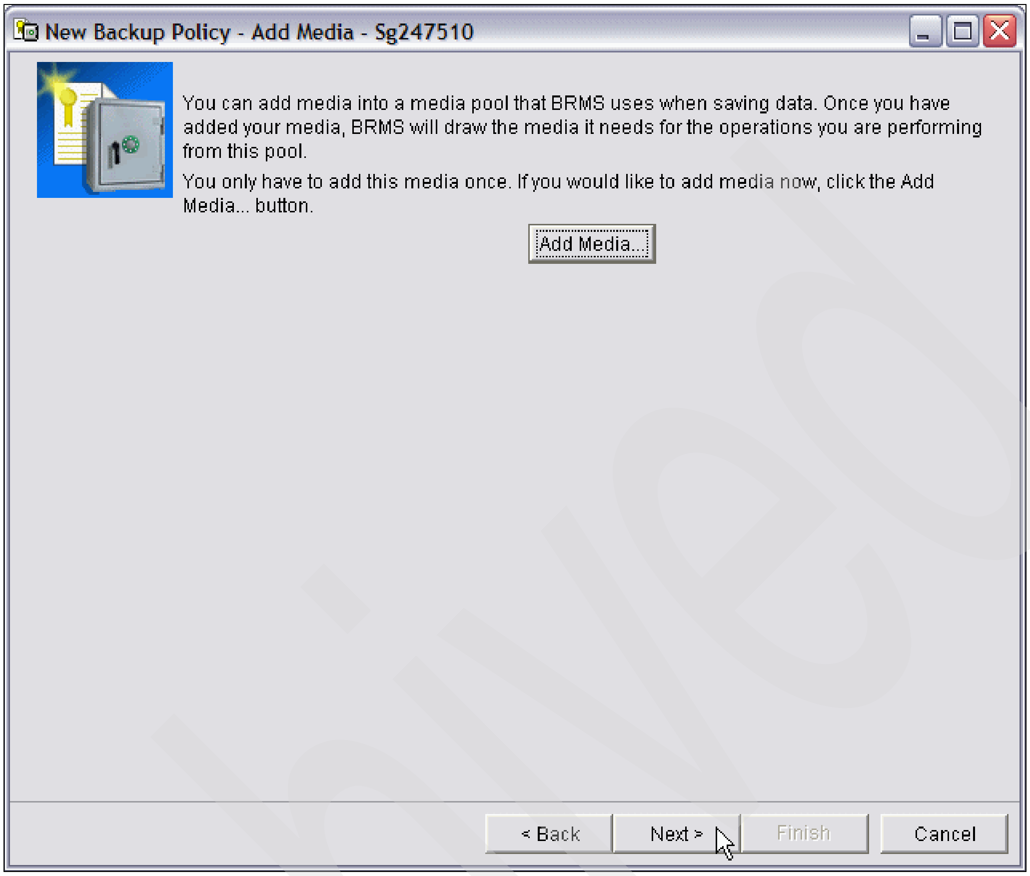



*Figure 6-65 New backup Policy - Add Media*

While setting up a backup policy, the BRMS plug-in for the iSeries Navigator allows you to do other things while in the middle of doing something, such as defining your backup policy.

One example is to add media (volumes). We mention this here. However, we have already added and initialized 10 volumes, therefore we do not have to add a new volume while finishing up defining our new backup policy.

Click **Next**.

24. This opens the summary window shown in Figure 6-66. Review the summary information, especially the settings area and the text under that area. This area reminds us to be careful of using the Cancel button and that, after finishing the new policy creation, we should schedule when to run it.

    You can also use the **Back** button to make changes.

    We click **Finish**.

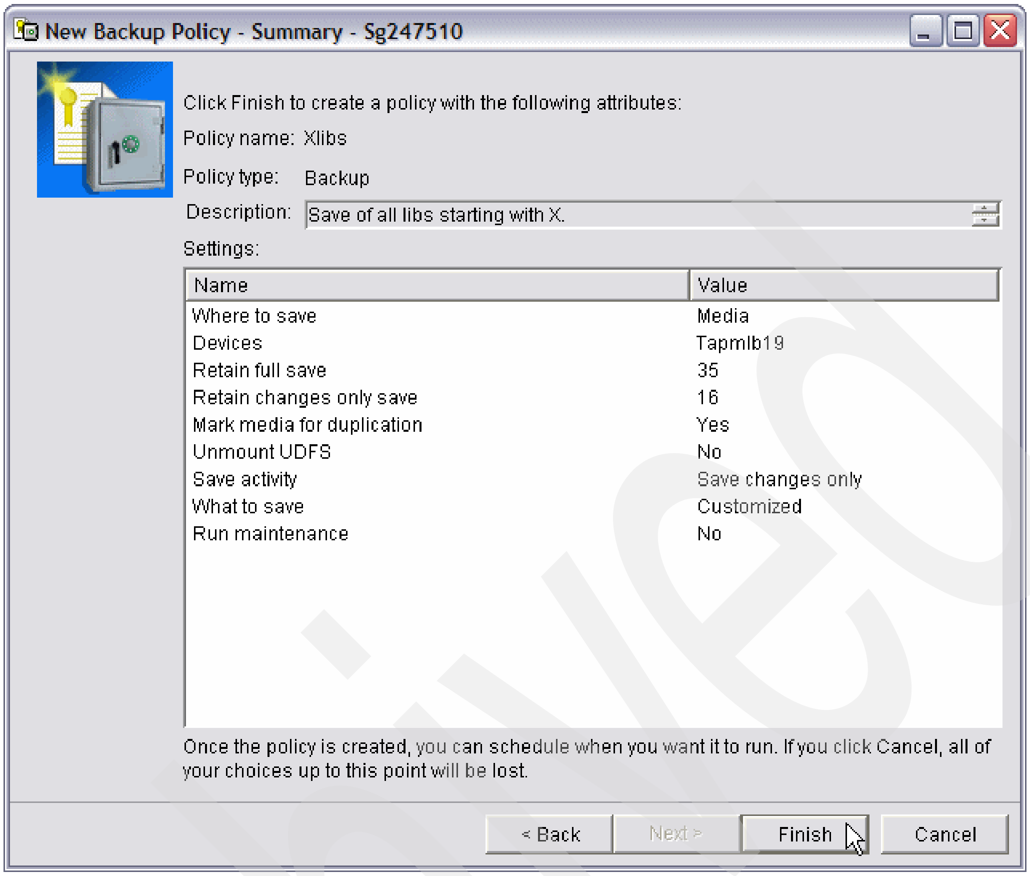



*Figure 6-66 New Backup Policy - Summary*

A progress window is presented while BRMS creates our backup policy.

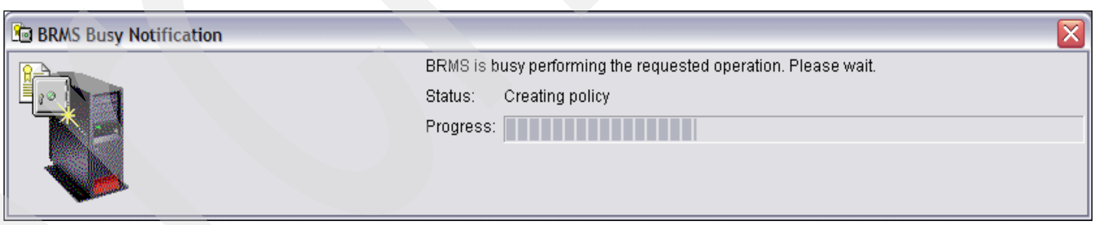



*Figure 6-67 BRMS Busy Notification*

25.Our backup policy was successfully created (Figure 6-67). We can run it now, schedule it now, or add some things to our backup policy.

We will add more things to our backup, but we are done so far. Click **Done**, as shown in Figure 6-68.

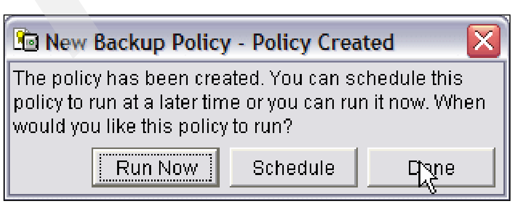



*Figure 6-68 New Backup Policy - Policy Created*

We are back to where we started (Figure 6-69), but we do not yet see our new backup policy.

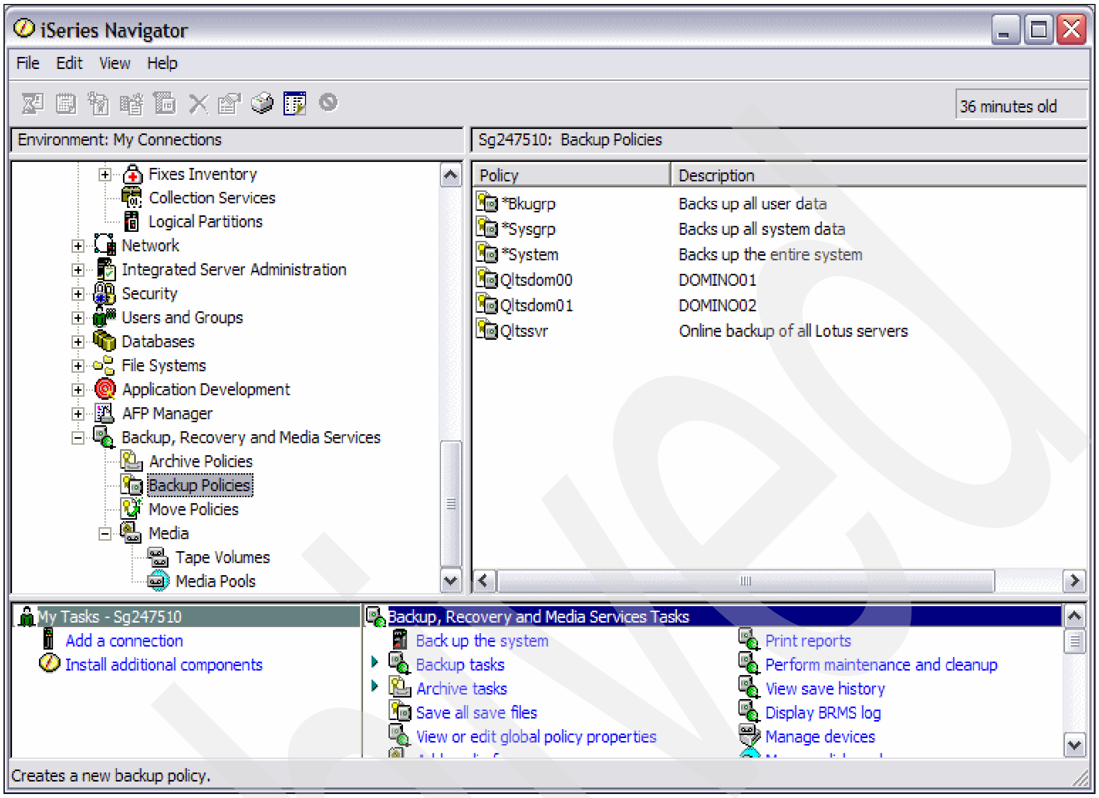



*Figure 6-69 New backup policy created, but not shown*

26. Press F5 for refresh. Our backup policy Xlibs appears in Figure 6-70. However, we want to tune (adjust) the policy a bit more.

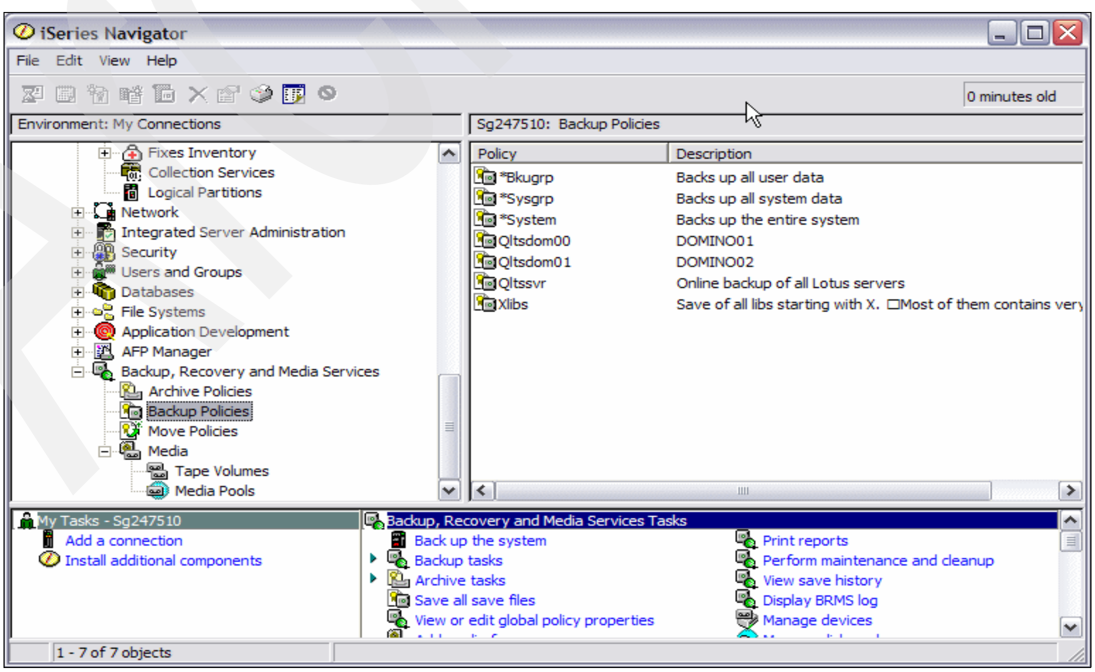



*Figure 6-70 iSeries Navigator - Backup Policy screen refresh*

## 6.5 Tailoring the backup example

In this section, we adjust our newly created backup policy.

As this is a backup of a series of test libraries all starting on X, there are only minor changes to be done.

In real life, you would make more significant adjustments that can include at least:

- Securing which i5/OS users can see, change, and use the backup policy or even use the virtual tape configuration objects.
- Plan ahead on what to do if an object to be saved has an exclusive lock on it by another job when the save is attempted. This is generally termed the *save while active* situation. In a more complex scenario, multiple objects to be saved could be locked as part of a transaction protected with commitment control.

  i5/OS save functions have parameters that address these possibilities. However, you have to study the iSeries Information Center articles under the following major topics to have a well-planned backup and recovery process that can handle these *locking conditions*:

  – Database
    • Commitment Control
  – Systems Management
    • Backup and Recovery

  You might have to quiesce other work while doing a save to unlock the affected object or choose some database save while active options.

> **Important:** i5/OS save while active provides some very powerful options for objects that have some kind of exclusive lock state on them while the system is trying to save that object.
>
> If Save while active is specified as *YES on the save function, then there is a set of related save while active parameters:
>
> – Save active wait time
> – Object locks wait time value including how to handle pending record changes (records locked for update) and in use, or for transactions with pending changes to reach a commit boundary, before continuing the save operation.
> – A message queue that is to receive “save while active progress messages”
>
> BRMS even provides a Monitor Save While Active (MONSWABRM) command that reviews the save while active message queue and looks for the message indicating the end of library synchronization. When synchronization is detected, you can issue a command to the system. The MONSWABRM command can be used as an exit (*EXIT) special value in a control group during backup processing.

In our simplified example, we do not address an exclusive lock by another job on an object being saved. We merely take a default option to not save the object so locked, and go on to the next object being save. We assume that such an object will probably be saved the next time our backup runs. This is not recommended in a production environment, but for our test libraries, it is fine.

Here are the small changes that we make to our recently created backup policy.

1. Find our backup policy by selecting **iSeries Navigator** → **Backup, Media and Recovery Services** → **Backup Policies**. Right-click our ***Xlibs policy***, and select **Properties**, as shown in Figure 6-71.

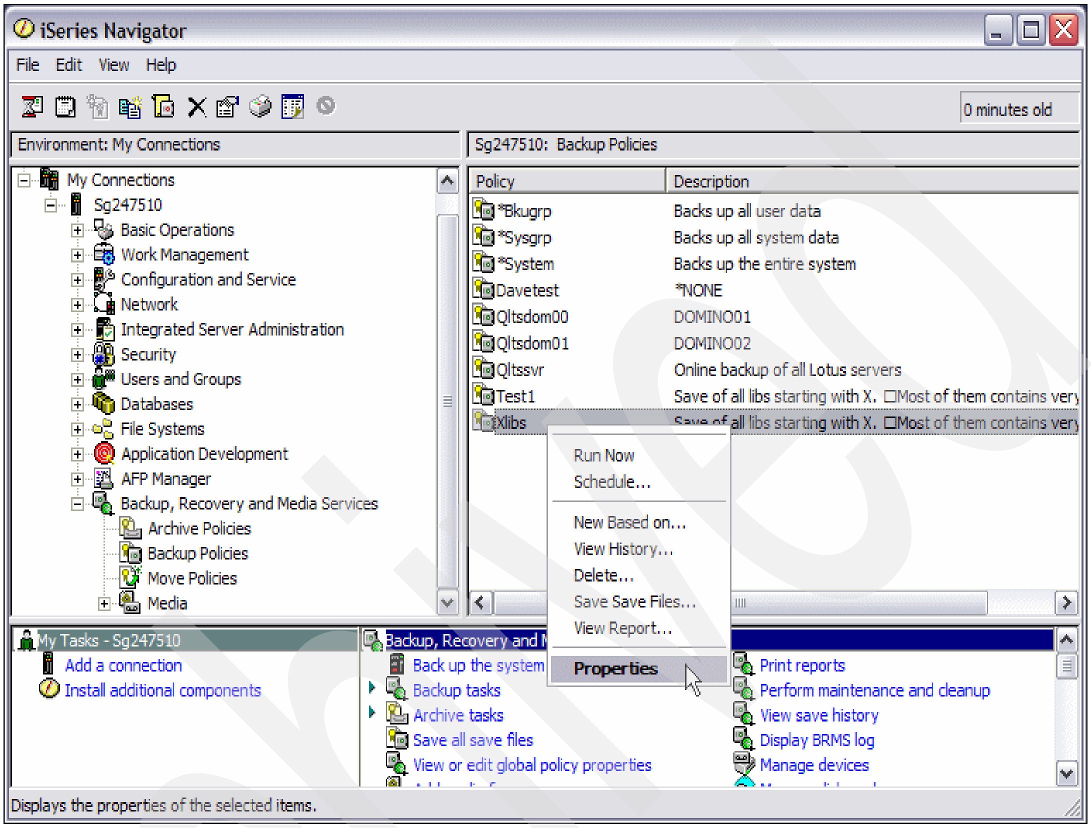



*Figure 6-71 iSeries Navigator - Backup Policy Properties*

2. The backup properties are divided into three categories (Figure 6-72):
   - Before: Specify additional actions before the actual backup starts.
   - During: Specify additional details on what, how, and to where our data should be backed up.
   - After: Specify additional details on actions to take after our backup has finished, regardless of whether it succeeded or not.

   Click **Before**.

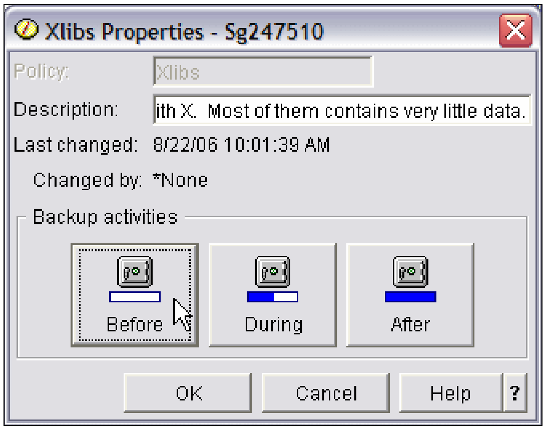



*Figure 6-72 Backup Policy Properties - Before tab*

3. There are three tabs under the Before button:
   - General tab

     In the General window shown in Figure 6-73 on page 193, you can see the list of actions that are possible before the backup starts and the days to specify when to run this backup. Consider carefully the shutdown options you can select.

     - In our example backup, we specify to run the backup each day Monday through Friday. Normally, our basic testing is done during weekdays. Major testing can happen during weekends. If so, we will make a runtime adjustment to our backup (we enabled this back in Figure 6-57 on page 178) policy.
     - In our simple backup example, we make sure that we do not take down anything else that is operating, therefore we make sure that all shutdown settings are deselected.
   - Job Queues
     - If there are job queues that have to be held during our backup, we specify them here.
   - Subsystems
     - If there are subsystem actions that have to performed, we specify them here.

   In our example, we specified only which days our backup is to run having determined that our backup would not disturb other current activity when we backed up.

   Click **OK**.

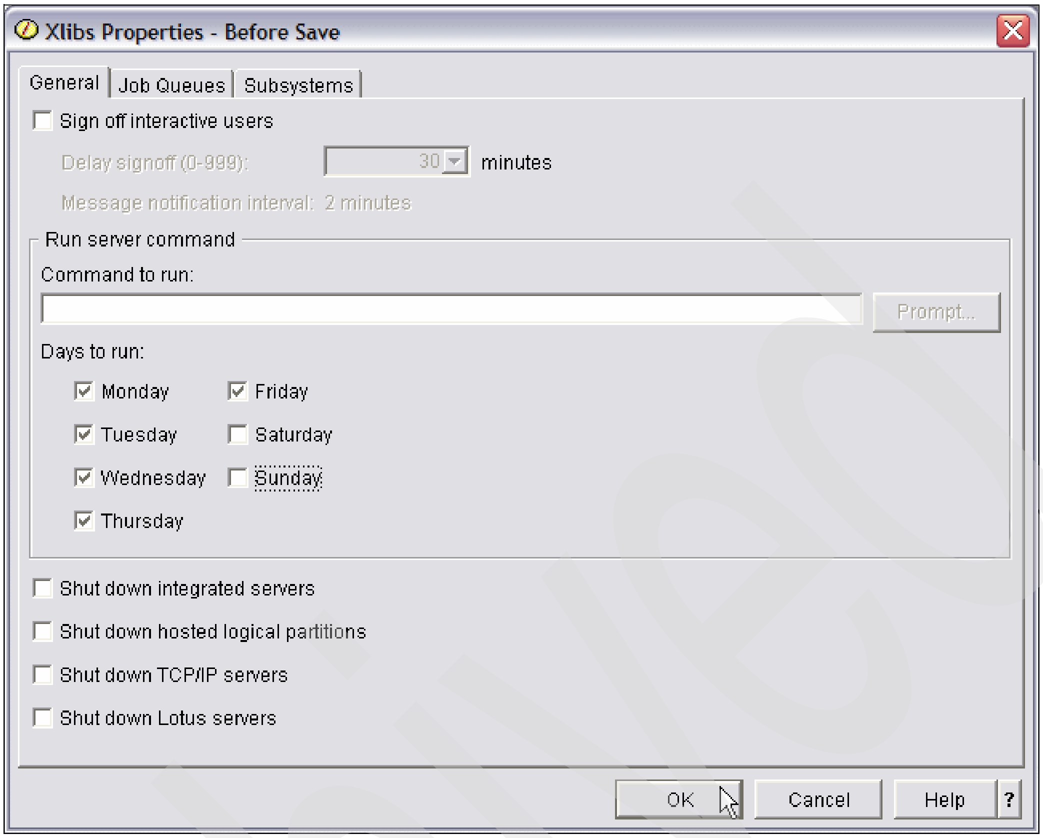



*Figure 6-73 Backup job Properties - Before Save*

4. We come back to the Properties panel (Figure 6-72 on page 192).

   From this panel, click **During**.

   The During tab properties provide many actions and options that can be chosen. In our simple example, there is not much we want to select from. We show only the window for the What tab in this book (Figure 6-74). However, in this section, we do list the functions possible under all five tabs shown when During is selected.

   These capabilities are available for any backup device, including the TS7510. They are included here for readers who are new to these backup capabilities using BRMS.

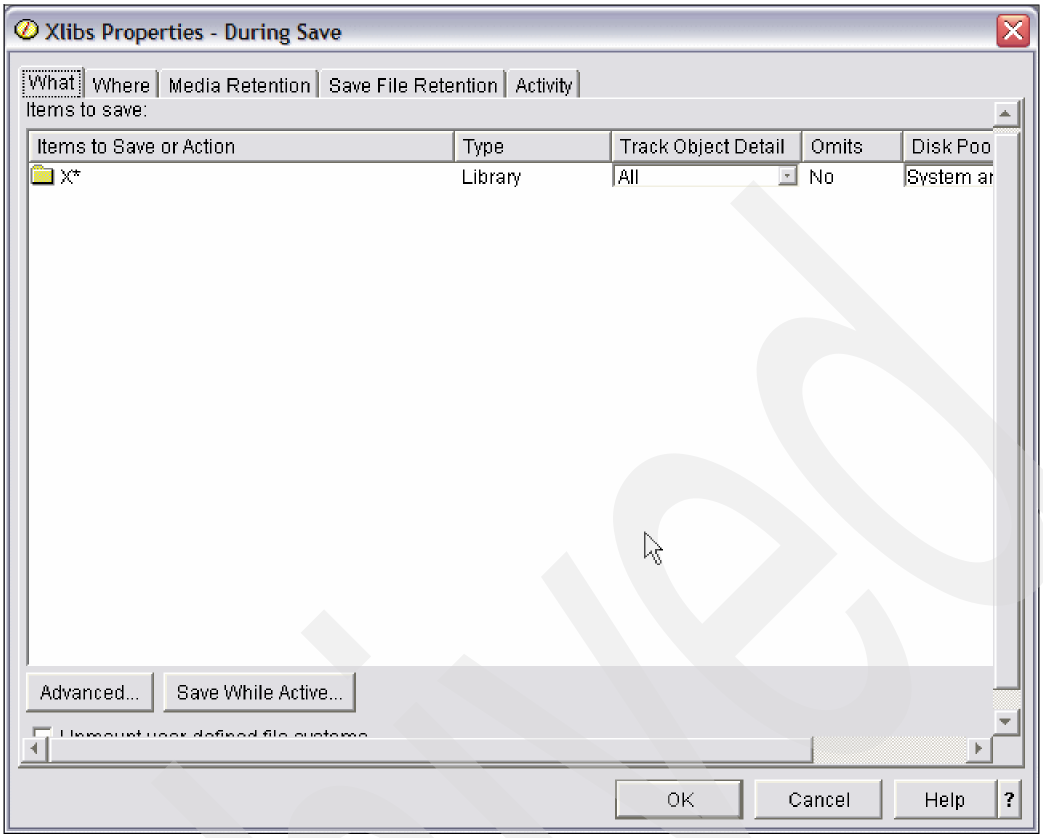



*Figure 6-74 Backup job Properties - During Save, What to save*

The five main tabs and a summary of their functions are listed below.

- **What:** Describes what to back up, but there are also a couple of other important things.
  - **Advanced button**: By clicking Advanced, a window opens up with some important settings.
    - Save journals while saving changed objects: Specifies whether you want to save objects whose changes are currently being entered in a journal. If you do not save these objects and you have to recover your system, you will have to retrieve any changes to these objects from your journal receivers. If you do save these objects, your save will take longer to complete, but a recovery will be easier. To optimize the availability of your system, you should back up these objects.
    - Access path: An access path is a description of the order in which records in a database file are processed. A file can have multiple access paths, if different programs have to see the records in different sequences. If you do not back up access paths, the system rebuilds them during a restore, which can significantly increase your recovery time on a very busy system with lots of access paths. When you back up access paths, your save takes longer and you use more media, but your restore is faster.

> **Note:** You should periodically audit your number of access paths (as well as other objects) stored within the entire i5/OS partition. You want to remove access paths and other objects that are no longer being used for several reasons, including avoiding saving many objects that should not be saved. Having many objects that really should not be saved also makes any restore processing longer than it should be.

        - Save contents of save file: Indicates that you want to back up the contents of save files and their descriptions. If you do not select this option, only the descriptions will be saved. It is recommended that you save the contents of your save files; however, you should be aware that these files are large and might contain duplicate data.
        - Save printer output: Indicates that you want to back up printer output with saved output queues. This provides a convenient way to back up spool files associated with other related backup objects.
        - Target release for restore operations: Specify the i5/OS release on which you plan to restore the items backed up by this policy.
        - Save exit program: Specify whether you want an exit program to run once the save has been preformed on the save item.
        - Backup policy for missed objects: This controls how BRMS handles objects that are missed when a backup policy runs. Objects on the system will not be backed up if they are locked and in use by other users. This option allows you to specify a backup policy where these objects will be listed, so that you can investigate if the locks are *normal* and possibly run a backup policy at a later time.
    - Save while active
        - If we must take a backup while users are working, we must get hold of every object by placing a lock on it. We also specify how long a time we will wait before giving up. This can be set for every section of our backup job. Save while active should be thoroughly evaluated by reviewing information center articles on this object.
    - Unmount user-defined file systems
        - Be aware that there is also this option to specify what to do with the file system being used.

        > **Attention:** Depending on your workstation's screen resolution or the window size being shown, you might miss seeing this option in the window. This option is under the Advanced... and Save while Active buttons.

- **Where:** Describes basically what type of output device our backup is planned to use.
    - Serial tape
    - Parallel tape
    - Save file
    - IBM Tivoli® Storage Manager
    - Media pool (type of media)
    - Device(s) to use
- **Media retention:** This specifies the number of days to keep our backed up data.
    - Values for full and incremental saves can be set independently.
    - Specify whether we allow changes at run time.
- **Save File Retention:** This specifies, uniquely, for save files how many days to keep your backed up save file.
    - Values for full and incremental saves can be set independently.
- **Activity:** You can specify the type of save activity that you would like to occur for every save item in this policy.
    - The setting on this page is the default setting that will be used every time the policy is run or scheduled, unless you choose to allow overrides.

– Allow overrides when policy is run: Enables you to override the backup activity and retention settings in the policy every time the policy is run or scheduled. If you select this check box, you will be asked to verify the save activity setting (full or changes-only save) every time you run or schedule the policy. If you do not select this check box, the policy will run using the current setting in the Properties.

– Force a full save when the last one is maximum days old or older: Select this option to force a full save after the specified number of days has passed.

Although we do not show you our actual selections, this is what we selected during our save of libraries starting with the name “X” character:

– Save journals while saving changed objects
– Save logical access paths
– Force a full backup after 15 days so that we ensure we never lose any backup data if full backups are not executed for some reason

5. You can select other choices. When done, click **OK**.
6. This brings us back to the Backup Policy Properties panel.

   Click **After**, as shown in Figure 6-75.

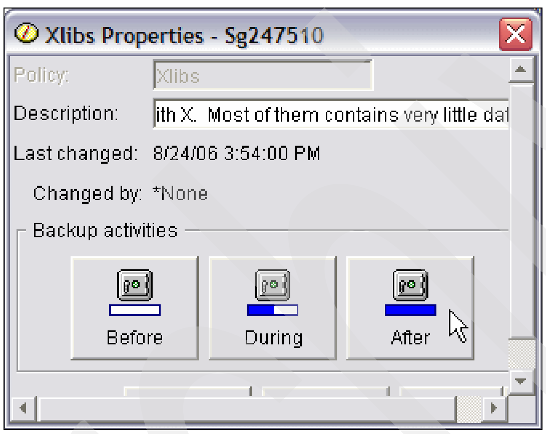



*Figure 6-75 Backup Policy Properties - After tab*

The After activities are divided into four tabs of settings:

► General

– Run server command: Indicates that you want to run an i5/OS command after the save fully completes.

– Media action when save ends: Specifies where you want the last volume used in the save to be positioned when the save ends.

  • Rewind
  • Leave
  • Unload

– Save media information: Specifies whether to automatically save the media information needed for recovery each time a save is performed using this policy. Choices are:

  • Libraries: Media information is saved at the library level. With library level media information, you will only have the information you need to recover objects to the library level, not the object level, should you need to recover your system.

  • Objects: Media information is saved at the object level. With object level media information, you will have the information you need to recover objects to the object level if you chose to save object level detail for the objects in the policy. For physical files, object level detail includes the detail for members. To see whether you chose to track object level detail for the objects in the policy, go to the What page of the During properties for the policy.

   - None: No media information is saved.

  – Start integrated servers
  – Start hosted logical partitions
  – Start TCP/IP servers
  – Start Lotus servers
  – Run maintenance: Enables you to specify whether you want to run maintenance at the end of the backup. All BRMS operations should be stopped prior to running maintenance. When you run maintenance, you automatically perform cleanup on your system, update backup information, and run reports. You should run maintenance daily.
  – Maintenance options: Control what maintenance activities occur when you run maintenance as part of a backup policy.

- Power down
  – How to end: Specifies whether you want the system to power down in a controlled fashion or immediately. If you power down the system in a controlled fashion, all active jobs end normally, and the programs running in those jobs are allowed to perform end of job processing, or cleanup. If you power down the system immediately, all jobs are ended immediately and no end of job processing is performed.
  – Delay time: If you choose to power down the system in a controlled manner, you can specify the length of time, in minutes, that you want the system to perform this shutdown. At the end of this period of time, all jobs still running will be ended immediately. You can also select No limit, which means that the system will not power down until all active jobs have ended. If you specify No limit and a batch job loops, the system will not power down. The maximum number of minutes that you can specify is 1666.
  – If you want the system to restart after it powers down, your choices are:
    - Restart source: Specifies whether you want the system to restart from the A-side or the B-side. The A-side contains the Licensed Internal Code and any code fixes that have been permanently applied to it. The B-side contains the Licensed Internal Code and any code fixes that have been temporarily or permanently applied to it. You can also select Use default on display, which means that the system is started from the side that is currently shown on the operator's display.
    - Restart type: Specifies what will be restarted after the system is powered down. You can restart the server, which means that the operating system will restart and the hardware will only restart if you apply a program temporary fix (PTF) that requires the hardware to restart. This is the fastest option. If you select i5/OS and hardware, both the hardware and i5/OS will restart. You can also use the current system setting, which you can see by clicking Advanced from the Restart tab in the System Properties.
  – If you are using a *single partition system*, you might have to *manually* start some TCP/IP servers and more when restarting. When running in a partitioned environment, you might have to manually start the partitions when the entire system configuration has been powered down and is just now powered on. This depends on whether you are using a Hardware Management Console (HMC) managed system or an i5/OS primary partition managed partitions. With the HMC partition definition interface, you

can specify which partitions (profiles) can be automatically started when the system has just been powered up.

Remember that in the Before panel you had options to shut down several servers before doing the save.

- Job queues
  - Job queues to release
- Subsystems
  - Subsystems to start

7. Click **OK** to keep the options that you selected. Otherwise, click **Cancel**.
8. We are back at the Xlibs Properties panel (see Figure 6-75 on page 196). We are done with all changes are made.

   Click **OK**. There is nothing more to do, therefore we are done modifying our policy. We are ready to run it.

> **Note:** Navigating through the Before, During, and After properties can be done in any order.

## 6.6 Running the backup we created

We show running the backup using the iSeries Navigator interface and again, using the i5/OS command interface.

### 6.6.1 Using iSeries Navigator to run our example backup

We run our backup directly from the iSeries Navigator as a one-time job. In real life, we would typically run a backup on a regular basis. You can schedule the running of the backups, but we do not show that in this book as we cannot show everything that BRMS can do in this IBM Redbook.

1. Sign on to the your i5/OS partition with iSeries Navigator. Expand **Backup, Media and Recovery Services** → select **our Backup policy** → select **Run now**, as shown in Figure 6-76.

   Note the other options in the options menu, including schedule, view the backup history, and view the report. Later in this chapter, we do show some examples of history and a report.

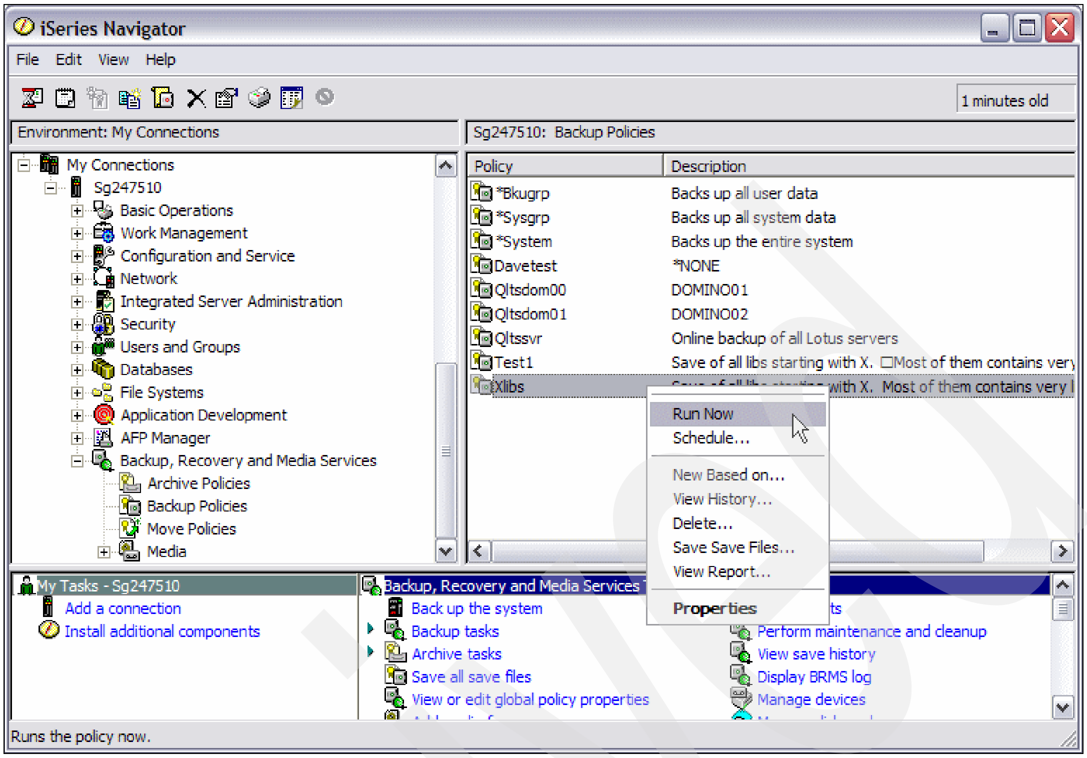



*Figure 6-76 iSeries Navigator - Run backup job now*

2. Run Now opens the window shown in Figure 6-77, which lets us make overrides to our defined backup. We run with the defined policy settings. Click **OK**.

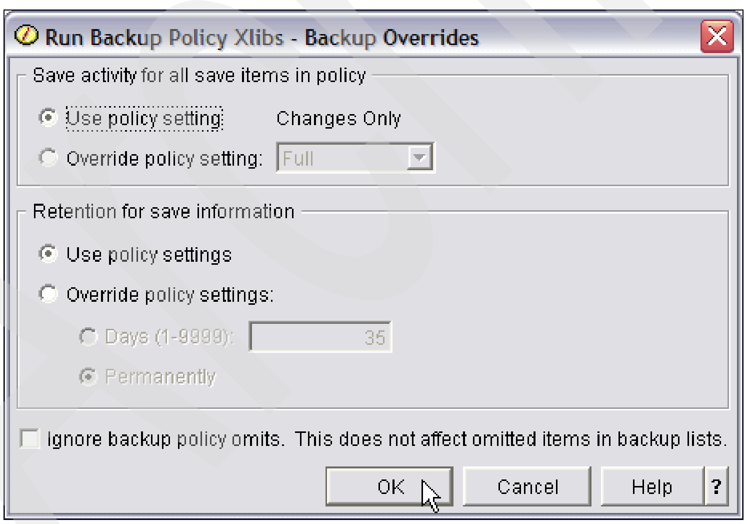



*Figure 6-77 Run Backup Policy - Backup Overrides*

3. The next window (Figure 6-78) asks us if we want to save the job log of our backup job. When running a backup for the first time, we always recommend this so that we can have the most complete information about the results of the backup. Select **Save task output when the BRMS task completes successfully**. Click **OK**.

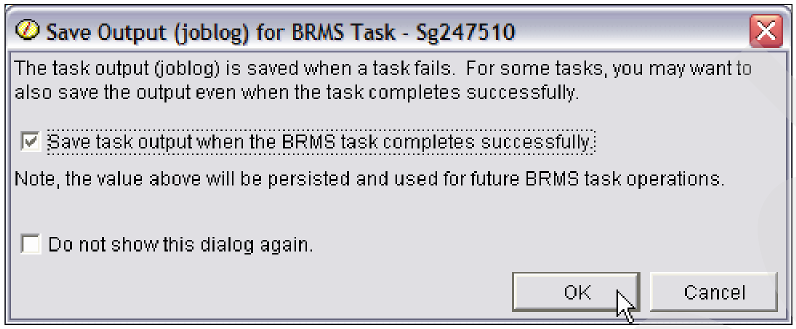



*Figure 6-78 Save output (joblog) for BRMS task*

4. The next window (Figure 6-79) simply tells us that the backup job has started. Click **OK**.

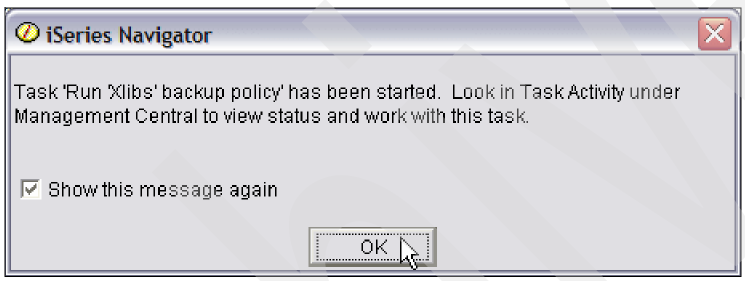



*Figure 6-79 iSeries Navigator - Backup policy started*

We are returned to the base iSeries Navigator window shown in the background of Figure 6-76 on page 199.

## 6.6.2 Using i5/OS commands to run our example backup

We have created and tailored our backup using the iSeries Navigator, but we can also run the same backup using i5/OS commands.

We use the Start Backup using BRMS (STRBKUBRM). This command has a lot of parameters, which are used to influence the way the backup is taken and what should be done after it has executed. We take the command defaults that use the defined backup policy settings.

All we have to specify is the name of our backup policy. In the i5/OS command interface, our backup is referred to as a *control group*.

Enter `STRBKUBRM CTLGRP(XLIBS)`. Press the Enter key.

Because we did not change any other parameter, this submits the backup at a batch job.

The full command text actually used by i5/OS looks like this, which includes parameter defaults:

```
STRBKUBRM CTLGRP(XLIBS) SCDTIME(*IMMED) SBMJOB(*YES) STRSEQ(*FIRST *FIRST)
APPEND(*CTLGRPATR) ACTIVITY(*CTLGRPATR) RETENTION(*CTLGRPATR 0035) OMITS(*PROCESS)
```

Example 6-2 shows an excerpt of the messages logged during the backup.

*Example 6-2 Messages while executing the example backup*

```
Begin processing for control group XLIBS type *BKU.
Devices TAPMLB19 will be used for control group XLIBS type *BKU.
Interactive users are allowed to stay active.
Starting save of library X* to devices TAPMLB19.
Member QA1ASLIB added to output file QA1ASLIB in library QTEMP.
Cartridge VTL000 volume VTL000 mounted on device TAPMLB19.
1 blocks processed for sequence 2, volume VTL000, on device TAPMLB19.
1 objects saved from library X240.
1 blocks processed for sequence 3, volume VTL000, on device TAPMLB19.
1 objects saved from library X241.
:                                  :                             :
........... (more)..... messages....
```

## 6.6.3 Determining the backup was successful

Because we just showed the command interface, we show viewing the BRMS lob using the command interface.

### Using DSPLOGBRM command to view the BRMS log

The most common way to determine if our backups were successful is through the BRMS log. This is the Display BRMS Log (DSPLOGBRM) command, which if entered without specifying additional parameters, shows you what took place since the previous midnight.

The BRMS log can be lengthy, therefore our advice is to shorten your view of it by looking for specific messages. The following are our examples of doing this with the DSPLOGBRM command:

- DSPLOGBRM TYPE(*BKU) SEV(40): Show all messages with severity 40 or higher.
- DSPLOGBRM TYPE(*BKU) MSGID(CPF3771): There are one or more of these messages of the format “n” objects saved from &3. “n” not saved.
- DSPLOGBRM TYPE(*BKU) MSGID(CPF3761): Identify if any object was locked by another job during the backup.
- DSPLOGBRM TYPE(*BKU) MSGID(BRM15A7): Identify if the backup had errors.
- DSPLOGBRM TYPE(*BKU) MSGID(CPF3774): This is a summary message indicating “n” objects saved from &3. “n” not saved. “n” not included.
- DSPLOGBRM TYPE(*BKU) MSGID(CPF3778): This is a summary message indicating “Not all objects saved from all libraries.”
- DSPLOGBRM TYPE(*BKU) MSGID(CPF3741): There can be one or more messages indicating “Object abc,123 in xyz not saved.”

Alternatively, you can look within a specific time interval, perhaps in conjunction with a message severity level:

```
DSPLOGBRM PERIOD((030000 *CURRENT) (060000 *CURRENT)) SEV(30)
```

### Using iSeries Navigator to view the BRMS log

You can use the iSeries Navigator to look at the entire log.

Using the iSeries Navigator interface, make sure that your iSeries Navigator session is connected to the Management Central system (partition) is the same system (partition) on which you ran your backups.

1. As shown in Figure 6-80, expand **Management Central** → **Task Activity** → **Backup, Recovery and Media Services**.

   This displays the status of all the BRMS jobs in the right pane.

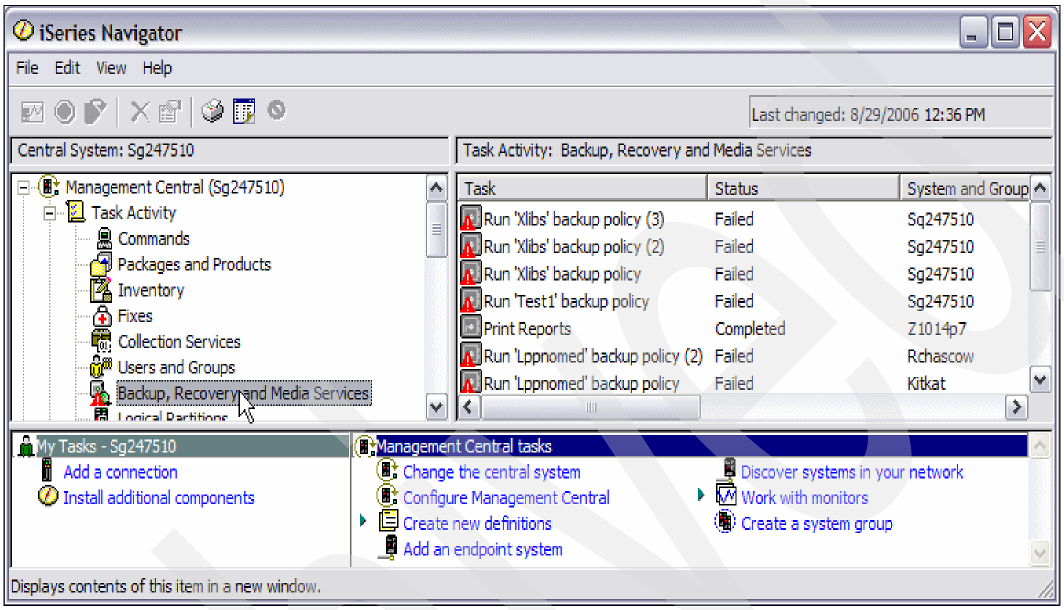



*Figure 6-80 iSeries Navigator - Expand Backup, Recovery and Media Services*

2. Right-click a job in the list. In our example, it will normally be the job at the top of the display area. However, in our screen capture, we selected the third task result item.

   Select **BRMS log**, as shown in Figure 6-81.

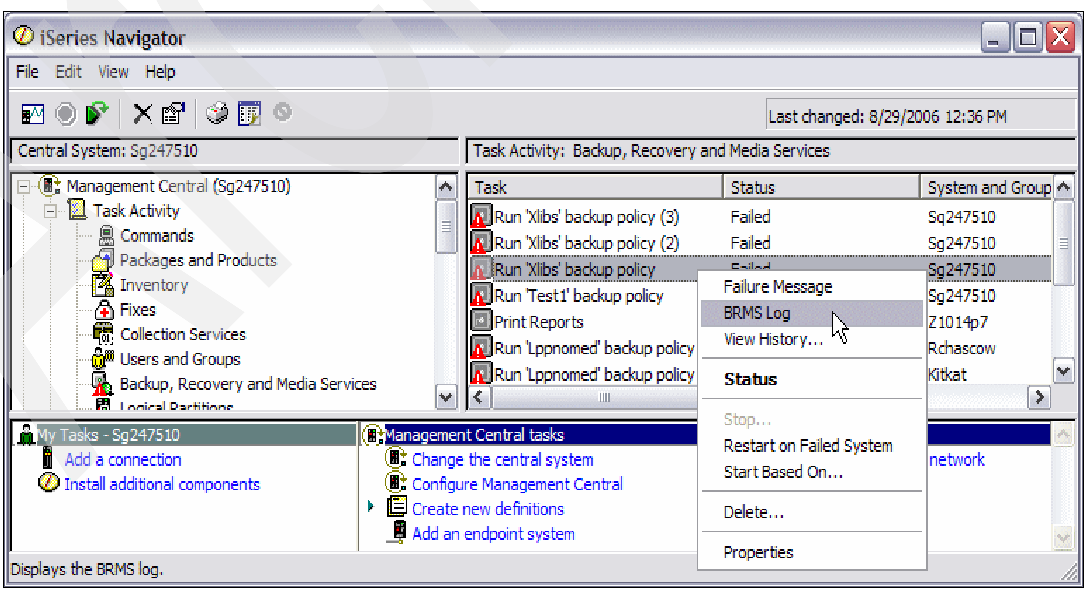



*Figure 6-81 iSeries Navigator - BRMS log based on a specific job*

3. This option initially opens an Include window (Figure 6-82). In this window, you can select what entry types, message IDs, dates, and times to subset your view of the log. Some values may be already filled in.

   Enter the appropriate values. Click **OK**.

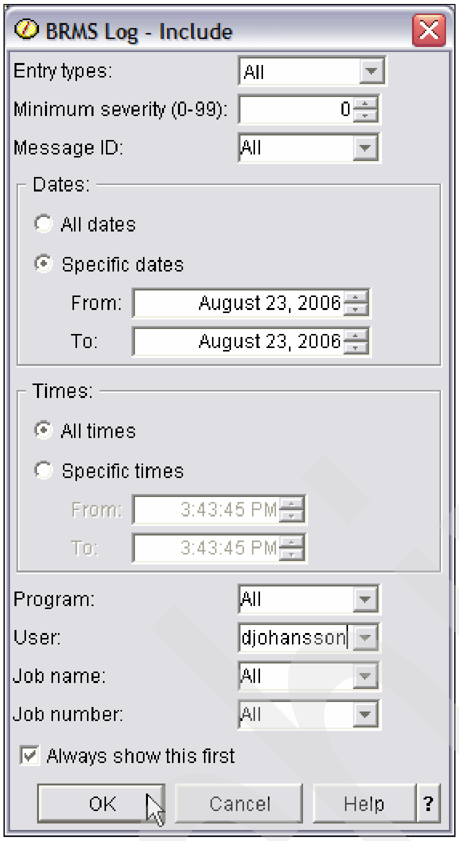
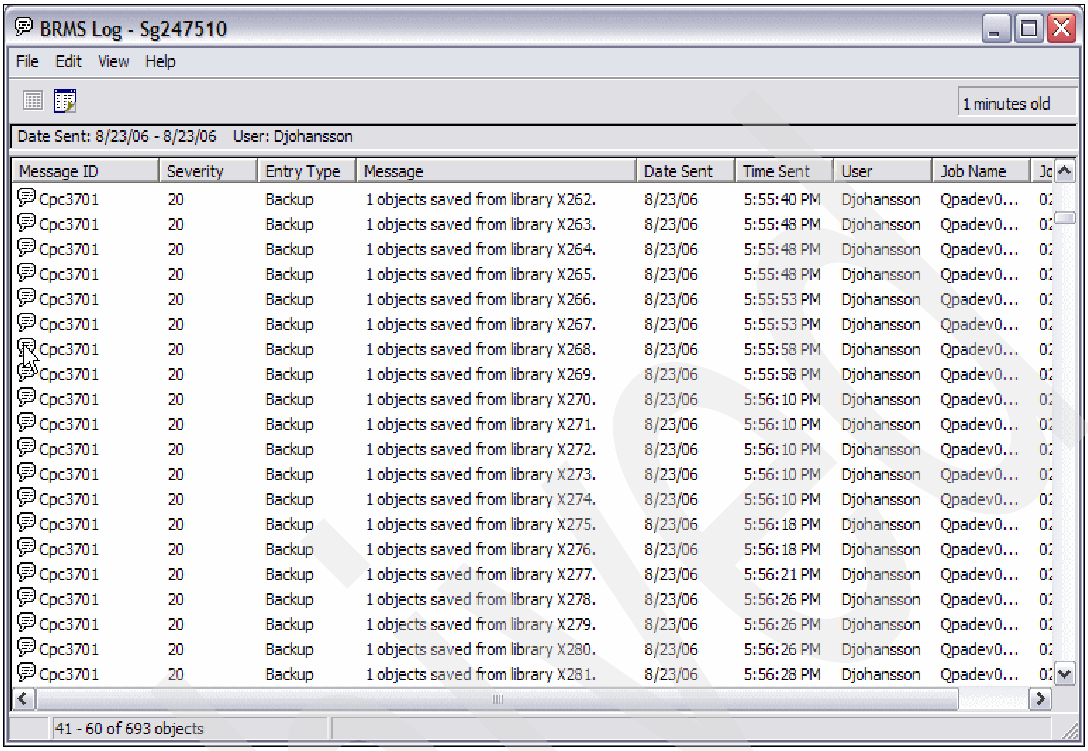



*Figure 6-82 BRMS log - Include*

4. The resulting log screen will look something like the one shown in Figure 6-83.

   Click any row to see detailed information about the specific message.



BRMS Log - Sg247510

File Edit View Help

1 minutes old

Date Sent: 8/23/06 - 8/23/06 User: Djohansson

| Message ID | Severity | Entry Type | Message | Date Sent | Time Sent | User | Job Name | Jc |
|---|---|---|---|---|---|---|---|---|
| Cpc3701 | 20 | Backup | 1 objects saved from library X262. | 8/23/06 | 5:55:40 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X263. | 8/23/06 | 5:55:48 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X264. | 8/23/06 | 5:55:48 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X265. | 8/23/06 | 5:55:48 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X266. | 8/23/06 | 5:55:53 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X267. | 8/23/06 | 5:55:53 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X268. | 8/23/06 | 5:55:58 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X269. | 8/23/06 | 5:55:58 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X270. | 8/23/06 | 5:56:10 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X271. | 8/23/06 | 5:56:10 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X272. | 8/23/06 | 5:56:10 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X273. | 8/23/06 | 5:56:10 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X274. | 8/23/06 | 5:56:10 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X275. | 8/23/06 | 5:56:18 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X276. | 8/23/06 | 5:56:18 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X277. | 8/23/06 | 5:56:21 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X278. | 8/23/06 | 5:56:26 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X279. | 8/23/06 | 5:56:26 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X280. | 8/23/06 | 5:56:26 PM | Djohansson | Qpadev0... | 0: |
| Cpc3701 | 20 | Backup | 1 objects saved from library X281. | 8/23/06 | 5:56:28 PM | Djohansson | Qpadev0... | 0: |

41 - 60 of 693 objects

*Figure 6-83 BRMS log*

This concludes our discussion of the BRMS log.

## Media information

The Work with Media using BRMS (WRKMEDBRM) command shows you all backups that have been taken, how many objects were saved, and more importantly, how many objects were not saved.

1. From a 5250 workstation, enter the `WRKMEDBRM` command. Press the Enter key.
2. Press F11 in the first screen shown.

   Normally, a portion of that screen will look something like Figure 6-84.

```
Saved          Save      Save    Item          ---- Objects ----   Control     Obj
Item           Date      Time    Type          Saved   Not Saved   Group       Dtl
PRIMBASE     9/04/06 17:34:02 *LIB              110           0   PRLIBS      *YES
PRIMPROF     9/04/06 17:34:06 *LIB              107           0   PRLIBS      *YES
PROFILE      9/04/06 17:34:06 *LIB               77           0   PRLIBS      *YES
```

*Figure 6-84 WRKMEDIBRM - Objects saved*

If you see the “Not saved” column has a value other than 0, there was some kind of problem (see Figure 6-85).

```
Saved        Save     Save    Item         ---- Objects ----  Control    Obj
Item         Date     Time    Type         Saved   Not Saved  Group      Dtl
PRIMBASE   9/08/06 17:42:39 *LIB             110           0  PRLIBS     *YES
PRIMPROF   9/08/06 17:42:41 *LIB             104           3  PRLIBS     *YES
PROFILE    9/08/06 17:42:42 *LIB              77           0  PRLIBS     *YES
```

*Figure 6-85   WRKMEDIBRM - Objects not saved*

From WRKMEDIBRM, you can get a good indication of why an object was not saved. Take option **9=Work with saved objects**. The column to the far right contains a message ID that identifies the specific error that the backup job encountered. In Figure 6-86, we show CPF3763, which says we are trying to save a damaged object.

A damaged object rarely occurs, but it can happen. This means the object has some information missing or in a format that makes the object unusable. You will have to investigate the damaged object using i5/OS functions outside the scope of this IBM Redbook.

```
                                          Save       Save               Message
Object       Library      Type          Date       Time    Volume     ID
VLT011RR     PRIMPROF     *FILE         9/08/06  17:42:41  BTG008     CPF3763
```

*Figure 6-86   WRKMEDIBRM - Object not saved because of error message*

An indication of even more problems will be if the “Saved objects” column has 0 and the “Not saved” column has 999999, as shown in Figure 6-87. This means the backup never saved a single object or it could have saved some objects, but some significant problem was encountered with the *tape device*, which prohibited the software from writing the appropriate double tape marks. The double tape marks normally enable the next save to tape function to know where to start writing data.

Now you have a problem trying to use that volume again. You cannot add more data to (after the last good file) to it. You can only write to tape sequence numbers less than the file sequence number of the last file on the volume. That is, there is no ending mark to start from, therefore effectively you have to overwrite the last file on the volume.

On a real tape volume, this means that volume is not a good candidate for using for the next save operation and specifying a save *with append*. In a real tape case, you might see the message CPF4290: `Labels not found while processing file`.

We experienced a very rare condition with an error on our virtual tape system. In this case, the condition would typically indicate that some serious tape software or disk device failure had occurred.

```
Saved        Save     Save    Item         ---- Objects ----  Control    Obj
Item         Date     Time    Type         Saved   Not Saved  Group      Dtl
WMS54M18   9/05/06 16:55:44 SAVLIB             0      999999  WMLIBS     *NO
```

*Figure 6-87   WRKMEDIBRM - After PF11*

```
Saved         Save      Save    Save    Parallel Volume    File        Expire
Item          Date      Time    Type    Devices  Serial    Sequence    Date
WMS54M18    9/05/06 16:55:44 *FILE             BTG008         1366   9/21/06
```

Figure 6-88 WRKMEDIBRM - Before PF11

The BRMS log shows this:

- 9/05/06 16:55:44 CPF4108 Media error on volume BTG008 device TAPMLB01.
- 9/05/06 16:55:44 CPF3751 Some libraries not saved.
- 9/05/06 16:55:45 BRM1820 control group WMLIBS type *BKU ended abnormally.

Before deciding to try using the volume again, you should check its media statistics. Maybe it is time to scrap that volume.

In our example, using a virtual tape device, we got media errors, the next time we tried to use that volume. The i5/OS problem log indicated `interface check`.

If the problem continues when using a virtual tape, contact IBM for possible service on the TS7510.

## 6.6.4 Media statistics

Making a health check of your media is done by printing the Media Statistics Report.

Your media supplier can inform you what values are acceptable or not. This is also possible to specify so that BRMS can avoid putting more data on such volumes. Type the following followed by the Enter key:

1. `GO BRMS`. Take the following options in the sequence of screens.
2. **1**. Media management
3. **6**. Media activity
4. **5**. Print media statistics
5. Enter `*THRESHOLDS`.

   Report QP1AVU created with “n” entries.
6. `WRKJOB`
7. **4**. Work with spooled files
8. **5** in front of file QP1AVU.

```
                 Media Threshold Information
Volume Reuse   Date    Expiration               Read    Write
Serial Date    Added    Date      Location  Uses Errors  Errors
BTG008 4/03/06 9/02/04  9/21/06   TAPMLB01  213   412       16
```

Figure 6-89 Media threshold information

### Media Threshold Specifications

To view or change Media Threshold Specification, perform the following steps:

1. `GO BRMS`. Take the following options in the sequence of screens.
2. **1**. Media management

3. **1**. Work with media classes
4. **2**=Change
5. Scroll to **Next page**.
6. Enter the values that your tape media or device supplier recommends.

   Figure 6-90 shows the values we used in our example.

```
                              Change Media Class

Media class . . . . . . . . . . . :   3570

Type choices, press Enter.

Media life  . . . . . . . . . . . .                Number of days, *NOMAX
Usage threshold . . . . . . . . . .                Times used, *NOMAX
Read error threshold  . . . . . . .                Number (KB), *NOMAX
Write error threshold . . . . . . .                Number (KB), *NOMAX
Uses before cleaning  . . . . . . .                Number, *NOMAX
Media manufacturer  . . . . . . . .
Manufacturer part number  . . . . .
Compatible part number  . . . . . .
Media supplier  . . . . . . . . . .
Supplier representative . . . . . .
Supplier telephone number . . . . .
Reorder point . . . . . . . . . . .                Number, *NONE
```

*Figure 6-90 Change Media Class - Media threshold values*

BRMS will from now on take actions based on the media threshold values entered. This to prevent pulling up media for write that is outside what the media supplier recommends.

> **Important:** Never reuse tape volume IDs as this will result in incorrect statistics being shown.

With a few exceptions, all that can be done to run and manage your backup using i5/OS commands can also be achieved using the iSeries Navigator interface and vice versa. You select the working environment interface you feel most comfortable with and you can mix the use of either interface. You have to make sure that you understand some of the slightly different terms used in the two interfaces. Refer to *Backup Recovery and Media Services for iSeries: Version 5*, SC41-5345.

## 6.6.5 View the history log from the iSeries Navigator

The last log we discuss is the BRMS history log.

1. As we did before for viewing the BRMS log, right-click your job and now select **View history**, as shown in Figure 6-91.

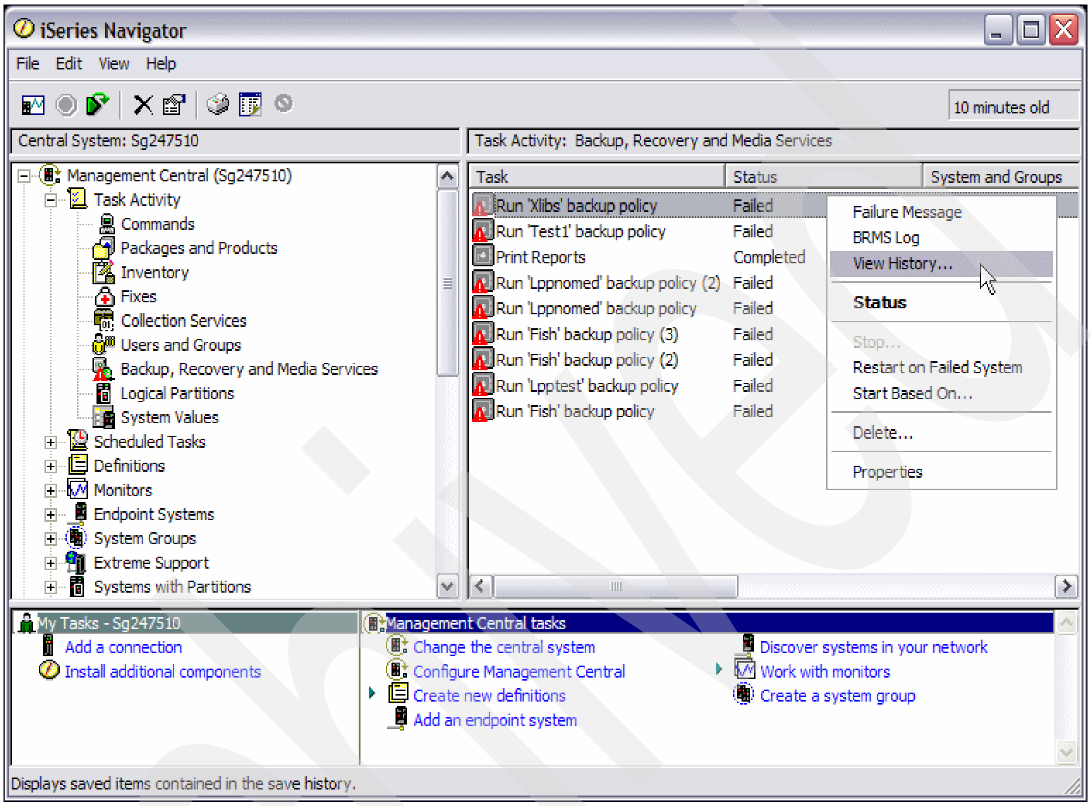



*Figure 6-91 iSeries Navigator - View History based on a specific backup job*

2. As with the BRMS log, we can “include” how much of the history entries we want to see. When the selections are done, click **OK**, as shown in Figure 6-92.

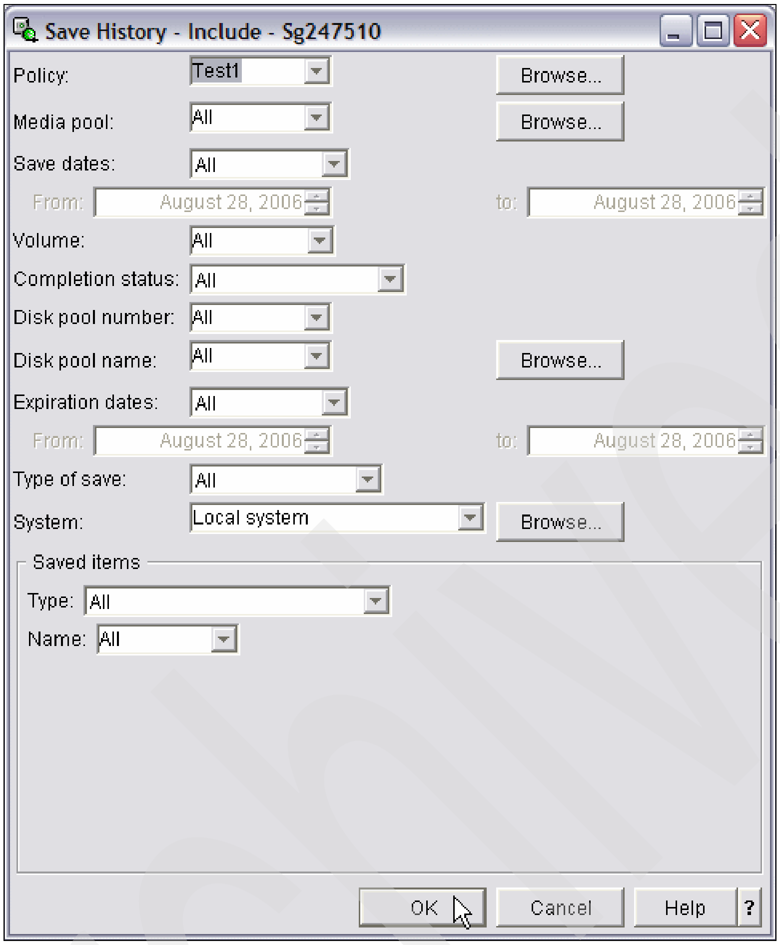
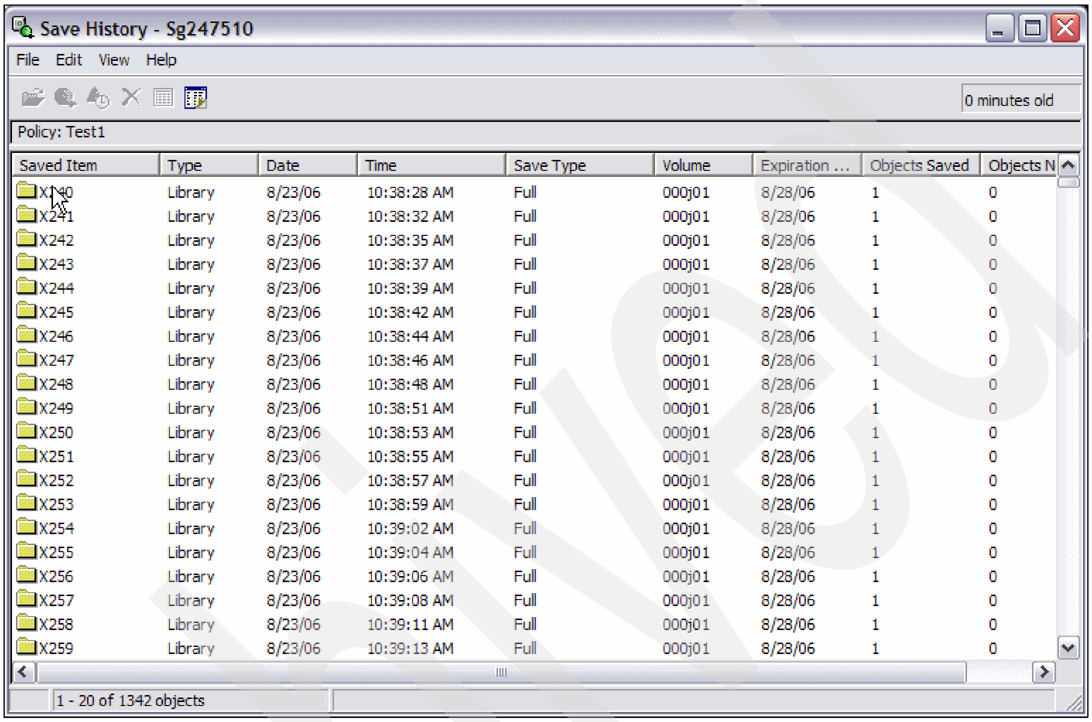



*Figure 6-92 Save History - Include*

An example of how a history log might look like is shown in Figure 6-93.

**Note:** For those who operate BRMS from the i5/OS commands environment, this corresponds to the Work with Media Information (WRKMEDIBRM) command.




| Saved Item | Type | Date | Time | Save Type | Volume | Expiration ... | Objects Saved | Objects N |
|---|---|---|---|---|---|---|---|---|
| X240 | Library | 8/23/06 | 10:38:28 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X241 | Library | 8/23/06 | 10:38:32 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X242 | Library | 8/23/06 | 10:38:35 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X243 | Library | 8/23/06 | 10:38:37 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X244 | Library | 8/23/06 | 10:38:39 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X245 | Library | 8/23/06 | 10:38:42 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X246 | Library | 8/23/06 | 10:38:44 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X247 | Library | 8/23/06 | 10:38:46 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X248 | Library | 8/23/06 | 10:38:48 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X249 | Library | 8/23/06 | 10:38:51 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X250 | Library | 8/23/06 | 10:38:53 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X251 | Library | 8/23/06 | 10:38:55 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X252 | Library | 8/23/06 | 10:38:57 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X253 | Library | 8/23/06 | 10:38:59 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X254 | Library | 8/23/06 | 10:39:02 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X255 | Library | 8/23/06 | 10:39:04 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X256 | Library | 8/23/06 | 10:39:06 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X257 | Library | 8/23/06 | 10:39:08 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X258 | Library | 8/23/06 | 10:39:11 AM | Full | 000j01 | 8/28/06 | 1 | 0 |
| X259 | Library | 8/23/06 | 10:39:13 AM | Full | 000j01 | 8/28/06 | 1 | 0 |

*Figure 6-93 Save History*

Again, you can click any message for detail information.

## 6.7 Using iSeries Navigator to restore an example library

As you see from Figure 6-93, we had completed a number of successful backup jobs, therefore let us go and restore something from one of them.

Normally, you might hesitate a bit to restore data when running full production, but our simple example backup dealt with test libraries, therefore we restore them without taking down any currently active users or worry about any other possible considerations that you might have in your production environment.

## 6.7.1 Finding what we have backed up

When selecting Backup, Recovery and Media Services using the iSeries Navigator, the lower portion of the window changes to include specific BRMS tasks. One of them is Restore iSeries data.

1. Using the expanded tasks pane, as shown in Figure 6-94, and click **Restore iSeries data**.

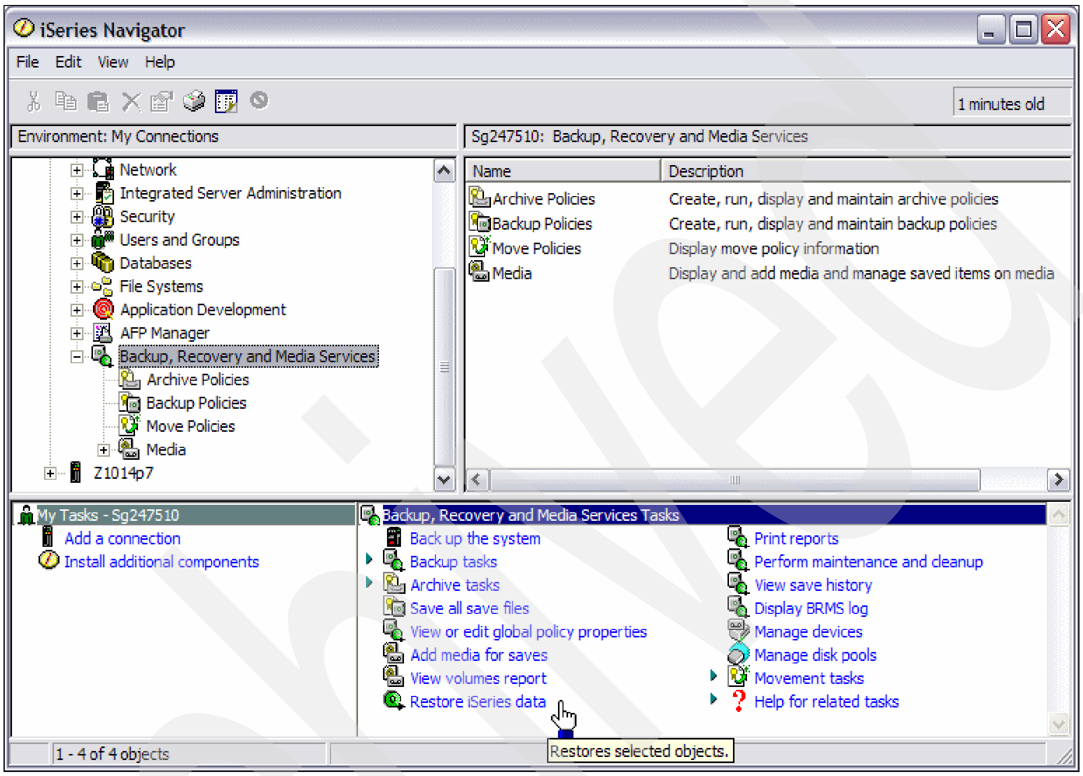



*Figure 6-94 iSeries Navigator - Restore iSeries data*

2. A help panel is presented first, informing you of the options available for a restore task, as shown in Figure 6-95.

   Click **OK**.

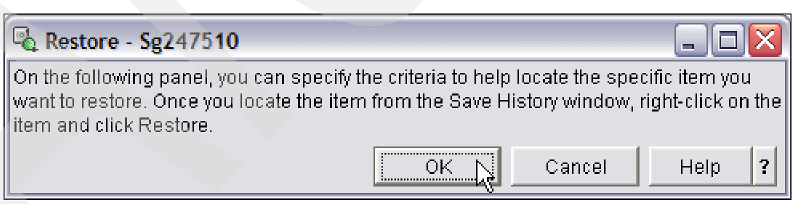



*Figure 6-95 Restore - Help information*

3. The history include window shown in Figure 6-96 opens. The window contents can be processed similar to the way we checked to see if our backup was successful or not. In our example, we are only interested in bringing back some of the X-libs, therefore we select that policy.

   Enter `Xlibs` into the Policy field. Note that you can click several of the Browse buttons to help you select what you want to restore.

   When finished with your Include selections, click **OK**.

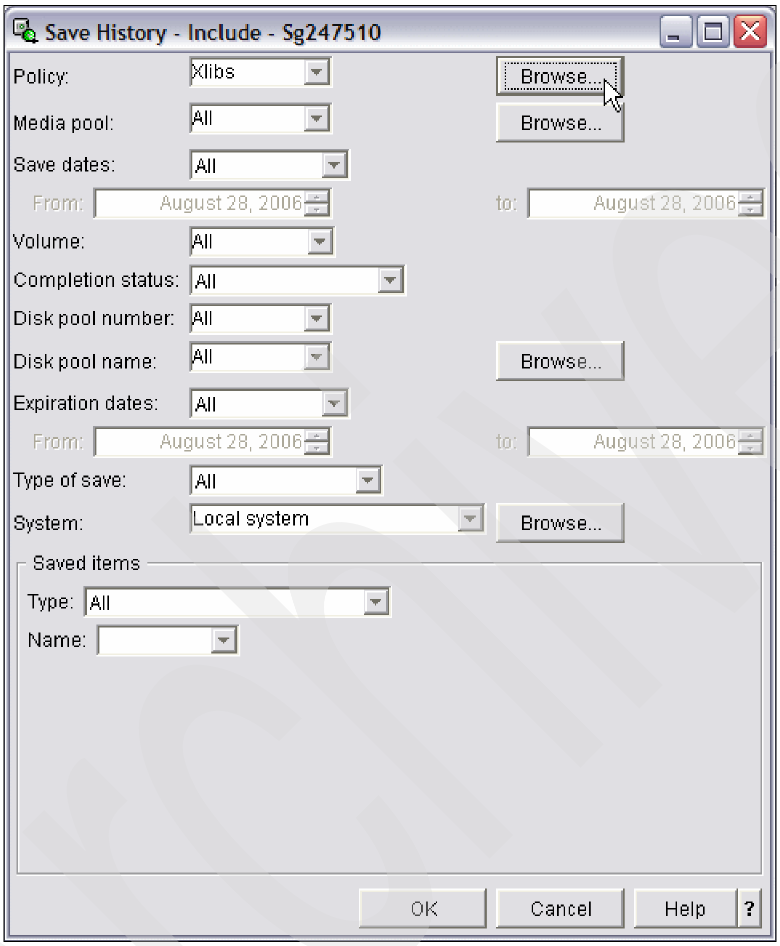



*Figure 6-96 Save History - Include*

4. Figure 6-97 shows the next window, which lists all the objects saved and the save result. Right-click the objects that you want to restore. In our simple example, we select **X240**. Select **Restore**.

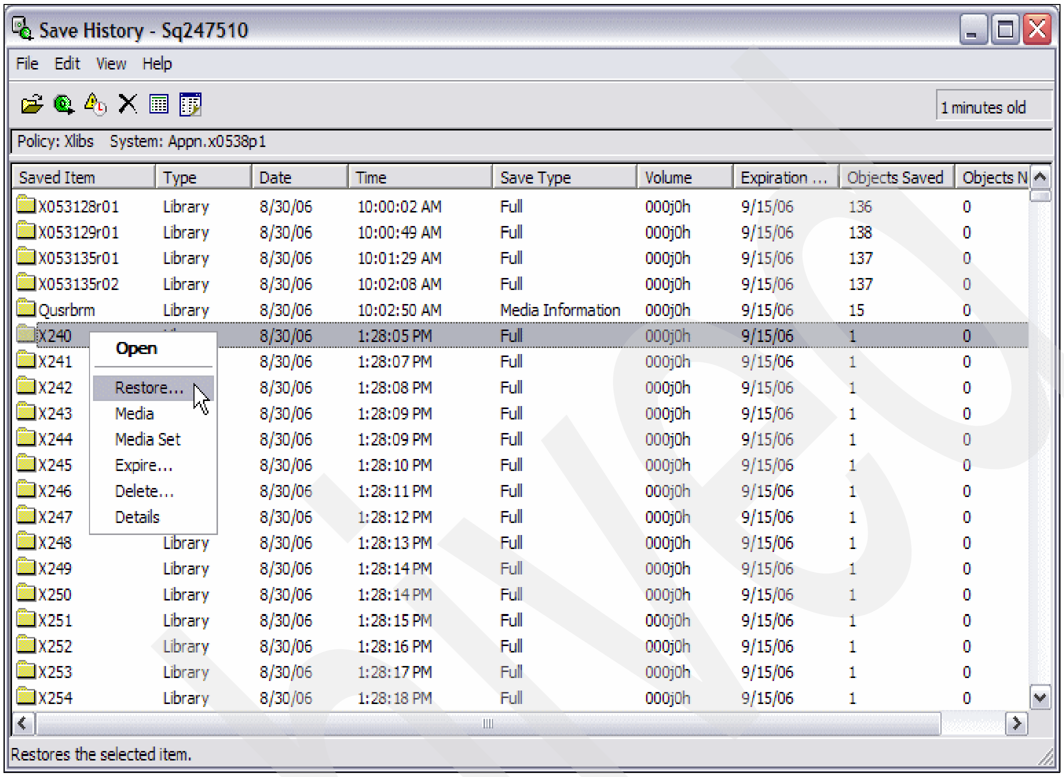


*Figure 6-97 Save History*

There is also another way of getting to the Save history panel. Expand **Backup, Recovery and Media Services** → click **Backup Policies** → right-click ***your backup policy*** → select **View History** and the same Save History - Include window is shown with one exception. Your backup policy is pre-filled.

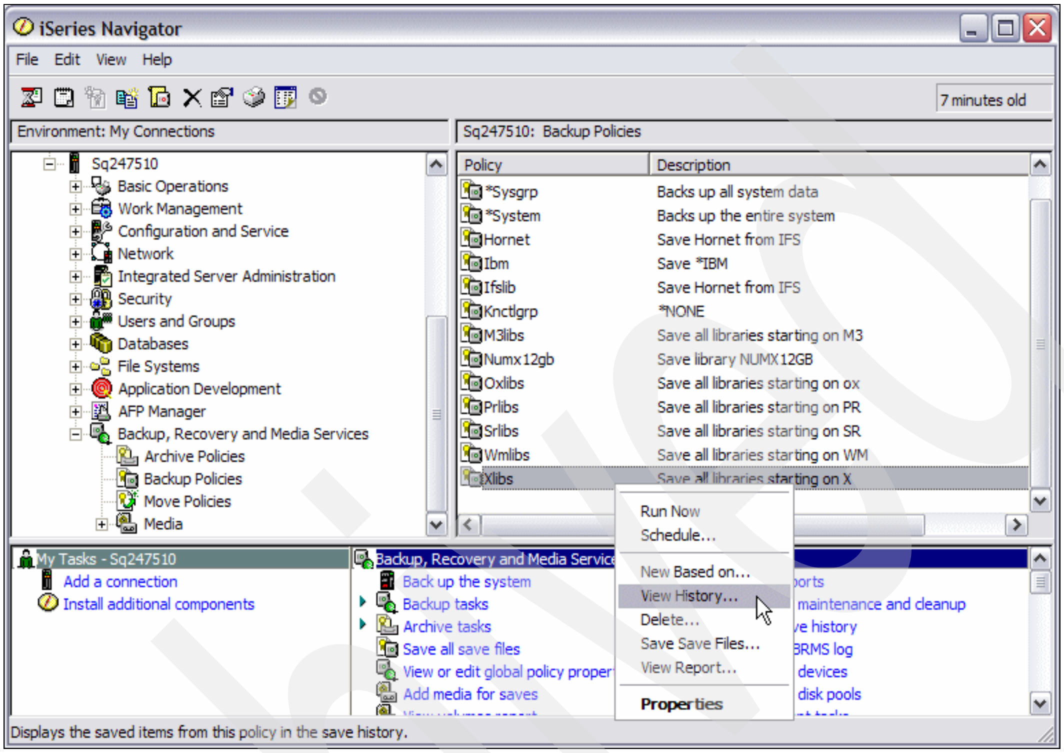



*Figure 6-98 iSeries Navigator - View History based on Backup Policy*

5. After you are done selecting what objects to restore, you get the Restore Wizard Welcome window shown in Figure 6-99.

   Click **Next**.

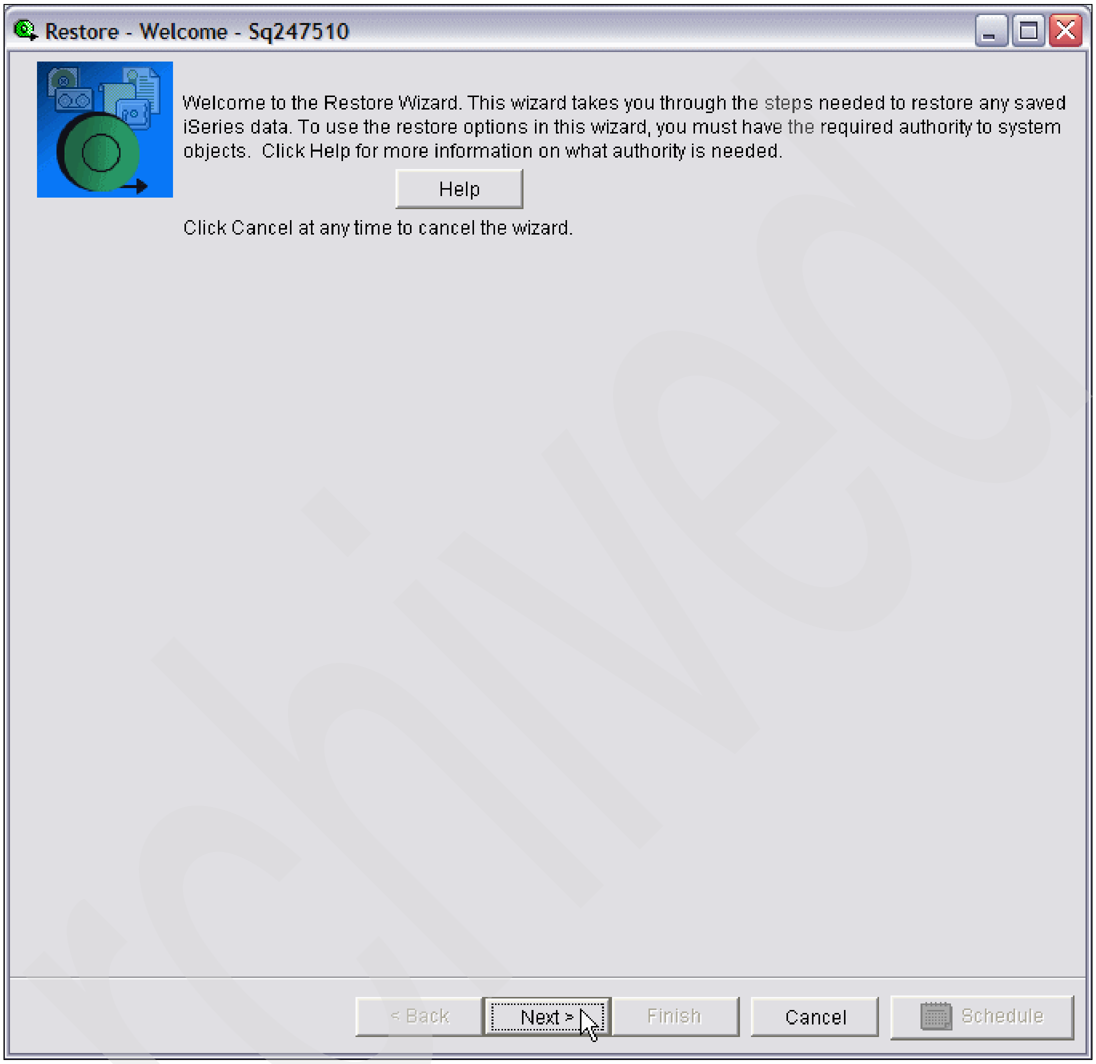



*Figure 6-99 Restore - Welcome*

6. When you have selected an i5/OS library, the next window Restore Entire Save (Figure 6-100) asks if you want to restore the whole library with its content or only some objects within the library. In our simple example, we had no objects in our X libraries, therefore there is nothing to select to restore, except the library itself.

   The default is to restore the whole library, therefore we click **Next**.

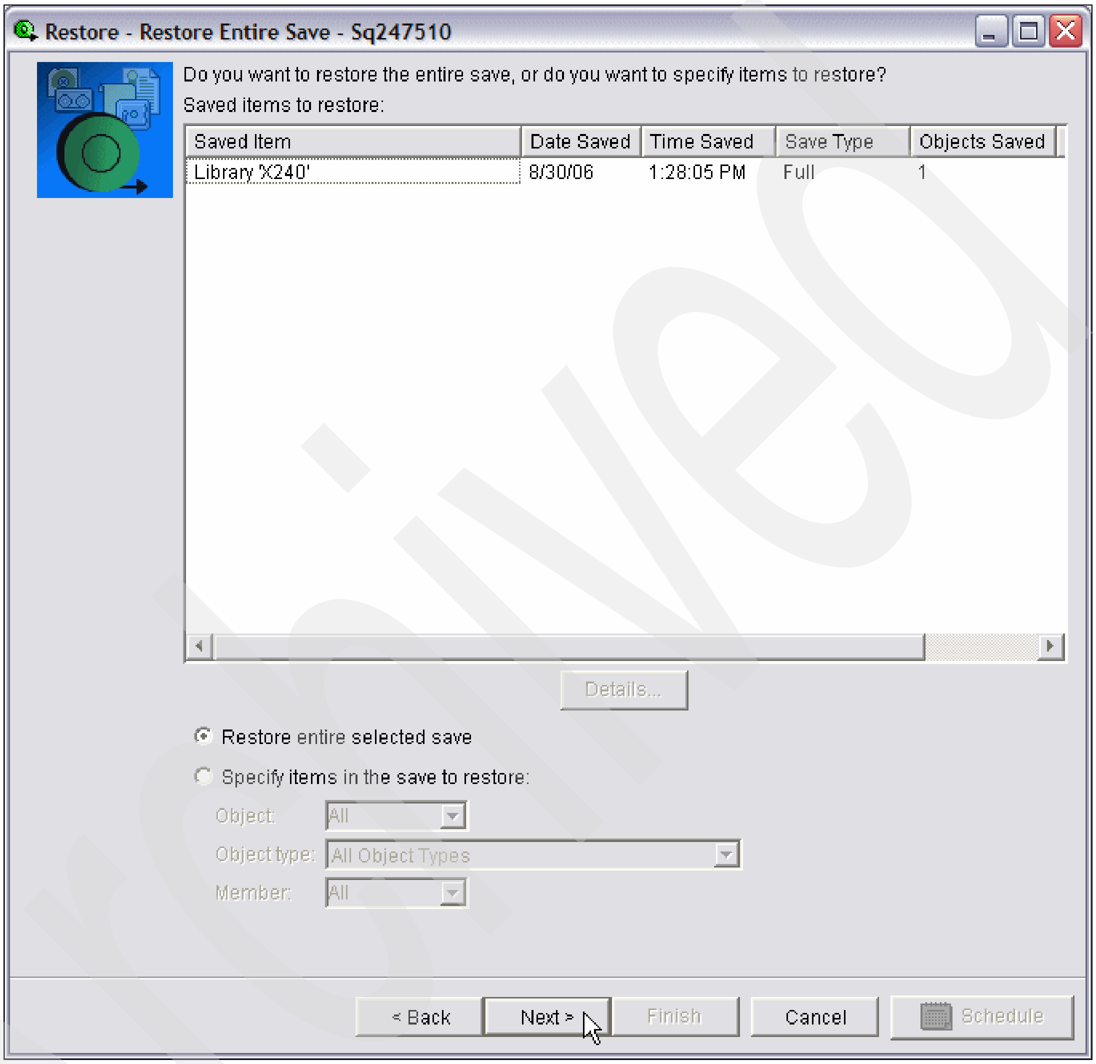



*Figure 6-100 Restore - Restore Entire Save*

7. The next wizard window (Figure 6-101) allows you to specify which auxiliary storage pool (ASP) you want to restore into. If you are not using user-defined storage pools, there is only one system storage pool (*system ASP* or *ASP1*) on the system. If you have additional ASPs defined, you can restore back into the same pool that the object was saved from or into a separate ASP.

   In our disk configuration, all disks are in the system ASP, therefore we ensure that **Yes, restore to the disk pool** is selected.

   Click **Next**.

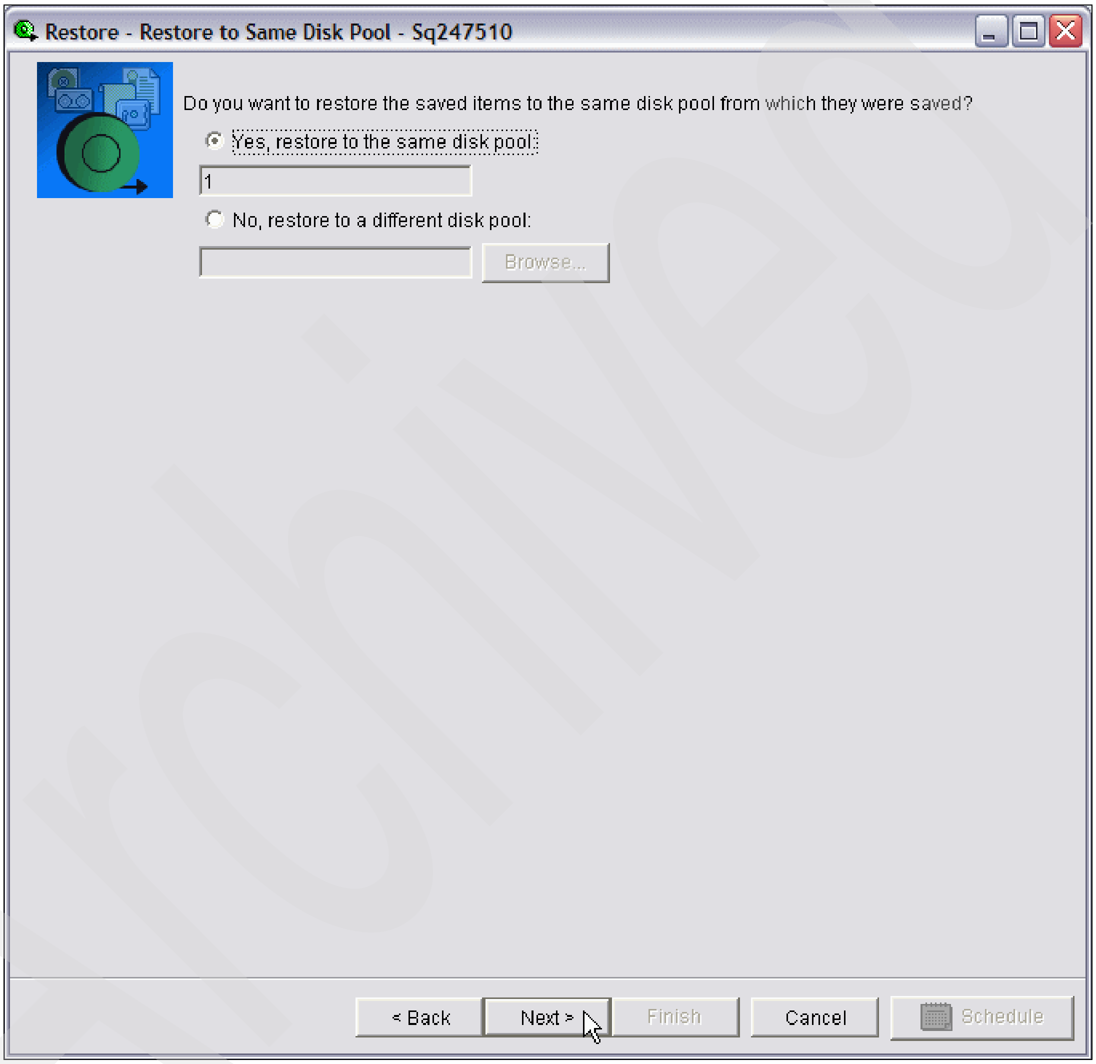



*Figure 6-101 Restore - Restore to Same Disk Pool*

8. The next window, Restore to Same Location (Figure 6-102), enables us to restore into the same library or object as the save or restore it to another location. For example, you can restore an object into a different library, restore a library as a different library, restore a stream file into a different directory, and so on. In our simple example, we specify to restore into the save location (restore library X240 on itself).

   Click **Next**.

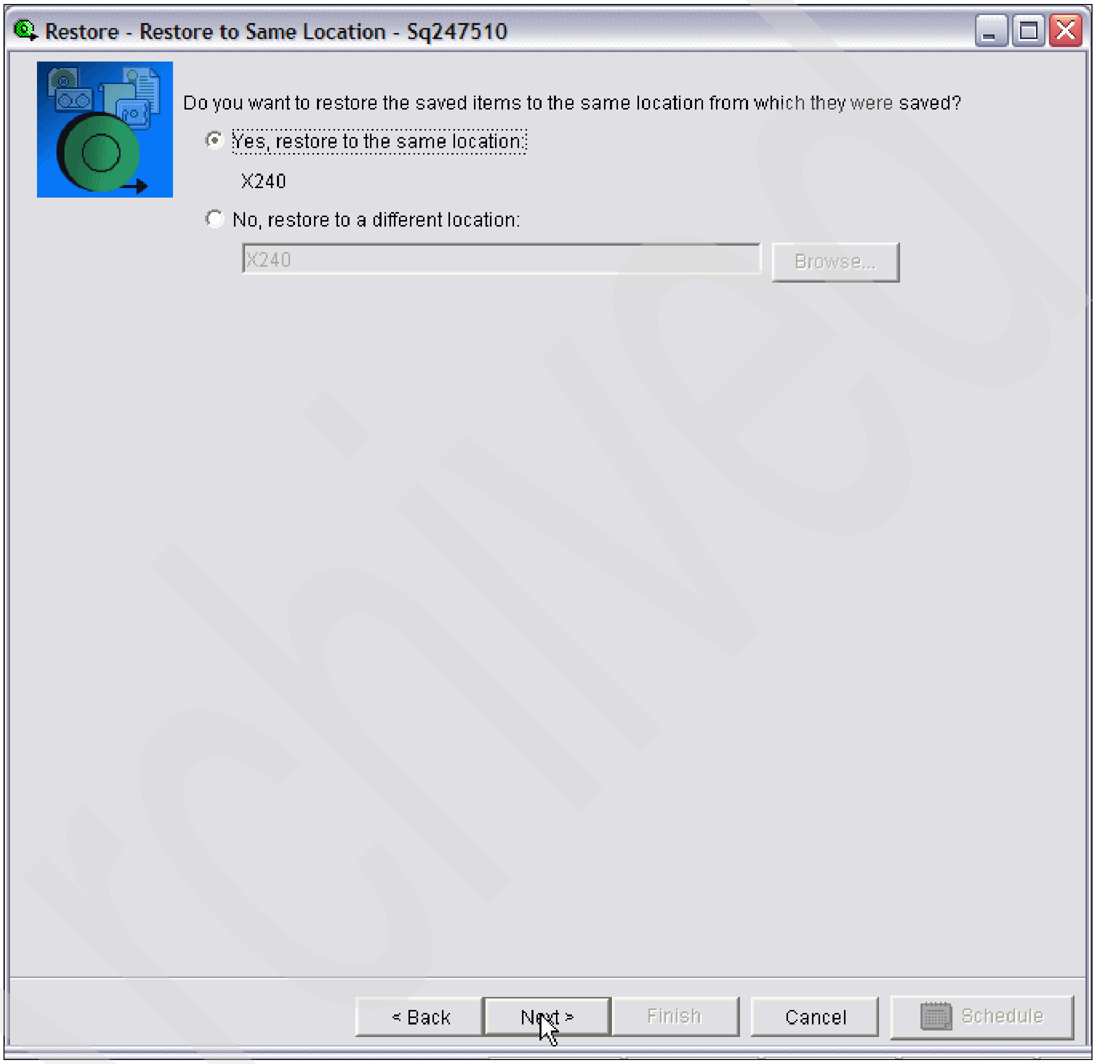



*Figure 6-102 Restore - Restore to Same Location*

9. This opens the Use Save History Device window (Figure 6-103). Review the choices available to you. You can select a tape device that contains your restore media. This can be a tape library or a tape device. Save history remembers that we saved to our virtual tape library, therefore we specify **Yes, automatically select a device**. The tape library can select which tape drive it can use.

   Click **Next**.

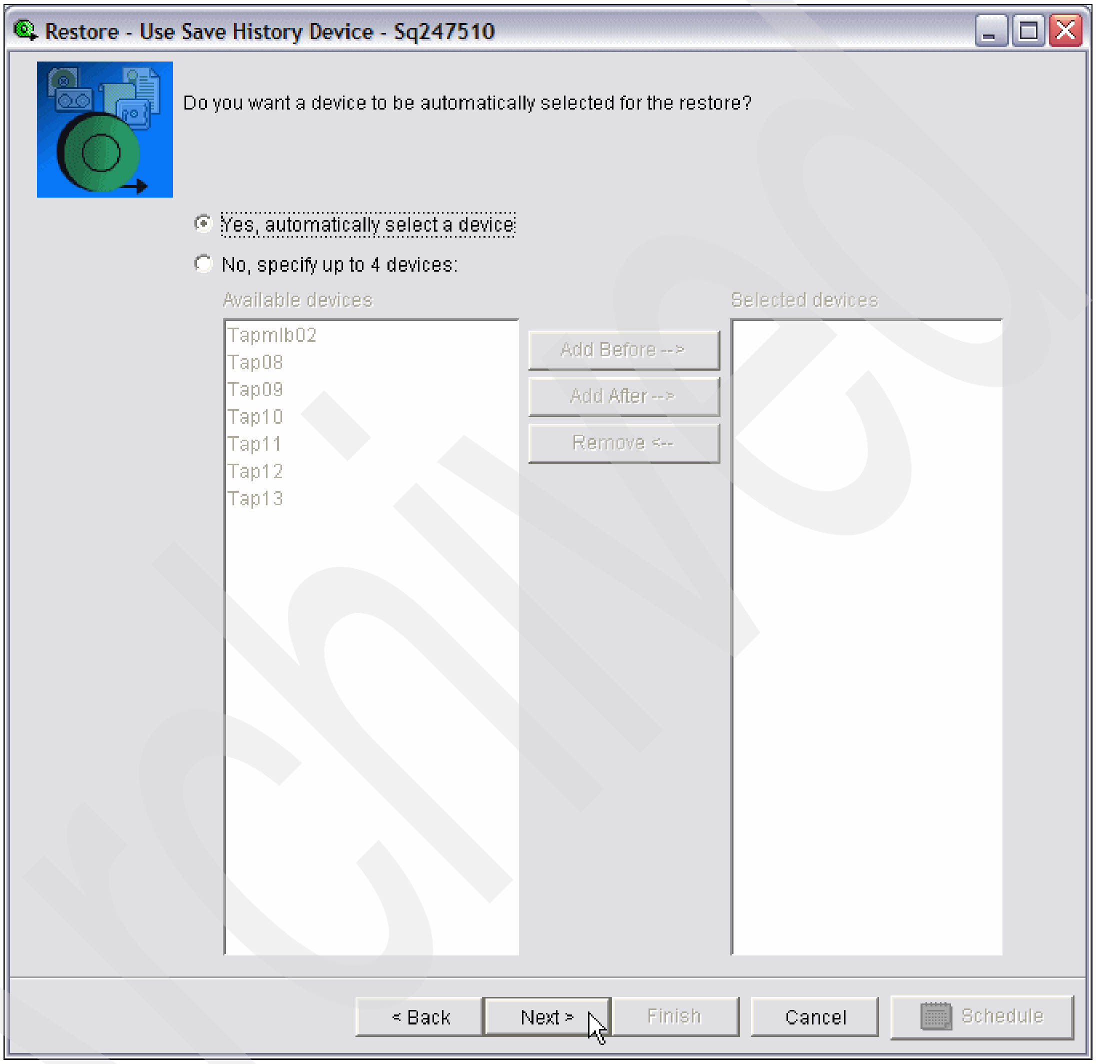



*Figure 6-103 Restore - Use Save History Device*

10. The volume containing our backup is presented in Figure 6-104.

If you do want to restore your backup to the same place as it was taken from, go to step 12 on page 221.

For our example, we explore altering restore options, click **Advanced Options**, as shown in Figure 6-104.

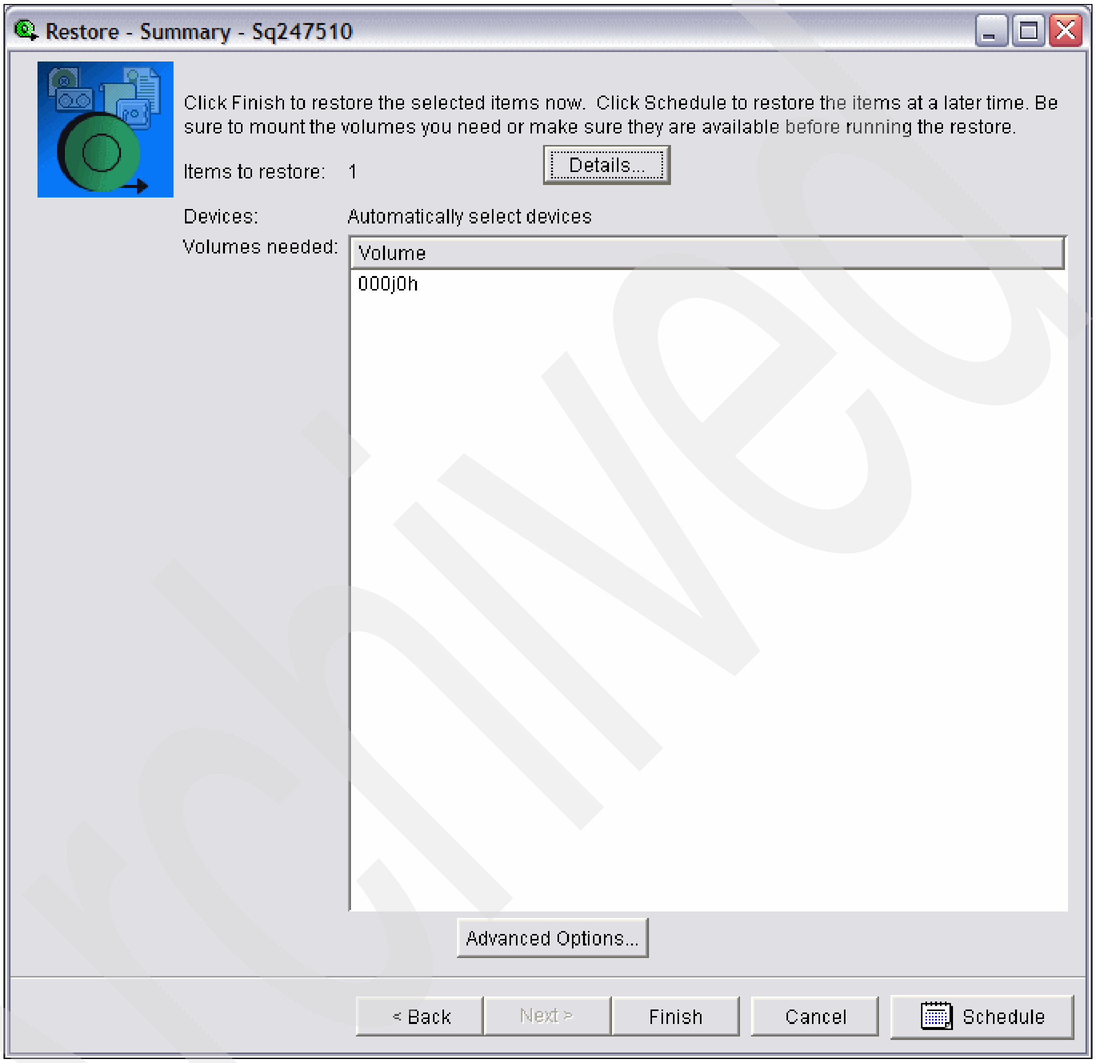



*Figure 6-104 Summary - Automatically selected device*

This is a virtual tape library, therefore there is no reason to specify what should happen with the cartridge after the restore is done. But if for some reason you later change the default option, Rewind, you find can this under the Advanced options window shown in Figure 6-105.

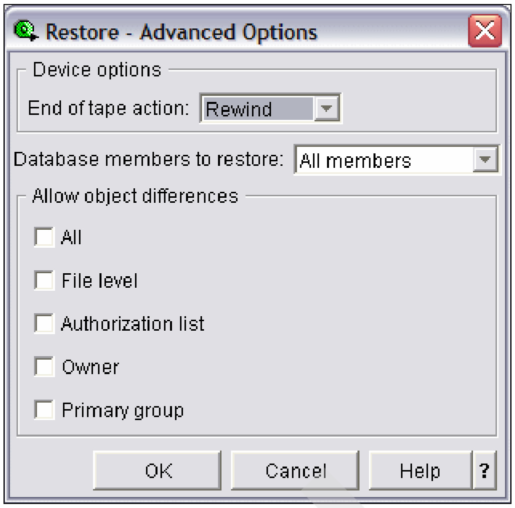



*Figure 6-105 Restore - Advanced Options*

11.The Advanced options window has other functions as well. Note the Allow object differences (for restore) options to select from. Use the online help functions to consider selecting these options. Click **OK** or **Cancel** to return to the Restore summary window (Figure 6-104 on page 220).

12.Back in the Restore summary window, click the **Details** button to get the Details window shown in Figure 6-106. In our simple example, you see the single saved library X240.

Click **Close** to return to the Summary window (Figure 6-104 on page 220). We are set to go.

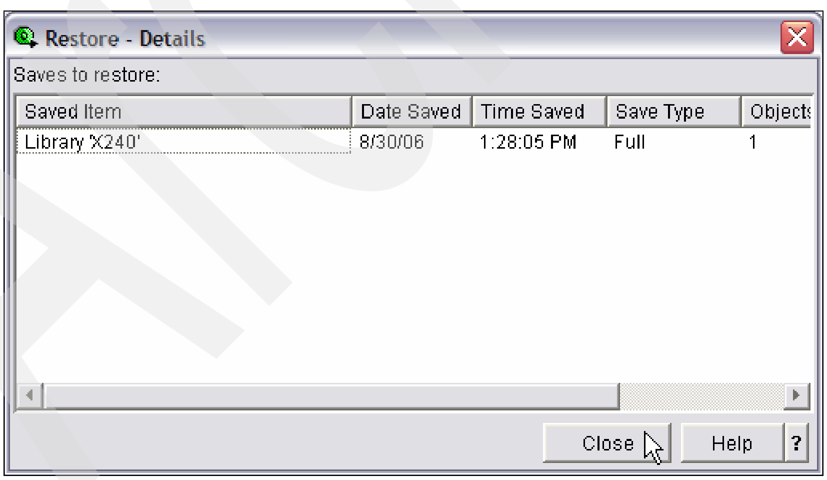



*Figure 6-106 Restore - Details*

13. In the Summary window (Figure 6-107), click **Finish** (or **Schedule** to run the restore later). In our simple example, we want to run the restore now.

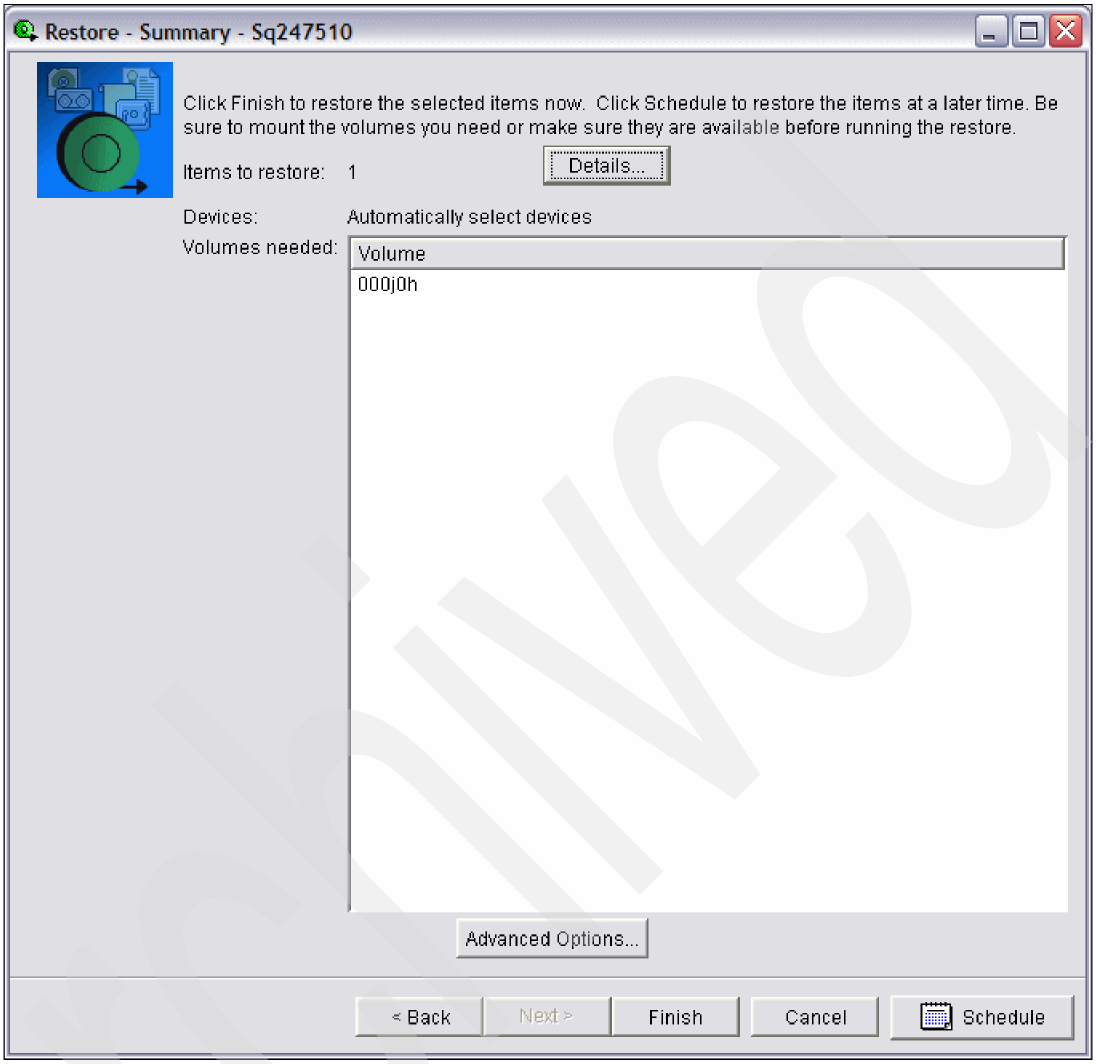



*Figure 6-107 Restore - Summary*

14. Clicking Finish opens the Save Output window, asking us if we want to save the results (job log) of the upcoming restore, as shown in Figure 6-108.

    We select **Yes** and click **OK**.

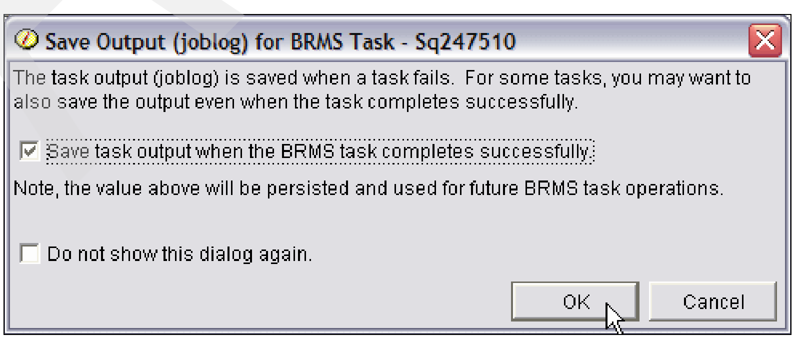



*Figure 6-108 Save joblog*

15. We get the restore job has been started window shown in Figure 6-109. Click **OK**.

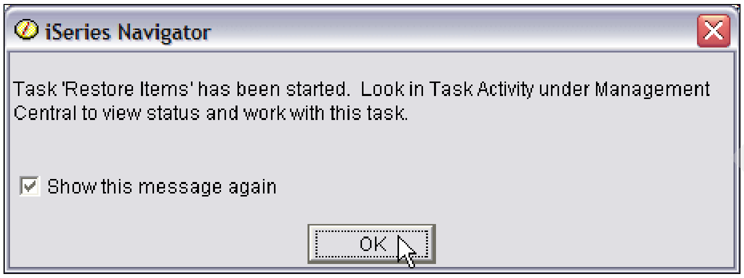



*Figure 6-109 Restore started window*

We have walked you through the example of using iSeries Navigator to restore using the TS7510. We have demonstrated that the TS7510 works just like any tape library.

## 6.8 Using i5/OS commands to restore an example library

We now describe the i5/OS commands to perform the same restore we just showed using iSeries Navigator.

1. From an i5/OS command screen, enter the Start Backup using BRMS (`STRBKUBRM`) command. We show only a few of the command screens in the following steps.
2. For the Option parameter use Help (F4) or directly type `*LIB`. Press Enter.
3. Type the Action parameter with `*RESTORE` and press Enter.
4. Type the Library parameter with the library name being restored.
5. There is nothing more to be entered. You do have options for “Use save files” and “Use TSM” (Tivoli Storage Manager). Note that the product that preceded TSM was called AdStar Data Storage Manager (ADSM). ADSM remains the term used in some help information and command parameters. In our scenario, we make these options ***NO**.

   Press Enter.

   The full command parameters that will be run, including default values is:

   `STRRCYBRM OPTION(*LIB) ACTION(*RESTORE) USESAVF(*NO) USEADSM(*NO) LIB(X240)`
6. Running the command opens the Select Recovery Items menu, as shown in Figure 6-110.

   Enter **1** (select) in the Opt column. Press Enter.

```
                            Select Recovery Items

                                    Select action  . . . . . : *ALL
                                    Select volume  . . . . . :
 Type options, press Enter.
   1=Select   4=Remove   5=Display   7=Specify object

    Saved         Save      Save    Save    Parallel Volume    File        Expire
Opt Item          Date      Time    Type    Devices  Serial    Sequence    Date
 1  X240        8/30/06 13:28:05 *FULL            000JOH         666    9/04/06
```

*Figure 6-110 Select Recovery Items*

This is followed by an information window, which displays what is being restored (Figure 6-111).

In our case, using a TS7510 and restoring a single object, the window shows for only a few seconds.

```
.............................................................................
:                         Display Recovery Items                  SG247510  :
:                                                                 09.14.52  :
:    Remaining items . . . . :            1                                 :
:    Remaining objects . . . :            1                                 :
:    Remaining size  . . . . :         ,0737 M   100,0 %                    :
:                                                                           :
: Saved                          Save  Volume                Exp    Objects :
: Item         Date      Time    Type  Serial   File Seq     Date    Saved  :
: X240         30-08-06 13:28:05 *FULL 000JOH       666      8-09-06     1  :
:                                                                           :
:  Press ATTN key to cancel recovery after current item completes.          :
:   Restoring library X240 from volume 000JOH sequence number 666.          :
:...........................................................................:
```

*Figure 6-111 Display Recovery Items*

When the restore has completed, you see a confirmation message:

`1 objects restored from X240 to X240.`

This concludes 6.2, "Example 1: A simple library backup setup" on page 131. This example included a lot, but not all of the capabilities of BRMS. In the next examples, we show BRMS interface to the two example configurations and backups defined in Chapter 3, "Planning for i5/OS and the TS7510" on page 35.

The following examples show only a few of the screens and windows that you would see using the real life step-by-step user interfaces.

## 6.9 Example 1 from planning for i5/OS and the TS7510

This is a setup of the example 1 outlined in 3.9.1, "Example 1: Four i5/OS partitions saving entire system in different time periods" on page 44.

In this example, we assume that the reader is familiar with BRMS capabilities and thus minimize figures and examples showing both the i5/OS command interface and the iSeries Navigator interface to BRMS. Almost all figures in this topics show you the i5/OS command interface. We also assume that you are also familiar enough with i5/OS backup terminology, therefore we do not spend time explaining every "save and restore term" that we used. However, we do provide here short summaries for:

- *SAVSECDTA: This represents the i5/OS command (non-BRMS) Save Security Data (SAVSECDTA), which saves all i5/OS security information without requiring a system in a restricted state. This save includes i5/OS security data of all users, their passwords, and their authorities.
- *SAVCFG: This represents the i5/OS command (non-BRMS) Save Configuration (SAVCFG), which saves all configuration and system resource management (SRM) objects without requiring the partition to be in a restricted state.

- *ALLUSR: This saves all user data.
- *ALLDLO: This saves all documents (document library objects (DLO)).
- *LINK: This saves all data in the internal file system.

We have four i5/OS partitions (which alternatively can have been different systems or combination of systems and partitions running i5/OS). Each partition saves a different amount of data on different days in the week. In this topic, we refer to each configuration as *System c* as listed below. All sizes listed are approximations based upon real system analysis of the amount of data to be saved each time. In real life, these sizes can fluctuate, depending on partition activity. You would then consider changing your original backup plan, especially if the sizes get significantly larger. The following is our example backup schedule:

- System A backs up 0.7 TB of data daily from Monday through Thursday, and on Sunday. On Monday through Thursday, backups are incremental. We have estimated the sizes (number of bytes) of each backup as 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 up 1.5 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.

To set this up is a relatively easy task. You create the same base definition and then only change which day to save what. What we save is this:

- *SAVSECDTA
- *SAVCFG
- *ALLUSR
- *ALLDLO
- *LINK

You do not even have to specify a specific BRMS control group to achieve that. There is one automatically created by BRMS at installation time, namely *BKUGRP.

However, in our example, we want to modify the IBM-provided control group a bit to meet our requirements. Therefore, we start by copying the IBM-provided *BKUGRP and name the copy P1SYSADAIL (Partition1, System A, daily backup) to give an indication of what the control group backs up.

1. In the i5/OS command environment, type `WRKCTLGBRM` end press Enter.
2. Use option **3** to copy the control group *BKUGRP (Figure 6-112).

```
                     Work with Backup Control Groups

Type options, press Enter
  1=Create    2=Edit entries    3=Copy      4=Delete   5=Display
  6=Add to schedule   8=Change attributes   9=Subsystems to process ...
              Full       Incr        Weekly
    Control   Media      Media       Activity
Opt Group     Policy     Policy      MTWTFSS  Text

3   *BKUGRP   *BKUPCY    *BKUPCY     *BKUPCY  Backs up all user data
    *SYSGRP   SAVSYS     SAVSYS      *BKUPCY  Backs up all system data
    *SYSTEM   SYSTEM     SYSTEM      *BKUPCY  Backs up the entire system
```

*Figure 6-112   Work with Backup Control Groups - Copy*

3. Give it the name `P1SYSADAIL`, as shown in Figure 6-113.

```
                    Copy Backup Control Group

 To copy control group, type New Name, press enter.

 Control                     Remote       Remote
 Group          New Name     Location     Network ID
 *BKUGRP        P1SYSADAIL   *LCL
```

*Figure 6-113   Copy Backup Control Group*

4. All the attributes connected to *BKUGRP are copied and we have to alter them.

   Use option **8** as shown in Figure 6-114 in front of our new control group and press Enter.

```
                     Work with Backup Control Groups

Type options, press Enter
  1=Create    2=Edit entries    3=Copy      4=Delete   5=Display
  6=Add to schedule   8=Change attributes   9=Subsystems to process ...
              Full       Incr        Weekly
    Control   Media      Media       Activity
Opt Group     Policy     Policy      MTWTFSS  Text

    *BKUGRP   *BKUPCY    *BKUPCY     *BKUPCY  Backs up all user data
    *SYSGRP   SAVSYS     SAVSYS      *BKUPCY  Backs up all system data
    *SYSTEM   SYSTEM     SYSTEM      *BKUPCY  Backs up the entire system
8   P1SYSADAIL *BKUPCY   *BKUPCY     IIII  F  System A partition 1 daily bac
```

*Figure 6-114   Work with Backup Control Groups - Change Attributes*

5. This opens the attributes for this control group (Figure 6-115 on page 228). We do not make any drastic changes to the standard setup, but we do make the following changes to the IBM-supplied parameter values:
   – Set the “Sign off interactive users” from what is stated in the backup policy to `*YES`.
   – Set the “Sign off limit” from what is stated in the backup policy to `10` minutes.
   – Set the “Default weekly” activity from what is stated in the backup policy to incremental Monday to Thursday (and full backups to Sunday). This is indicated by `IIII F`.
   – Set “Incremental type” to our value of `*INCR` (day by day saves).
   – Set “Force full backup days” to `10` days.
   – Set “Append to media” to `*YES`.
   – Set the “End of tape option” to do nothing (`*LEAVE`).
   – Set “Save journaled objects” to `*YES`.

> **Tip:** A backup tip is to consider setting the save journaled objects when saving changed objects in the backup policy to *YES. This way you can have this option already defaulted if you copy this backup policy as a base for another backup policy. By default, you now have this option enabled in these new backup policies.

6. After you have made the above changes, review all the parameter values. We highlight the changes we made by using bold font in Figure 6-115 on page 228. When you are sure that you have what you want, use F3 to save the changes.

> **Important:** The values specified in a control group overrides any other BRMS settings. Avoid entering too many general settings in a control group. It is better to specify everything that is in common in the system and backup policy, because a change at that level will affect all control groups pointing to them. We suggest reviewing the IBM-supplied System and Backup policy parameter values before making changes in the control group. Use the command WRKPCYBRM *SYS and *BKU respectively to see the values.

```
       Change Backup Control Group Attributes for Group P1SYSADAIL

Media policy for:
  Full backups . . . . . . . . . . . . . . *BKUPCY
  Incremental backups  . . . . . . . . . . *BKUPCY
Backup devices . . . . . . . . . . . . . . *BKUPCY
Parallel device resources:
  Minimum resources  . . . . . . . . . . . *NONE
  Maximum resources  . . . . . . . . . . .
Sign off interactive users . . . . . . . . *YES
Sign off limit . . . . . . . . . . . . . . 10
Default weekly activity  . . . . . . . . . IIII  F
Incremental type . . . . . . . . . . . . . *INCR
Force full backup days . . . . . . . . . . 10
Automatically backup
    media information  . . . . . . . . . . *BKUPCY
Save access paths  . . . . . . . . . . . . *BKUPCY
Save contents of save files  . . . . . . . *BKUPCY
Save spooled file data . . . . . . . . . . *BKUPCY
Data compression . . . . . . . . . . . . . *BKUPCY
Data compaction  . . . . . . . . . . . . . *BKUPCY
Target release . . . . . . . . . . . . . . *BKUPCY
Clear  . . . . . . . . . . . . . . . . . . *BKUPCY
Object pre-check . . . . . . . . . . . . . *BKUPCY
Append to media  . . . . . . . . . . . . . *YES
End of tape option . . . . . . . . . . . . *LEAVE
Journaled objects  . . . . . . . . . . . . *YES
Use optimum block size . . . . . . . . . . *BKUPCY
IPL after backup . . . . . . . . . . . . . *BKUPCY
   How to end  . . . . . . . . . . . . . . *BKUPCY
   Delay time, if *CNTRLD  . . . . . . . . *BKUPCY
   Restart after power down  . . . . . . . *BKUPCY
   IPL source  . . . . . . . . . . . . . . *BKUPCY
   IPL restart type  . . . . . . . . . . . *BKUPCY
Save active wait time:
   Object locks  . . . . . . . . . . . . . 120
   Pending record changes  . . . . . . . . 120
   Other pending changes . . . . . . . . . 120
Backup item exit program . . . . . . . . . *BKUPCY
   Exit program library  . . . . . . . . .
   Exit program format . . . . . . . . . .
Missed object policy . . . . . . . . . . . *BKUPCY
  Clear missed objects . . . . . . . . . . *NO
Allow activity overrides . . . . . . . . . *YES
Allow retention overrides  . . . . . . . . *YES
Additional management:
  TCP/IP servers . . . . . . . . . . . . . *NO
  Lotus servers  . . . . . . . . . . . . . *NO
  Integrated Windows servers . . . . . . . *NO
  Guest partitions . . . . . . . . . . . . *NO
Unmount user-defined file systems  . . . . *NO
Run maintenance after backup . . . . . . . *NO
```

*Figure 6-115 Change Backup Control Group Attributes*

We have now specified that interactive users must be signed off before the backup starts, but we probably have to also stop other activity within the partition. We do that by taking the subsystems down. We also specify that they should be restarted when the backup has finished or if it fails for some reason.

**Important:** Before ending all subsystems except QCTL, check with your application provider to ensure that you take into account any special considerations for the applications currently in process. Some applications require specific tasks to completed before they are ended.

7. Use option **9** (Subsystems to process ...) in front of our new control group shown in Figure 6-114 on page 226 and press Enter.
8. Enter appropriate values for your environment. Our example is shown in Figure 6-116.

```
                        Subsystems to Process

Use . . . . . . . . . :   *BKU
Control group . . . . :   P1SYSADAIL

                                            End
  Seq    Subsystem     Library       Option     Delay       Restart
   10    *ALL          *ALL          *CNTRLD    10          *YES
```

*Figure 6-116 Work with Backup Control Groups - Subsystems to Process*

9. If there is a need to hold job queues, you can do so by entering option **10** and specifying the job queue and associated action. In our example, we did not specify any job queue actions, as shown in Figure 6-117.

```
                       Job Queues to Process

Use . . . . . . . . . :   *BKU
Control group . . . . :   P1SYSADAIL

Type choices, press Enter.

  Seq    Job queue     Library        Hold       Release
  ---    ----------    ---------      ------     -------
```

*Figure 6-117 Work with Backup Control Groups - Job Queues to Process*

10. Finally, we alter the control group itself.

    Use option **2** (Edit entries) in front of our new control group (Figure 6-114 on page 226) and press Enter.

11. You get a screen that looks similar to the one shown in Figure 6-118 on page 230. The changes we make are:

    a. In the text field, enter: `System A partition 1 daily backup`.

    b. Change the column "Retain Object Detail" for every backup item to `*YES`.

    For all backup items, we would like to have detail information that makes restore on object level much easier. By specifying details, BRMS will present to you a list of objects to restore. If you do not specify this, then you have to give BRMS the names of all the objects.

**Tip:** You have to review and judge for yourself the benefits of detail information. Detail information, in general, makes recovery of an object easier, but it also increases backup time. As the number of objects backed up increases, the BRMS inventory files can potentially grow excessively large.

Do not keep detail information longer than necessary. You are still able to recover your data, but BRMS cannot present a list of objects to pick from. If your intention is restoring complete libraries only, you do not need any detail information.

```
                     Edit Backup Control Group Entries

Group . . . . . . . . . . : P1SYSADAIL
Default activity  . . . . : IIII  F
Text  . . . . . . . . . . : System A partition 1 daily backup


                        Auxiliary   Weekly    Retain  Save      SWA
      Backup      List  Storage     Activity  Object  While     Message
Seq   Items       Type  Pool Device MTWTFSS   Detail  Active    Queue
  10  *EXIT                         *DFTACT
  20  *SAVSECDTA                    *DFTACT   *YES
  30  *SAVCFG                       *DFTACT   *YES
  40  *ALLUSR           *SYSBAS     *DFTACT   *YES    *NO
  50  *ALLDLO                       *DFTACT   *YES    *NO
  60  *LINK             *ALLAVL     *DFTACT   *YES    *NO
  70  *EXIT                         *DFTACT
```

*Figure 6-118 Edit Backup Control Group Entries*

We have now created a backup control group template that can be copied and modified to create backup control groups for the other partitions. We only have to give them appropriate names and a descriptive text, plus change the backup scheme. That is, we change which days should have full backup, which days should have an incremental or changed objects backup run, and on which days no backups are to be performed.

We can also consider additionally using an *EXIT to specify that we want to do an initial program load (IPL) on one of the days. However, be careful that you do not start an IPL (restart) before all the backup tasks have completed.

## 6.9.1 Scheduling the TS7510 example 1 backup

The last task we show in this example is scheduling the backup job.

1. Use option **6** (Add to schedule) in front of our backup control group (Work with Backup Control Groups screen, Figure 6-114 on page 226).

   How you schedule jobs differs with the job scheduler product that you use. Therefore, the next screen you see is different, depending on that job scheduler.

   In this book, we use the standard job scheduler built into i5/OS. There are other IBM and non-IBM job schedule applications available for i5/OS. The one supplied by IBM is the Advanced Job Scheduler for iSeries, 5722-JS1.You can run 5722-JS1 using either its i5/OS commands or as a plug-in to iSeries Navigator.

In Figure 6-119, we show the i5/OS job scheduler Add Job Schedule Entry screen after prompting with F4.

2. It is very important to give a meaningful name and description to your scheduled backup job. This makes it easier to identify this backup job from all other jobs running or completed on the system.

> **Attention:** Our backup policy ends all subsystems, except the controlling subsystem, before the backup. Therefore, when the backup runs the only active subsystem is the IBM-provided QCTL. This subsystem has job queue QCTL.
>
> Always ensure that any job queue you select in the function that corresponds to the Add Job Scheduler Entry command is not affected by having its associated subsystem ended. In our example shown in Figure 6-119, we used job queue QCTL.

```
                          Add Job Schedule Entry (ADDJOBSCDE)

 Job name . . . . . . . . . . . . .   P1SYSADAIL
 Command to run . . . . . . . . . .   STRBKUBRM CTLGRP(P1SYSADAIL) SBMJOB(*NO)
 Frequency  . . . . . . . . . . . .   *WEEKLY
 Schedule date  . . . . . . . . . .   *NONE
 Schedule day . . . . . . . . . . .   *ALL
 Schedule time  . . . . . . . . . .   '00:01'
 Omit date  . . . . . . . . . . . .   *NONE
 Recovery action  . . . . . . . . .   *SBMRLS
 Job description  . . . . . . . . .   *USRPRF
 Job queue  . . . . . . . . . . . .   QCTL
 User . . . . . . . . . . . . . . .   *CURRENT
 Message queue  . . . . . . . . . .   *USRPRF
 Text 'description' . . . . . . . > 'System A partition 1 daily backup'
```

*Figure 6-119 Add Job Schedule Entry*

Adjust the frequency and other schedule information that fits your time requirements. In our example, we schedule the job to run 1 minute after midnight.

By using BRMS, our scheduled job runs the BRMS command Start Backup using BRMS (STRBKUBRM).

3. Sign on to each of the other partitions (systems) and create its backup control group repeating all the steps we have shown you, with any adjustments as per the description in 3.9.1, “Example 1: Four i5/OS partitions saving entire system in different time periods” on page 44. Use a similar scheduled job name syntax and descriptions to the one we showed in this partition A example:

   a. P2SYSBDAIL Text: System B partition 2 daily backup

   b. P3SYSCDAIL Text: System C partition 3 daily backup

   c. P4SYSDDAIL Text: System D partition 4 daily backup

   This concludes setting up the backup example 1.

# 6.10 Example 2 from planning for i5/OS and the TS7510

This is a setup of example 2, which we outlined in 3.9.2, “Example 2: Two i5/OS partitions saving user data, replicating saved data to remote site once a week” on page 45.

As we did in 6.9, “Example 1 from planning for i5/OS and the TS7510” on page 224, we assume that you are familiar with BRMS capabilities and thus minimize figures and examples showing almost all figures in this topics using the i5/OS BRMS command interface. We also assume that you are familiar enough with i5/OS backup terminology, therefore we do not spend time explaining the various save and restore terminology used. See 6.9, “Example 1 from planning for i5/OS and the TS7510” on page 224 for short descriptions of *SAVSECDTA and *SAVCFG.

In this example, we include backing up Domino server objects in two partitions (or systems) running Domino under i5/OS. We can do full backups all the time or a full backup periodically with incremental backups in between full backups. Because discussing all the considerations for backing up Domino on i5/OS is beyond the scope of this book, we refer you to the following for a good general overview of backing up Domino under i5/OS:

- Technical support Web site:

  `http://www.ibm.com/servers/eserver/iseries/service/brms/domino.html`

- IBM Redbook *Implementing Domino 7 for i5/OS*, SG24-7311.

Although we show some specific examples of doing incremental backups of Domino, we encourage you to review the documentation in the resources listed above. Do this to evaluate whether the default actions that BRMS takes for backing up Domino are sufficient. Full Domino backups are sufficient for many customer installations. If this is the case, the examples we show in this section may not be necessary.

In this example, for one partition, we back up a Domino server. Fortunately, this is as easy as example 1 from 3.9.1, “Example 1: Four i5/OS partitions saving entire system in different time periods” on page 44. With the integration typical under IBM System i models and i5/OS and products such as BRMS, BRMS automatically creates a control group for each Domino server in the partition. They are named QLTSDOMnn. Internally each control group is created using the BRMS command:

```
QNOTES/SAVDOMBRM SERVER('DOMINO00') CTLGRP(QLTSDOM00)
```

You can run this control group alone or incorporate the SAVDOMBRM command into your own control group. If you use another control group, ensure that the CTLGRP parameter contains the name of the control group that it is running in.

To set up such a runable control group, perform the exact same steps as in 6.9, “Example 1 from planning for i5/OS and the TS7510” on page 224.

Assuming we save Domino in the ordinary daily backup, we require some modifications.

We run backup “changes” only on all days except Sunday, which does a full backup. In our example, we are using incremental backups of Domino while it is active. If you want to do this, you must ensure that Domino transaction logging is active.

BRMS supports the online backup of Domino servers while they are active. This online backup implies that the Domino server databases on i5/OS can be saved while they are in use and thus requires no i5/OS save while active synchronization points. This is considered a true online backup of Domino. The standard i5/OS save command interface functions do not support the ability to save Domino servers while they are running.

BRMS does, however, have this capability for full online backups of a Domino server. This backup includes Domino database files and changes files. The changes files contain all updates to a database while it is being backed up. These two objects are bound together during the backup in order to provide for restoration of databases in the event of a recovery. Incremental online backups build on this by also including saves of the Domino transaction logs.

BRMS uses a concept called a *package* to bind the backup of the databases to the changes files and associated transaction logs. Online backups of Domino servers are stored in the BRMS history information as packages.

The Domino data is stored in the Integrated File System (IFS). We do not want to back up that data twice, therefore we have to exclude it from the IFS (*LINK) portion of the backup. We do that by replacing the *LINK statement with a link list.

> **Note:** We use an explicit link list to omit saving the Domino files within the i5/OS IFS. By default, BRMS provides some considerations for omitting Domino files. If you are new to backing up Domino, consider using this default support first. We recommend first reviewing the information at:
>
> http://www.ibm.com/servers/eserver/iseries/service/brms/domino.html
>
> If the default processing is not sufficient for your environment, consider using the link list that we show in our example.

1. Type the Work with BRMS Lists (`WRKLBM`) command on a 5250 session. Press Enter. This command shows a list for backups (*BKU) and archive (*ARC). Lists are groups of objects. The Work with Lists display allows you to add, change, or remove a list or lists. Lists can be one of the following types:
   - Folder (*FLR)
   - Object (*OBJ)
   - Spooled file (*SPL)
   - File system (*LNK)
2. Use option **1** (Add) to create a new link list named `OMITDOMINO` with *`BKU` for Use and `*LNK` for Type. Press Enter.

```
                       Work with Lists

1=Add   2=Change   3=Copy   4=Remove   5=Display   6=Print

Opt  List Name   Use   Type  Text
 1    OMITDOMINO  *BKU  *LNK
```

*Figure 6-120 Work with Lists - Create list OMITDOMINO*

3. In the Add Link List screen (Figure 6-121), give the new link list a meaningful description and press Enter.

```
                       Add Link List

Use . . . . . . . . . . :  *BKU

List name . . . . . . .  OMITDOMINO
Text  . . . . . . . . .  Omit Domino data from IFS backup
```

*Figure 6-121   Add Link List - Add text*

You receive the message: `List OMITDOMINO of type *LNK is added`. We now have to define what this new list will include and what will be excluded.

4. In the Work with Lists screen, enter option **2** (Change) to add items to our link list.
5. For the Objects parameter (in Figure 6-122):
   a. Enter **`'/*'`** for the Name field.
   b. Enter `*INCLUDE` into the Include or omit field.
   c. Enter a *plus* sign into the for more values field.
6. These object parameter values specify to save all i5/OS IFS files (/*). Press Enter. This opens the Specify More Values for the Parameter Omit screen as shown in Figure 6-123.

```
                Change Link List (CHGLNKLBRM)

List . . . . . . . . . . . . . . > OMITDOMINO    Character value
Usage type . . . . . . . . . . . > *BKU          *BKU, *ARC
Objects:
  Name . . . . . . . . . . . . .   '/*'

  Include or omit  . . . . . . .   *INCLUDE      *INCLUDE, *OMIT
               + for more values +
Directory subtree  . . . . . . .   *ALL          *ALL, *DIR, *NONE, *OBJ
Text . . . . . . . . . . . . . . > 'Omit Domino data from IFS backup'
```

*Figure 6-122   Change Link List - include /**

7. You see the first include for all i5/OS IFS files (Figure 6-123). Now we specify our Domino server (domino00) with the `*omit` option and `/domino00/*`, which means to exclude the Domino server IFS files from the “save all” (/*) preceding parameter value.

```
              Specify More Values for Parameter OBJ

 Objects:
   Name . . . . . . . . . . . . . . > '/*'

   Include or omit  . . . . . . .   *INCLUDE

   Name . . . . . . . . . . . . . . > '/domino00/*'

   Include or omit  . . . . . . .   *omit
```

*Figure 6-123 Change Link list - Specify more values for parameter OBJ*

8. Press Enter until you are back at the Work with List menu (Figure 6-120 on page 233).

   We now have a link list that saves everything except Domino catalogs. We next have to adjust our backup control group.

9. From an i5/OS workstations, enter `WRKCTLGBRM`, and press Enter.

   The Work with Control Groups using BRMS (WRKCTLGBRM) command allows you to produce a display or report of backup, archive, and migration control groups. If you display control group information, you are taken to the selected Work with Control Groups display where you can create, delete, change, or display control groups. If you report control group information, the selected control group report is produced.

10. Use option **2** as we are adding the Domino backup and the Link list into our control group.

11. In the first line under the Seq heading, you can add a new item entry and specify via sequence number where to insert the new backup item. As shown in Figure 6-124, enter `*EXIT` before or after the sequence number for *LINK. Press Enter.

```
                     Edit Backup Control Group Entries

Group . . . . . . . . . . : P2EXAMPLE2
Default activity  . . . . . IIIIIIF
Text  . . . . . . . . . . . System E partition 1 daily backup incl. Domino


                        Auxiliary   Weekly    Retain  Save      SWA
      Backup      List  Storage     Activity  Object  While     Message
Seq   Items       Type  Pool Device MTWTFSS   Detail  Active    Queue
  65  *EXIT
  10  *EXIT                         *DFTACT
  20  *SAVSECDTA                    *DFTACT   *YES
  30  *SAVCFG                       *DFTACT   *YES
  40  *ALLUSR           *SYSBAS     *DFTACT   *YES    *NO
  50  *ALLDLO                       *DFTACT   *YES    *NO
  60  *LINK             *ALLAVL     *DFTACT   *YES    *NO
  70  *EXIT                         *DFTACT
```

*Figure 6-124 Edit Backup Control Group Entries - Add an *EXIT line*

When the screen returns, the sequence area is renumbered, and our new entry is shown as sequence 70 and the previous *EXIT entry is now sequence 80 (Figure 6-126).

12. Place the mouse cursor on our added *EXIT line and press F10.
13. This opens the User Exit Maintenance screen shown in Figure 6-125. Add the command Save Domino with BRMS command:

    `SAVDOMBRM SERVER('DOMINO00') CTLGRP(P2EXAMPLE2)`

    > **Important:** The CTLGRP parameter must exactly match the control group name that you previously specified.

    Press Enter.

```
                 User Exit Maintenance

   Sequence number . . . . . . . :    70
   Where used  . . . . . . . . . :  *EXIT
   Weekly activity . . . . . . . :  *DFTACT  MTWTFSS
   Command . . . . . . . . . . . .  SAVDOMBRM SERVER('DOMINO00')
CTLGRP(P2EXAMPLE2)
```

*Figure 6-125 Control Group User Exit Maintenance*

14. We have now specified the backup to not only save the complete IFS plus Domino data (which also resides in the IFS). To exclude saving duplicates, we also have to insert our exclude list. We achieve that by combining the Domino backup and the Domino exclude list that will be used instead of the full *LINK save, with one exception, Sundays.
15. Add a new entry as shown in Figure 6-126, after *LINK specifying the link list name (`omitdomino`) that we specified earlier as another list type `*LNK`.

```
                     Edit Backup Control Group Entries

Group . . . . . . . . . . : P2EXAMPLE2
Default activity  . . . . . IIIIIIF
Text  . . . . . . . . . . . System E partition 1 daily backup incl. Domino

Type information, press Enter.

                          Auxiliary    Weekly    Retain  Save      SWA
      Backup      List    Storage      Activity  Object  While     Message
Seq   Items       Type    Pool Device  MTWTFSS   Detail  Active    Queue
  65  omitdomino  *LNK
  10  *EXIT                            *DFTACT
  20  *SAVSECDTA                       *DFTACT   *YES
  30  *SAVCFG                          *DFTACT   *YES
  40  *ALLUSR             *SYSBAS      *DFTACT   *YES    *NO
  50  *ALLDLO                          *DFTACT   *YES    *NO
  60  *LINK               *ALLAVL      *DFTACT   *YES    *NO
  70  *EXIT                            *DFTACT
  80  *EXIT                            *DFTACT
```

*Figure 6-126 Edit Backup Control Group Entries - Add omit list*

We now have three items targeting the IFS that control what is saved and what is not saved. While just an example, it does include some real world backup examples taking into consideration *saving almost everything* while treating Domino data to be backed up as requiring some special handling. This includes excluding the Domino files in the standard IFS backup, but using the Save Domino data using BRMS command function for special handling of Domino backup data.

The options we have shown so far include:

– *LINK that saves everything.
– *EXIT with the command SAVDOMBRM that saves Domino data.
– omitdomino to omit the saving of Domino data as part of the saving of “all” IFS data.

16. Our completed edited control group entries so far are shown in Figure 6-127.

We now change which day to run the Domino-related backup entries in the list:

– A full backup on Sunday
– Incremental all other days

Specify the changes as shown for sequence numbers, 60, 70, and 80:

– 60: Full save on Sunday
– 70: Incremental save Monday through Saturday for the IFS except for the files associated with Domino server domino00
– 80: Run the exit program (command) SAVDOMBRM.

```
                      Edit Backup Control Group Entries

Group . . . . . . . . . . : P2EXAMPLE2
Default activity  . . . . . IIIIIIF
Text  . . . . . . . . . . . System E partition 1 daily backup incl. Domino

                             Auxiliary   Weekly    Retain  Save      SWA
      Backup      List  Storage     Activity  Object  While     Message
Seq   Items       Type  Pool Device MTWTFSS   Detail  Active    Queue

  10  *EXIT                         *DFTACT
  20  *SAVSECDTA                    *DFTACT   *YES
  30  *SAVCFG                       *DFTACT   *YES
  40  *ALLUSR           *SYSBAS     *DFTACT   *YES    *NO
  50  *ALLDLO                       *DFTACT   *YES    *NO
  60  *LINK             *ALLAVL           F   *YES    *NO
  70  OMITDOMINO  *LNK  *ALLAVL     IIIIII    *NO     *NO
  80  *EXIT                         IIIIII SAVDOMBRM SERVER('DOMINO00') CTLG..
```

*Figure 6-127 Edit Backup Control Group Entries - Change weekly activity*

17. We have another Domino backup consideration. We cannot reasonably save Domino data with Domino active. Therefore, we must insert two extra statements. One that shuts down our Domino server before the backup and the second, which restarts the server after the backup completes.

We can place the end and the start Domino *EXIT list entries on either side of our current the SAVDOMBRM *EXIT. In fact, we show you those list entries in Figure 6-128.

Add two more *EXITs:

– One containing `ENDDOMSVR SERVER(DOMINO00) OPTION(*CNTRLD)`
– The other `STRDOMSVR SERVER(DOMINO00)`

```
                    Edit Backup Control Group Entries

Group . . . . . . . . . . : P2EXAMPLE2
Default activity  . . . . . IIIIIIF
Text  . . . . . . . . . . . System E partition 1 daily backup incl. Domino

                         Auxiliary   Weekly    Retain  Save      SWA
      Backup      List   Storage     Activity  Object  While     Message
Seq   Items       Type   Pool Device MTWTFSS   Detail  Active    Queue

  10  *EXIT                          *DFTACT
  20  *SAVSECDTA                     *DFTACT   *YES
  30  *SAVCFG                        *DFTACT   *YES
  40  *ALLUSR            *SYSBAS     *DFTACT   *YES    *NO
  50  *EXIT                                F ENDDOMSVR SERVER('DOMINO00')
                                                       OPTION(*CNTRLD)
  60  *ALLDLO                        *DFTACT   *YES    *NO
  70  *LINK              *ALLAVL           F   *YES    *NO
  80  *EXIT                                F STRDOMSVR SERVER('DOMINO00')
  90  OMITDOMINO  *LNK   *ALLAVL     IIIIII    *NO     *NO
 100  *EXIT                          IIIIII SAVDOMBRM SERVER('DOMINO00')
                                                      CTLGRP(P2EXAMPLE2)
 110  *EXIT
```

*Figure 6-128   Edit Backup Control Group Entries - ending and starting Domino*

Looking at Figure 6-128, you can see where we inserted the ENDDOMSVR and STRDOMSVR exits. This brings us to one last Domino server shutdown consideration.

We have to ensure that the Domino server has completely shut down before that part of the backup starts. We inserted the ENDDOMSVR command exit (sequence 50 in our example) before the SAVDLO step (sequence 60 in our example). This helps ensure that the Domino server gets time to completely shut down while the backup of the Document library objects and files is being performed.

Depending on your Domino activity when the backup is run or scheduled to be run, you might have to add another *EXIT list entry to make sure that all Domino servers have shut down.

If your backups within a Domino environment have all active Domino shutdowns completed in time, you need not add this *EXIT list entry. However, in case it becomes necessary we offer the following:

Insert an extra *EXIT in the list which uses the i5/OS Delay Job (DLYJOB) command with an appropriate delay wait time for the backup to continue. We do not show this additional entry in our example.

18. When all the backup list entries are satisfactory for your environment, press F3, select exit option **1** for save and exit.

## 6.10.1 Scheduling the TS7510 example 2 backup

To schedule the TS7510 example 2 backup, use option **6** (Add to schedule) on the Work with Backup Control Groups screen (not shown here) similar to what we did for step 1 in 6.9.1, “Scheduling the TS7510 example 1 backup” on page 230.

The control group backing up of the first partition of example 2 is complete.

# 6.11 Domino Transactional logging

You can back up a Domino server while it is active when doing a full backup. If you want to do an incremental Domino backup, then Domino Transactional logging must be active.

Transactional logging is Domino's implementation of journaling. When BRMS backs up Domino data, first the base files are backed up and then a second step backs up any transaction log.

## 6.11.1 Determining if Domino Transactional logging is active

To determine if Domino Transactional logging is active:

1. Type `WRKDOMSVR`, and press Enter.
2. Enter option Select **8** = "Work Console", and press Enter (the server must be started).
3. Type `show server` in the command screen. Press Enter.

   The information displayed might look as shown in Figure 6-129.
4. Press page up if needed.

```
                       Work with Domino Console               Server: DOMINO00

 Mail Tracking:          Not Enabled
 Mail Journaling:        Not Enabled
 Shared mail:            Not Enabled
 Number of Mailboxes:    1
 Pending mail: 0         Dead mail: 0
 Waiting Tasks:          0
 Transactional Logging:  Enabled
 Fault Recovery:         Enabled
 Activity Logging:       Not Enabled
 Server Controller:      Not Enabled
 Diagnostic Directory:   /domino00/notes/data/IBM_TECHNICAL_SUPPORT
 Console Logging:        Not Enabled
 Console Log File:       /domino00/notes/data/IBM_TECHNICAL_SUPPORT/console.lo
```

*Figure 6-129 Domino console - Show server*

In our example, you see that transaction logging is enabled.

Again, for more information about backing up Domino, consult the other documentation that we have already mentioned in this chapter:

http://www.ibm.com/servers/eserver/iseries/service/brms/domino.html

Also see the IBM Redbook *Implementing Domino 7 for i5/OS*, SG24-7311.

# 6.12 Duplication of data saved to the TS7510

In most business backup and recovery processes, at least some *saved data* has to be saved to a real physical media so that the media can be physically moved to a highly protected and secure site.

When there is a need for additional protection of data saved to a TS7510, you can use either the TS751 replication capabilities described in 2.7.5, “Network Replication” on page 28, or save the data directly from i5/OS to a physically connected real tape device.

Duplicating can be achieved in a number of ways, including:

- Mirror the complete virtual library itself, using the TS7510’s Network Replication function
- Duplicating volumes
- Duplicating specific backups

Earlier in this book, for example in the **Important** text box on page 11, we discussed the considerations of using the TS7510’s export and import and replication capabilities outside of any tape or backup management application such as BRMS. An overview of these capabilities is included in:

- 2.7.4, “Import, export, auto archive” on page 27
- 2.7.5, “Network Replication” on page 28

In this chapter, we discuss using BRMS because of its backup tracking and its excellent recovery instructions produced when it handles all backup and duplication functions.

## 6.12.1 Duplicating volumes using BRMS

> **Attention:** This section only describes the principles. It does not show every command in detail.

By using the Duplicate Media using BRMS (DUPMEDBRM) command, you ensure that BRMS can tell you where your backups are. That they actually were copied is important. You are free to duplicate in any of the following ways using BRMS (because BRMS considers the virtual volumes and virtual tape devices as a real volume or device):

- Virtual to virtual
- Physical to physical
- Virtual to physical
- Physical to virtual

The DUPMEDBRM command allows duplicating in a variety of ways ranging from totally manual (by specifying the exact data set to copy and where to copy it), to a fully automated procedure. We do not list all possible combinations in this IBM Redbook, but we show an example.

First, a “from” and a “to” location is required. In our example, they are:

- TAPMLB01, which is our virtual TS7510 library
- TAPMLB02, which is a real 3582 LTO library

Being tape libraries, the BRMS command INZBRM *DEVICE takes care of creating corresponding locations. Copying is allowed within the same tape library, but a sufficient number of allocatable tape drives must exist.

Secondly, we also require an off-site location.

BRMS automatically creates a location named *Vault*. If that is an acceptable name, you only have to edit its address, contact, and telephone number information. Preferably, you should create one (or more) of your own, using the Work with Locations using BRMS (WRKLOCBRM) command. See Figure 6-130 for an example.

> **Important:** Note that you must never allow any tape volume expiration in a place where there is no robot mechanism that can load a volume into a tape drive.

```
                                   Storage Location

 Storage location  . . . . . . . . :   BASEM_SAFE
 Text  . . . . . . . . . . . . . . :   Building 4, basement safe

 Address line 1  . . . . . . . . . :   DP dept. safe to the left of the
 Address line 2  . . . . . . . . . :   elevator in the basement of building 4.
 Address line 3  . . . . . . . . . :   A spare key can be obtained 24 hrs
 Address line 4  . . . . . . . . . :   from the security dept. at 3-9999.
 Address line 5  . . . . . . . . . :
 Contact name  . . . . . . . . . . :   Marilyn Oliver
 Contact telephone number. . . . . :   T/L: 456-6939
 Retrieval time  . . . . . . . . . :   .3
 Allow volumes to expire . . . . . :   *NO
 Media slotting  . . . . . . . . . :   *NO
```

*Figure 6-130 Example of an external Storage location*

We have defined two media classes, TS7510BACK and TS7510DUPS, as shown in Figure 6-131 and Figure 6-132.

```
                             Media Class

 Media class . . . . . . . . . . . :   TS7510BACK
 Density . . . . . . . . . . . . . :   *ULTRIUM2
 Media capacity  . . . . . . . . . :   *DENSITY
 Mark for label print  . . . . . . .   *NONE
 Label size  . . . . . . . . . . . :   6 LPI
 Label output queue  . . . . . . . :   *SYSPCY
   Library . . . . . . . . . . . . :
 Shared media  . . . . . . . . . . :     *YES
 Write once media  . . . . . . . . :     *NO
 Text  . . . . . . . . . . . . . . :   TS7510 volumes
```

*Figure 6-131 Media class - Virtual TS7510 volumes*

```
                              Media Class

Media class . . . . . . . . . . . :   TS7510DUPS
Density . . . . . . . . . . . . . :   *ULTRIUM2
Media capacity  . . . . . . . . . :   *DENSITY
Mark for label print  . . . . . . .   *NONE
Label size  . . . . . . . . . . . :   6 LPI
Label output queue  . . . . . . . :   *SYSPCY
  Library . . . . . . . . . . . . :
Shared media  . . . . . . . . . . :     *YES
Write once media  . . . . . . . . :     *NO
Text  . . . . . . . . . . . . . . :   Duplicated TS7510 volumes
```

*Figure 6-132 Media class - Physical LTO-2 volumes (copies of backup sets on virtual tapes)*

We use three locations:

- TAPMLB01, which is our virtual TS7510 library
- TAPMLB02, which is a 3582 LTO library
- BASEM_SAFE, which is an off-site storage location

We also use two media classes:

- TS7510BACK, the virtual setup we use taking our backups
- TS7510DUPS, real LTO-2 cartridges holding copies of our backups

We are now ready to start creating our move policies.

A move policy specifies between which locations a volume should rotate. The simplest move is specify only a location where the tape volume stays until it is a candidate for expiration. You can also create more sophisticated move policies, such as, first three days in the tape library (in case a restore is required), then stored in an out-of-house location for two weeks, and then, in another week, store in the computer room safe, and finally, returning to the tape library for expiration where the volume can become a scratch volume and be reused.

Any movement setup is possible. Figure 6-133 shows the move policy using BRMS (WRKPCYBRM) command. We define a new move policy using WRKPCYBRM *MOV and specifying the values shown in Figure 6-133.

```
                            Move Policy

Move policy  . . . . . . . . . .  TS7510DUPL
Home location  . . . . . . . . .  TAPMLB02
Use container  . . . . . . . . .  *NO
Verify moves . . . . . . . . . .  *YES
Calendar for working days  . . .  *ALLDAYS
Calendar for move days . . . . .  *ALLDAYS
Text . . . . . . . . . . . . . .  Duplicated backups -> off-site safe

 Seq    Location      Duration
  10    BASEM_SAFE    *EXP
```

*Figure 6-133 Example of a move policy moving duplicated volumes off-site*

In our example, we do not move our virtual volumes, only the duplicate one. Therefore, we do not need any move policy for our virtual volumes.

Next, we show using our new move policy.

The move policy is referred to inside a media policy. The media policy tells which media class to use, how many days a backup is saved, which move policy is applied, and two things important for duplication process:

- "Mark volumes for duplication" specifies whether we want to duplicate the complete volume
- "Mark history for duplication" tells which backup sets are to be duplicated.

We determine that we require separate media and move policies. One set defines the original data and the other defining the copy. We let the original volume stay in the tape library, assuming it is short lived; therefore, we require a media policy specifying the number of days it is protected.

Duplication must be set to *YES (Figure 6-134), unless you do duplication as a manual procedure. When a tape stays in a tape library and never moves outside, we do not require any move policy.

```
                              Media Policy

Media policy . . . . . . . . . . .   TS7510BACK
Retention type . . . . . . . . . .   2
  Retain media . . . . . . . . . .   15
Move policy  . . . . . . . . . . .   *NONE
Media class  . . . . . . . . . . .   TS7510BACK
Storage location . . . . . . . . .   *ANY
Save to save file  . . . . . . . .   *NO
  ASP for save files . . . . . . .   *SYSTEM
  Save file retention type . . . .   4
Retain save files  . . . . . .   *NONE
  ASP storage limit  . . . . . . .   *SYS
Secure media . . . . . . . . . . .   *NO
Text . . . . . . . . . . . . . . .   Daily backup to TS7510
Required volumes . . . . . . . . .   *NONE
Mark volumes for duplication . . .   *YES
Mark history for duplication . . .   *NO
```

*Figure 6-134   Media Policy - Volumes to duplicate*

The copied data may have its own life cycle. It can be saved for a long time. Being a copy, there is probably no need for immediate access. To free up space in the library and shielding the backup from accidental or deliberate destruction, physical volumes should move to some kind of *safe place*, a safe.

Therefore, we require a media policy (Figure 6-135) for the length of time being saved. We show no duplicating settings here, unless we actually require a second real, physical copy. We also require a move policy telling where and how it moves.

```
                          Media Policy

Media policy . . . . . . . . . . :   TS7510DUPS
Retention type . . . . . . . . .    2
  Retain media . . . . . . . . .    45
Move policy  . . . . . . . . . .    TS7510DUPD
Media class  . . . . . . . . . .    TS7510DUPS
Storage location . . . . . . . .    *ANY
Save to save file  . . . . . . .    *NO
  ASP for save files . . . . . .    *SYSTEM
  Save file retention type . . .    4
    Retain save files  . . . . .    *NONE
  ASP storage limit  . . . . . .    *SYS
Secure media . . . . . . . . . .    *NO
Text . . . . . . . . . . . . . .    Duplicate TS7510 daily backup volumes
```

*Figure 6-135 Media Policy - Duplicate volumes*

If we have set everything up correctly, we now have an automated process for copying our backups.

Our control group specifies:

- When and what to back up
- To which library (or tape drive)

Its media policy tells:

- Which media class is used
- Which move policy to use
- How many days the backup is saved
- If the result should be duplicated or not

The move policy in turn specifies:

- How the resulting volume should rotate between locations

The media class identifies:

- Which kind of media is being targeted

After the backup is completed, at a suitable time, we run DUPMEDBRM, which gives us a physical copy of our backup that follows the specifications in its media policy. This contains all the other settings.

The last thing to set up is whatever we needed to do that is a manual operation. This is done by physically moving tape volumes according the move scheme outlined by the move policies.

We should, however, consider one thing more. That is scheduling the BRMS maintenance job. This enables, among other things, overdue volumes to get their expiration flag set. Otherwise, BRMS will not consider them scratches, regardless of how many days have passed since their expiration date.

The Start Expiration for BRMS (STREXPBRM) command offers another alternative: Turning the expire flag on.

## Performing the volume duplication with BRMS

As discussed, the command used for duplication is DUPMEDBRM.

Assume that we have a backup on volume 759AGK, which is marked for duplication. In Figure 6-136, you see 759AGK among two other volume serial numbers.

```
Volume       Creation Expiration          Move     Media    Dup Move
Serial Expired  Date    Date    Location  Date     Class    Sts Policy

740AGK  *YES  07/20/06 08/24/06 TAPMLB01 08/18/06 TS7510BACK     *NONE
743AGK  *YES  06/20/06 07/25/06 TAPMLB01 08/18/06 TS7510BACK     *NONE
759AGK        10/22/06 11/01/06 TAPMLB01 *NONE    TS7510BACK 1   *NONE
```

*Figure 6-136 WRKMEDBRM - One volume marked for duplication*

We now run DUPMEDBRM with the following parameters:

- VOL(*SEARCH)
- SCHMEDCLS(TS7510BACK)
- FROMDEV(TAPMLB01)
- TODEV(TAPMLB02)
- MEDPCY(TS7510DUPS)
- OBJDTL(*YES)
- SAVMEDINF(*LIB)

Figure 6-137 shows these parameters and more.

```
                   Duplicate Media using BRM

From volume identifier . . . . . > *SEARCH
File group . . . . . . . . . . .   *ALL
File group type  . . . . . . . .   *ALL
From media class . . . . . . . . > TS7510BACK
From device  . . . . . . . . . . > TAPMLB01
To device  . . . . . . . . . . . > TAPMLB02
From sequence number:
  Starting file sequence number    *FIRST
  Ending file sequence number  .   *LAST
To sequence number . . . . . . .   *END
To media policy  . . . . . . . . > TS7510DUPS
From device end option . . . . . > *REWIND
To device end option . . . . . . > *UNLOAD
From system  . . . . . . . . . .   *LCL
Retain object detail . . . . . . > *YES
Expiration date  . . . . . . . .   *MEDPCY
Move policy  . . . . . . . . . .   *MEDPCY
Media class  . . . . . . . . . .   *MEDPCY
Location . . . . . . . . . . . .   *MEDPCY
Secure volume  . . . . . . . . .   *MEDPCY
Required volumes . . . . . . . .   *MEDPCY
Mark volumes for duplication . .   *MEDPCY
Mark history for duplication . .   *MEDPCY
Save media information . . . . .   *LIB
```

*Figure 6-137 DUPMEDBRM*

We run the DUPMEDBRM command with the parameter values that we have selected. In the BRMS log, we typically see:

- 10/22/06 13:17:10 BRM1135 Volume 759AGK marked for duplication.
- 10/22/06 13:17:25 BRM1669 Devices TAPMLB01 will be used.
- 10/22/06 13:17:25 BRM1669 Devices TAPMLB02 will be used.
- 10/22/06 13:18:36 BRM1565 Media duplication started for volume 759AGK.
- 10/22/06 13:37:13 BRM1138 Duplication mark for volume 759AGK removed.
- 10/22/06 13:37:14 BRM1566 Tape duplication completed.

After duplication, WRKMEDBRM shows (including volumes from TAPMLB02) the following in Figure 6-138.

```
Volume       Creation Expiration          Move      Media     Dup Move
Serial Expired   Date  Date     Location Date      Class     Sts Pcy

740AGK  *YES  07/20/06 08/24/06 TAPMLB01 08/18/06 TS7510BACK    *NONE
743AGK  *YES  06/20/06 07/25/06 TAPMLB01 08/18/06 TS7510BACK    *NONE
759AGK        10/22/06 11/01/06 TAPMLB01 *NONE    TS7510BACK *  *NONE

829AGK        10/22/06 12/06/06 TAPMLB02 *NONE    TS7510DUPS    TS7510DUPD
831AGK  *YES  09/20/06 *NONE    TAPMLB02 *NONE    TS7510BACK    *NONE
```

*Figure 6-138 WRKMEDBRM - One volume duplicated*

**Note:** Duplication status indicators are:

- ***:** The data on the media volume has been duplicated.
- **1:** The data on the media volume has been marked for duplication.

What remains to be done is to issue the i5/OS command MOVMEDBRM, which ejects volume 829AGK from the 3582 tape library, thus change location to BASEM_SAFE.

The Work with Media Information with BRMS (WRKMEDIBRM) command now shows the following in Figure 6-139.

```
                        Media Information Report

Saved       Save  Item  Save     Save     Expire  Objects Not  File Volume
Item        Type  Type  Date     Time      Date    Saved  Saved Seq Serial
*SAVSECDTA *FULL *LIB 10/22/06 10:13:18 11/01/06    160    0    1  759AGK
*SAVSECDTA *FULL *LIB 10/22/06 10:13:18 12/06/06    160    0  216  829AGK
*SAVCFG    *FULL *LIB 10/22/06 10:30:33 11/01/06    133    0    2  759AGK
*SAVCFG    *FULL *LIB 10/22/06 10:30:33 12/06/06    133    0  217  829AGK
QGPL       *FULL *LIB 10/22/06 10:31:11 11/01/06   1620    0    3  759AGK
QGPL       *FULL *LIB 10/22/06 10:31:11 12/06/06   1620    0  218  829AGK
QUSRSYS    *FULL *LIB 10/22/06 10:31:55 11/01/06   1922    0    4  759AGK
QUSRSYS    *FULL *LIB 10/22/06 10:31:55 12/06/06   1922    5  219  829AGK
ISALIB     *INCR *LIB 10/22/06 10:43:45 11/01/06      4    0    5  759AGK
ISALIB     *INCR *LIB 10/22/06 10:43:45 12/06/06      4    0  220  829AGK
KLD        *INCR *LIB 10/22/06 10:43:59 11/01/06      1    0    6  759AGK
KLD        *INCR *LIB 10/22/06 10:43:59 12/06/06      1    0  221  829AGK
KLDNEW     *INCR *LIB 10/22/06 10:44:09 11/01/06      1    0    7  759AGK
KLDNEW     *INCR *LIB 10/22/06 10:44:09 12/06/06      1    0  222  829AGK
KLDNEW1    *INCR *LIB 10/22/06 10:44:18 11/01/06      1    0    8  759AGK
KLDNEW1    *INCR *LIB 10/22/06 10:44:18 12/06/06      1    0  223  829AGK
RMTJRN     *INCR *LIB 10/22/06 10:46:16 11/01/06      4    0    9  759AGK
RMTJRN     *INCR *LIB 10/22/06 10:46:16 12/06/06      4    0  224  829AGK
QUSRBRM    *FULL *LIB 10/22/06 10:46:31 11/01/06    231    0   10  759AGK
QUSRBRM    *FULL *LIB 10/22/06 10:46:31 12/06/06    231    0  225  829AGK
*ALLDLO    *FULL *DLO 10/22/06 10:47:55 11/01/06 200290    0   11  759AGK
*ALLDLO    *FULL *DLO 10/22/06 10:47:55 12/06/06 200290    0  226  829AGK
*LINK      *FULL *LNK 10/22/06 10:54:50 11/01/06 964690   14   12  759AGK
*LINK      *FULL *LNK 10/22/06 10:54:50 12/06/06 964690    0  227  829AGK
QUSRBRM    *QBRM *OBJ 10/22/06 12:18:57 11/01/06     19    0   13  759AGK
QUSRBRM    *QBRM *OBJ 10/22/06 12:18:57 12/06/06     19    0  228  829AGK
         * * * * *   E N D   O F   L I S T I N G   * * * * *
```

*Figure 6-139 Detail information after duplication is complete*

**Notes:**

- The copy has the exact same date and time stamp as the original. There is no notation when the actual copy took place.
- Because we specified sequence number *END for the target volume, BRMS placed the data on a volume that had been used before but not yet moved to its target location, therefore the sequence numbers differ.

We also show restoring library KLDNEW (Figure 6-140). As long as we have not passed the expiration date, BRMS will present us two restore options. Select the one you find most convenient.

The command for this is Start Recovery with BRMS (STRRCYBRM):

```
STRRCYBRM OPTION(*LIB) ACTION(*RESTORE) LIB(KLDNEW)
```

```
    Saved         Save     Save    Save  Volume File     Expire
Opt Item          Date     Time    Type  Serial Sequence Date

1   KLDNEW     10/22/06 10:44:09 *FULL 759AGK     7    11/01/06
_   KLDNEW     10/22/06 10:44:09 *FULL 829AGK   222    12/06/06
```

*Figure 6-140 Restoring one library*

You respond to the screens that follow as you would usually do.

Restoring from a virtual tape library is identical to restoring from a real tape library, except that it finds the backup volume much quicker.

This concludes the duplication section.

# 7

# Measuring, monitoring, and problem determination

This chapter discusses the various tools to measure and monitor the activity of the IBM Virtualization Engine TS7510 functions and interfaces.

# 7.1 Reporting function in IBM Virtualization Engine TS7510

IBM Virtualization Engine TS7510 has a powerful built-in reporting facility, which enables you to produce various reports for a specific time period. They are shown in graphs and in text. Reports such as throughput of entire IBM Virtualization Engine TS7510, throughput of a particular logical unit number (LUN) in SV5 or SX5, or throughput of a Fibre Channel (FC) port in CV5, can help to analyze performance issues and improve configuration to achieve better performances.

## 7.1.1 Types of reports

The following type of reports are available in IBM Virtualization Engine TS7510:

- Server Throughput Report

  The Server Throughput Report displays the overall throughput of the IBM Virtualization Engine TS7510.

- SCSI/Fibre Channel Throughput Report

  The SCSI/Fibre Channel Throughput Report shows the data that goes through Fibre adapter on the 3954 Model CV5.

- SCSI Device Throughput Report

  The SCSI Device Throughput Report shows the utilization of the LUN in 3955 Model SV5 or 3955 Model SX5.

- Physical Resources Configuration Report

  The Physical Resources Configuration Report lists all of the physical resources on IBM Virtualization Engine TS7510.

- VE for Tape Disk Space Usage Report

  The VE for Tape Disk Space Usage Report shows the amount of disk space that is used by each FC port connected to SV5.

- Physical Resources Allocation Report

  The Physical Resources Allocation Report shows the disk space usage and layout of each LUN, or of a particular LUN in SV5 and SX5.

- Fibre Channel Adapters Configuration Report

  The Fibre Channel Adapters Configuration Report shows worldwide port names (WWPNs) and port information for each FC port.

- Replication Status Report

  The Replication Status Report displays information about replication activity.

- Virtual Library Information

  The Virtual Library Information report shows information about each tape library being emulated, including the virtual tape drives, tapes, and slots.

- Virtual Tape Information

  The Virtual Tape Information report shows information about each virtual tape, including the barcodes, size, and location.

- 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.

## 7.1.2 Creating, viewing, and exporting reports

To produce reports in IBM Virtualization Engine TS7510, perform the following steps:

1. Log in to the Virtualization Engine for Tape Console. In the left panel, right-click **Reports** and select **New**, as is shown on Figure 7-1.

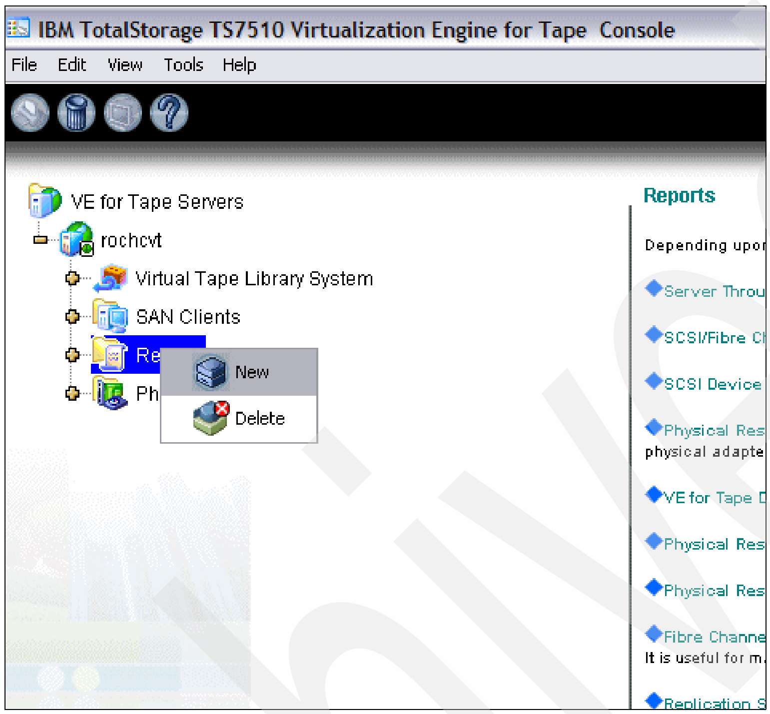



*Figure 7-1 Create new report*

2. You are presented a panel with possible report types. Choose one of them by selecting it and click **Next**. For this example, we selected **Server Throughput Report**, which shows the throughput of the entire IBM Virtualization Engine TS7510. The selection is shown in Figure 7-2.

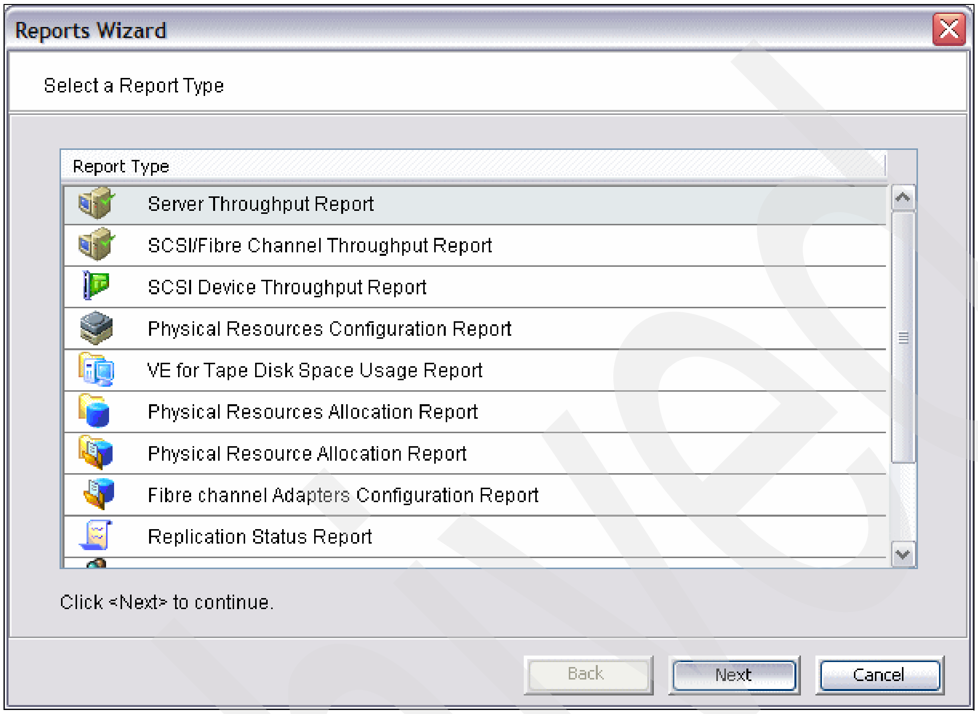



*Figure 7-2 Selecting report type*

3. You are presented a panel where you select which time period you want the report to include. Select a time period and click **Next**. In our example, we selected the report to be done for the whole day August 24, as shown in Figure 7-3.

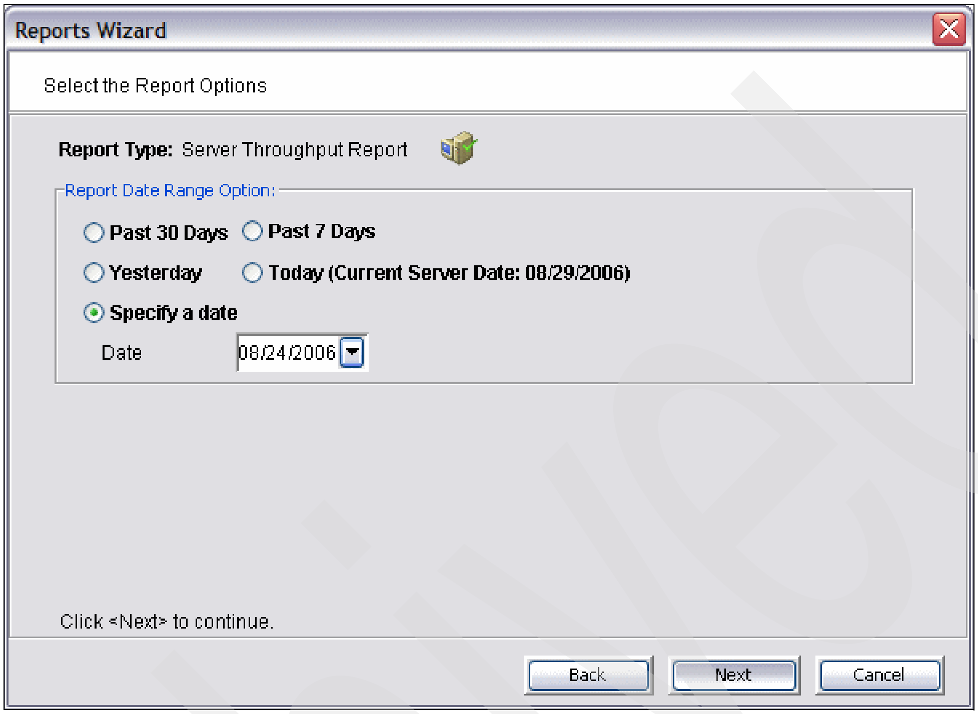



*Figure 7-3 Specifying the time period for the report*

4. In the panel that opens, you specify the title of report, or leave the default title. Click **Next**. In our example, we left the title as default showing the date when the report was produced, as shown in Figure 7-4.

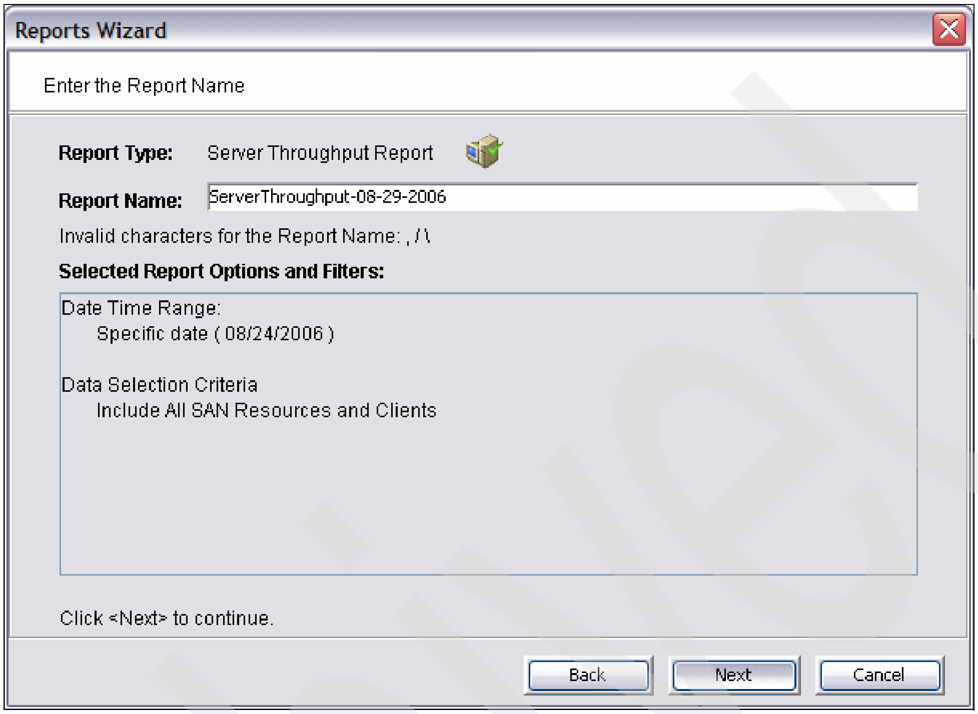



*Figure 7-4 Specifying the title of the report*

5. You are presented the panel where you can check the type of report, time period of the report, and date of producing the report. If you agree with the listed data, confirm it by clicking **Finish**. This is shown in Figure 7-5.

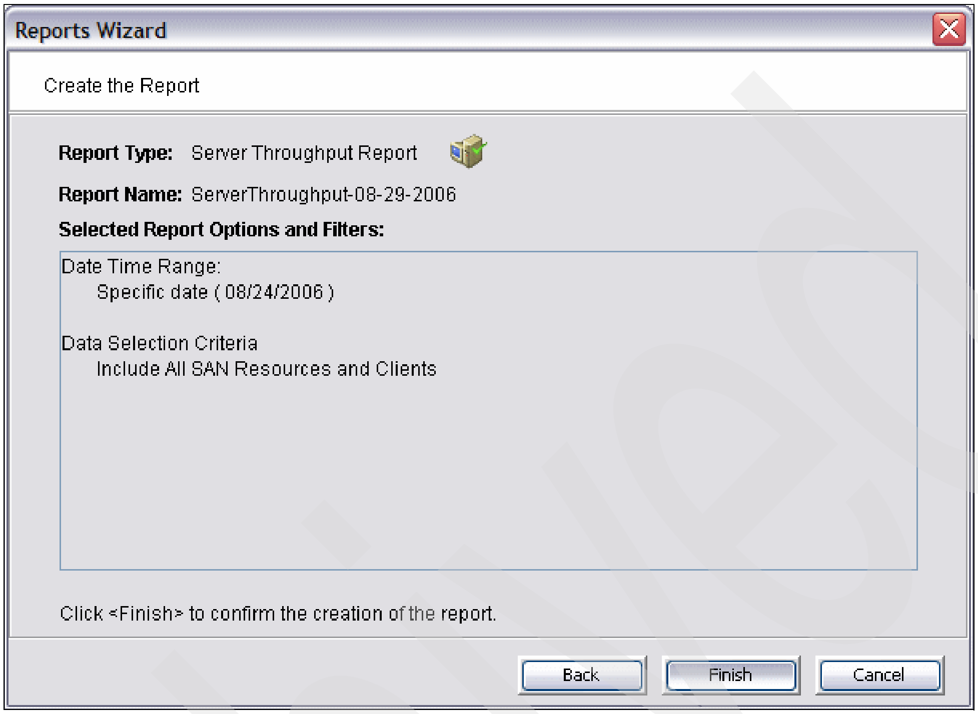



*Figure 7-5 Confirming the report*

The report is now shown in the right panel, as is seen in Figure 7-6. As we can observe in the graph, there was high input and output traffic around 9 a.m. and 11:30 a.m., and there was high write activity at about 1:30 p.m.

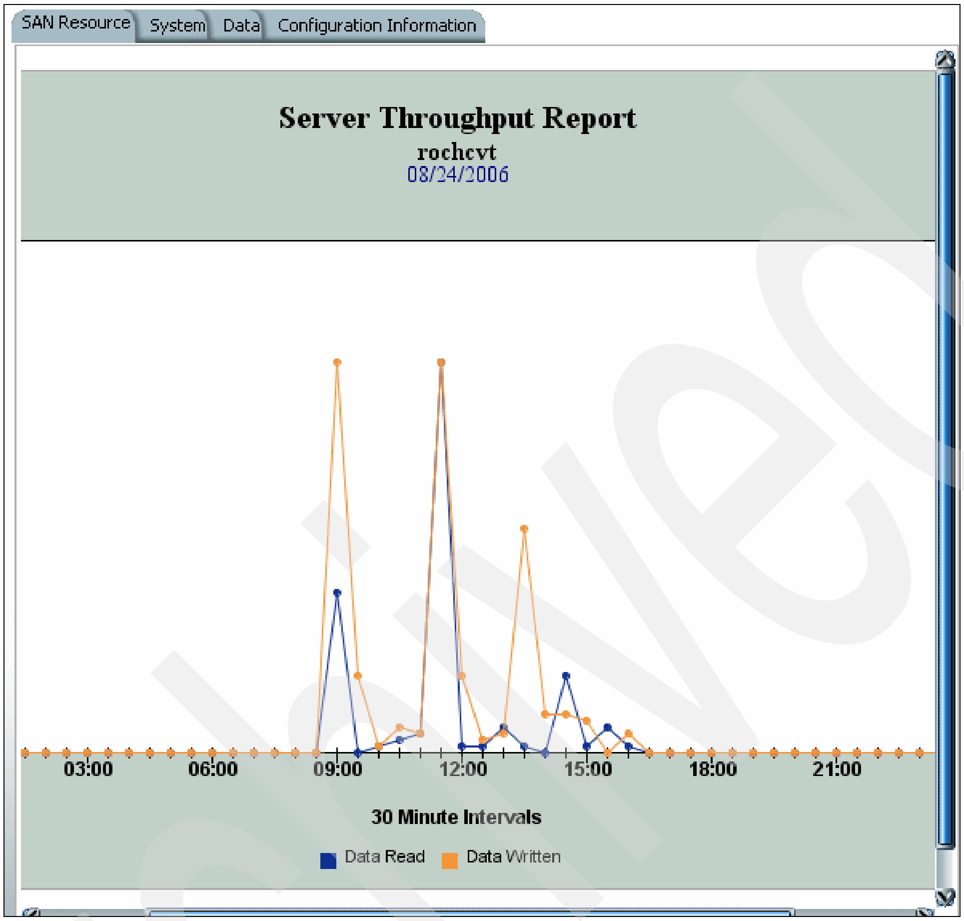



*Figure 7-6 Server Throughput Report*

6. In the right panel, click the **System** tab. You are presented the graph that shows CPU and memory usage of 3954 Model CV5. Because CV5 performs emulation of virtual libraries, it is important to follow the usage of its resources. When using compression, you can expect high CPU usage. In our example, CPU usage is less than 5% and memory usage does not go over 450 MB. This is shown in Figure 7-7.

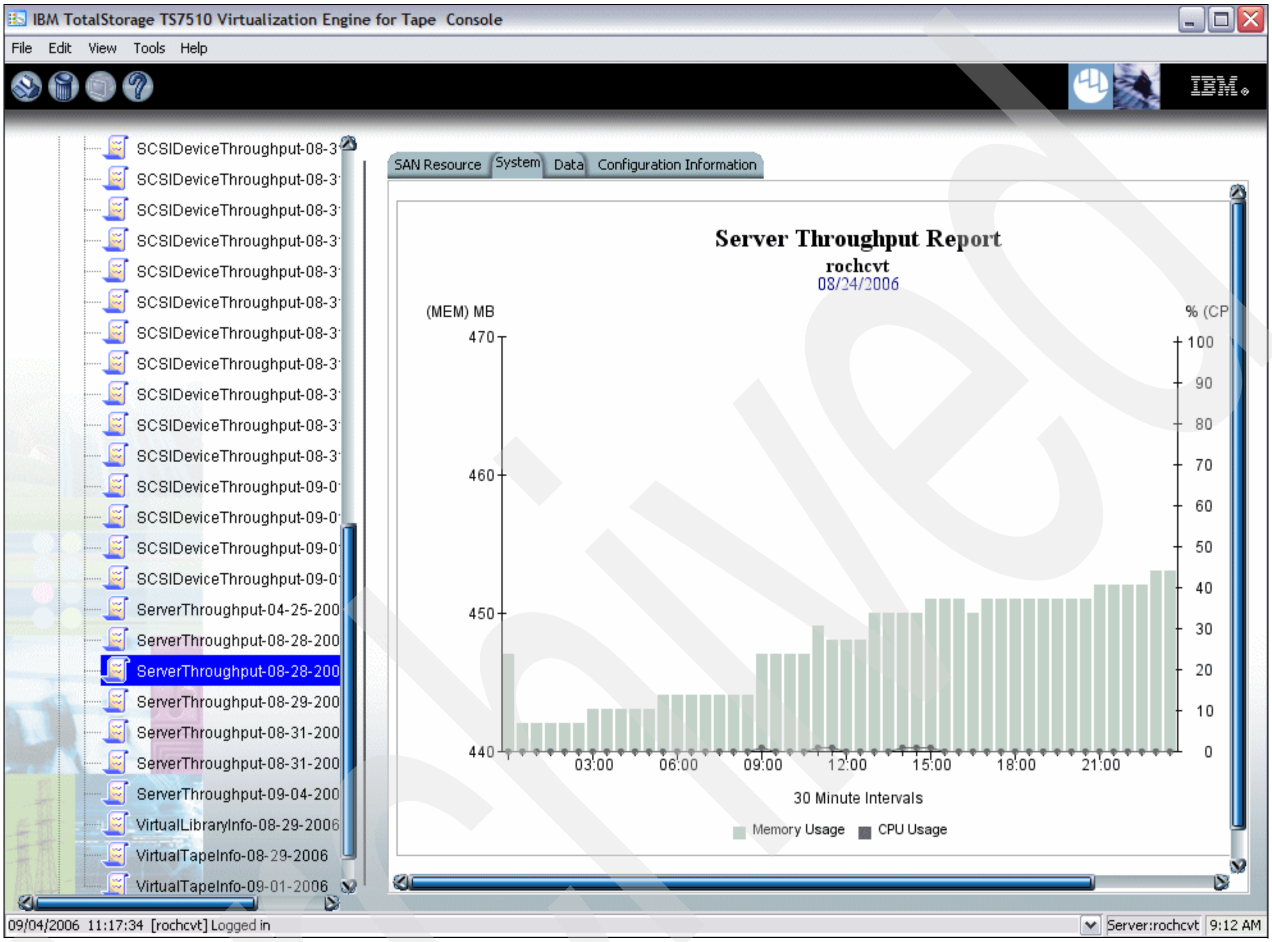
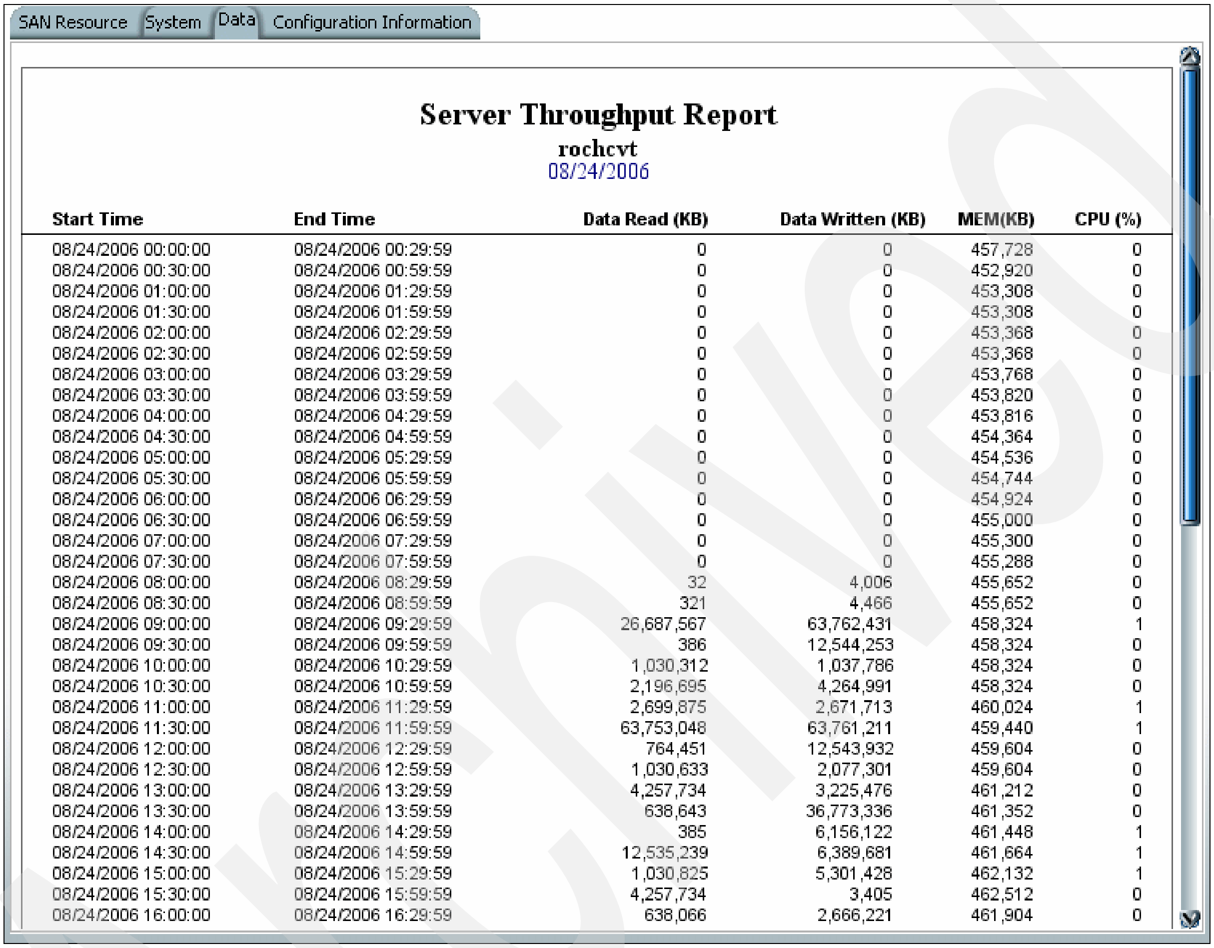



*Figure 7-7 Usage of CV5 resources: System*

Note that you can move the vertical line separating the left and right panes to the left to increase the size of any report pane for easier viewing. You can also print or export the right pane information of any report.

7. Click the **Data** tab. It shows the throughput in spreadsheet format, in 30-minute intervals, as can be seen in Figure 7-8.

> **Note:** If you use different time period for the report, the time intervals in the reported graphs and spreadsheets might be different.



SAN Resource | System | Data | Configuration Information

**Server Throughput Report**

rochcvt

08/24/2006

| Start Time | End Time | Data Read (KB) | Data Written (KB) | MEM(KB) | CPU (%) |
|---|---|---|---|---|---|
| 08/24/2006 00:00:00 | 08/24/2006 00:29:59 | 0 | 0 | 457,728 | 0 |
| 08/24/2006 00:30:00 | 08/24/2006 00:59:59 | 0 | 0 | 452,920 | 0 |
| 08/24/2006 01:00:00 | 08/24/2006 01:29:59 | 0 | 0 | 453,308 | 0 |
| 08/24/2006 01:30:00 | 08/24/2006 01:59:59 | 0 | 0 | 453,308 | 0 |
| 08/24/2006 02:00:00 | 08/24/2006 02:29:59 | 0 | 0 | 453,368 | 0 |
| 08/24/2006 02:30:00 | 08/24/2006 02:59:59 | 0 | 0 | 453,368 | 0 |
| 08/24/2006 03:00:00 | 08/24/2006 03:29:59 | 0 | 0 | 453,768 | 0 |
| 08/24/2006 03:30:00 | 08/24/2006 03:59:59 | 0 | 0 | 453,820 | 0 |
| 08/24/2006 04:00:00 | 08/24/2006 04:29:59 | 0 | 0 | 453,816 | 0 |
| 08/24/2006 04:30:00 | 08/24/2006 04:59:59 | 0 | 0 | 454,364 | 0 |
| 08/24/2006 05:00:00 | 08/24/2006 05:29:59 | 0 | 0 | 454,536 | 0 |
| 08/24/2006 05:30:00 | 08/24/2006 05:59:59 | 0 | 0 | 454,744 | 0 |
| 08/24/2006 06:00:00 | 08/24/2006 06:29:59 | 0 | 0 | 454,924 | 0 |
| 08/24/2006 06:30:00 | 08/24/2006 06:59:59 | 0 | 0 | 455,000 | 0 |
| 08/24/2006 07:00:00 | 08/24/2006 07:29:59 | 0 | 0 | 455,300 | 0 |
| 08/24/2006 07:30:00 | 08/24/2006 07:59:59 | 0 | 0 | 455,288 | 0 |
| 08/24/2006 08:00:00 | 08/24/2006 08:29:59 | 32 | 4,006 | 455,652 | 0 |
| 08/24/2006 08:30:00 | 08/24/2006 08:59:59 | 321 | 4,466 | 455,652 | 0 |
| 08/24/2006 09:00:00 | 08/24/2006 09:29:59 | 26,687,567 | 63,762,431 | 458,324 | 1 |
| 08/24/2006 09:30:00 | 08/24/2006 09:59:59 | 386 | 12,544,253 | 458,324 | 0 |
| 08/24/2006 10:00:00 | 08/24/2006 10:29:59 | 1,030,312 | 1,037,786 | 458,324 | 0 |
| 08/24/2006 10:30:00 | 08/24/2006 10:59:59 | 2,196,695 | 4,264,991 | 458,324 | 0 |
| 08/24/2006 11:00:00 | 08/24/2006 11:29:59 | 2,699,875 | 2,671,713 | 460,024 | 1 |
| 08/24/2006 11:30:00 | 08/24/2006 11:59:59 | 63,753,048 | 63,761,211 | 459,440 | 1 |
| 08/24/2006 12:00:00 | 08/24/2006 12:29:59 | 764,451 | 12,543,932 | 459,604 | 0 |
| 08/24/2006 12:30:00 | 08/24/2006 12:59:59 | 1,030,633 | 2,077,301 | 459,604 | 0 |
| 08/24/2006 13:00:00 | 08/24/2006 13:29:59 | 4,257,734 | 3,225,476 | 461,212 | 0 |
| 08/24/2006 13:30:00 | 08/24/2006 13:59:59 | 638,643 | 36,773,336 | 461,352 | 0 |
| 08/24/2006 14:00:00 | 08/24/2006 14:29:59 | 385 | 6,156,122 | 461,448 | 1 |
| 08/24/2006 14:30:00 | 08/24/2006 14:59:59 | 12,535,239 | 6,389,681 | 461,664 | 1 |
| 08/24/2006 15:00:00 | 08/24/2006 15:29:59 | 1,030,825 | 5,301,428 | 462,132 | 1 |
| 08/24/2006 15:30:00 | 08/24/2006 15:59:59 | 4,257,734 | 3,405 | 462,512 | 0 |
| 08/24/2006 16:00:00 | 08/24/2006 16:29:59 | 638,066 | 2,666,221 | 461,904 | 0 |

*Figure 7-8 Report data in numbers*

8. Click the **Configuration Information** tab. This shows information about virtual tape libraries (VTLs), virtual tape drives, virtual tapes, ports, and so on, in IBM Virtualization Engine TS7510, as is shown in Figure 7-9. Note that you can scroll down the window to see all the defined virtual devices.

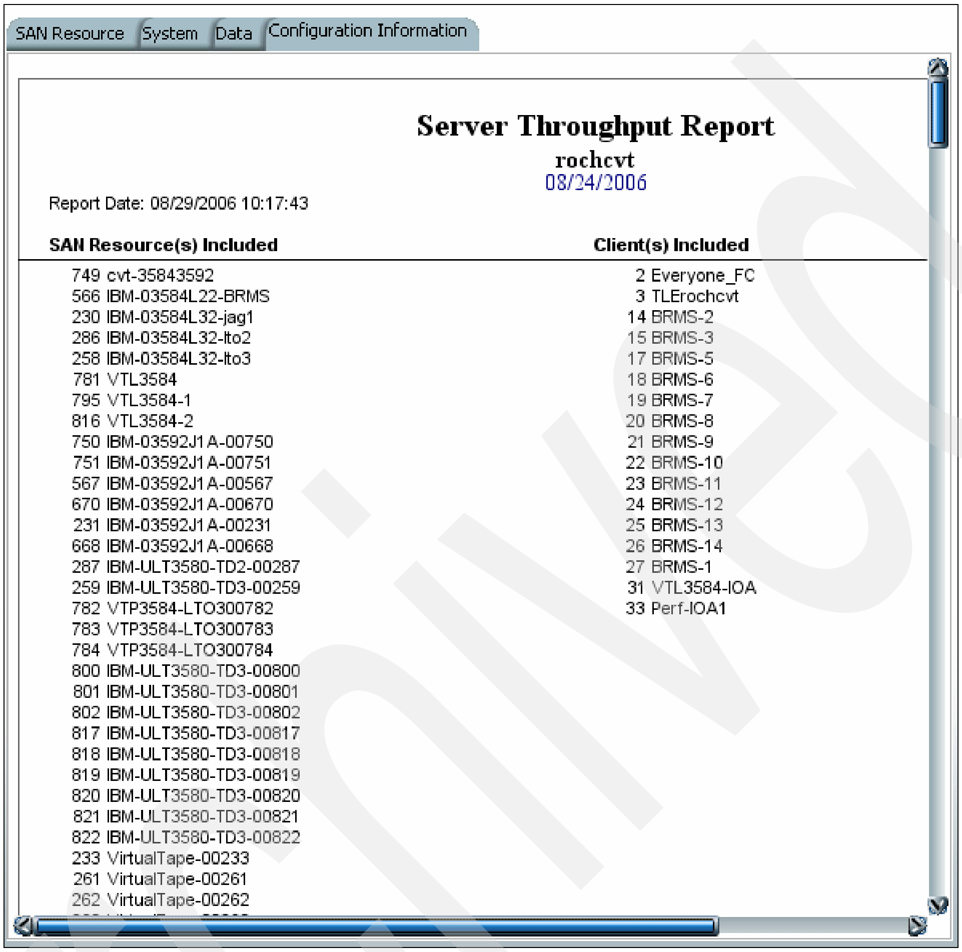



*Figure 7-9 Defined virtual devices in TS7510*

The report has been saved under the name that you specified during your report wizard dialog, as shown in our example in Figure 7-4 on page 254. You can later display it at any time by expanding **Reports** in the left panel, and clicking it. This is shown in Figure 7-10.

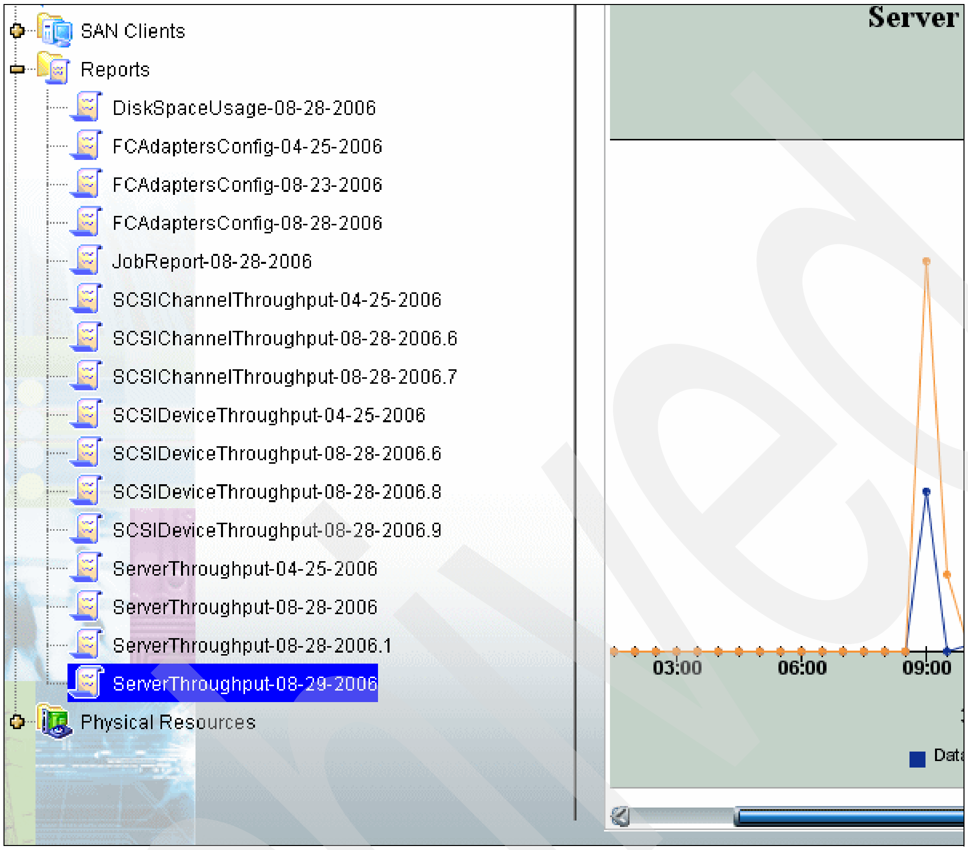



*Figure 7-10 Displaying the report*

### Exporting the report

If you want to save the report on your PC in spreadsheet form:

1. Right-click the report name in left panel and select **Export** from the pull-down menu. This is shown in Figure 7-11.

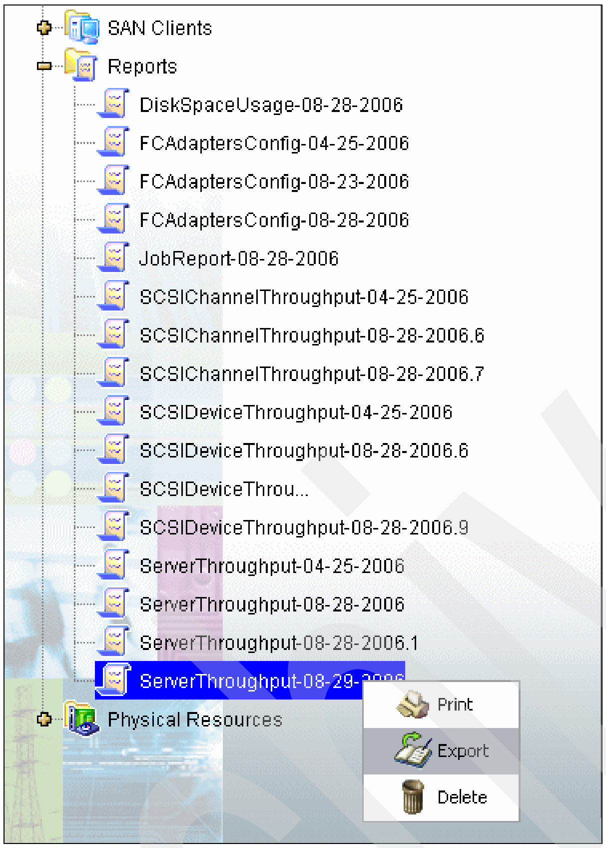



*Figure 7-11 Export a report*

2. You are presented a panel where you can select the folder in which to save the expected report, as is shown in Figure 7-12. After selecting the folder, click **Save**. This saves the report as a .csv file in selected folder.

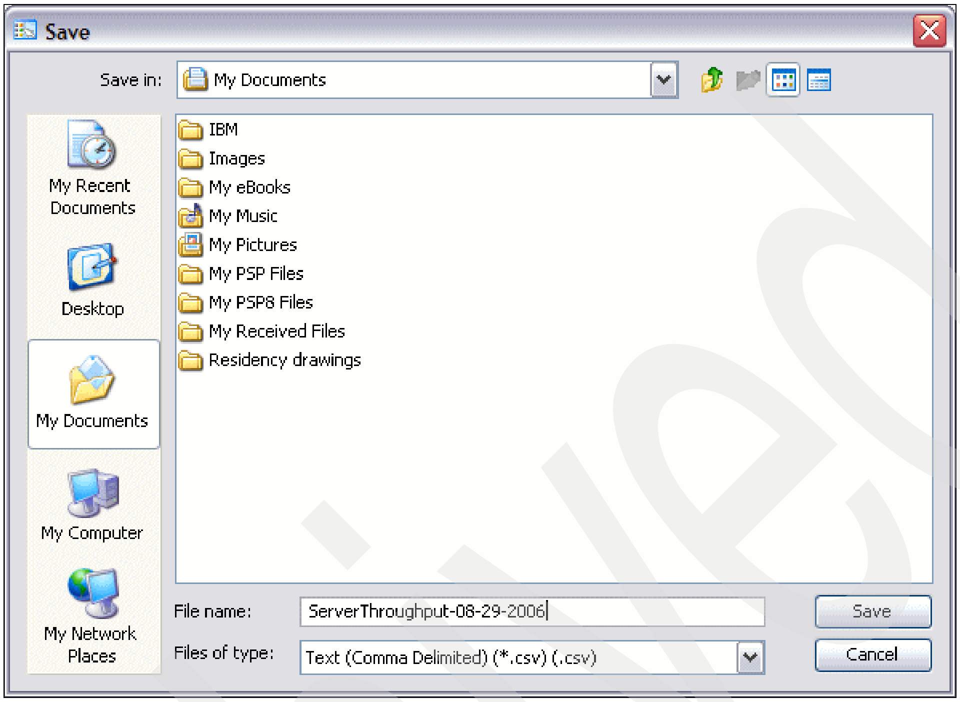



*Figure 7-12 Selecting location to save report*

By using all the information and steps that we have shown, you can produce any of the available report types. Some of the other report types are described in the following sections.

## 7.1.3 SCSI Device Throughput Report

This report shows the usage of a LUN in 3955 Model SV5 or 3955 Model SX5. When producing the report, select the required LUN to see its usage, as shown in Figure 7-13.

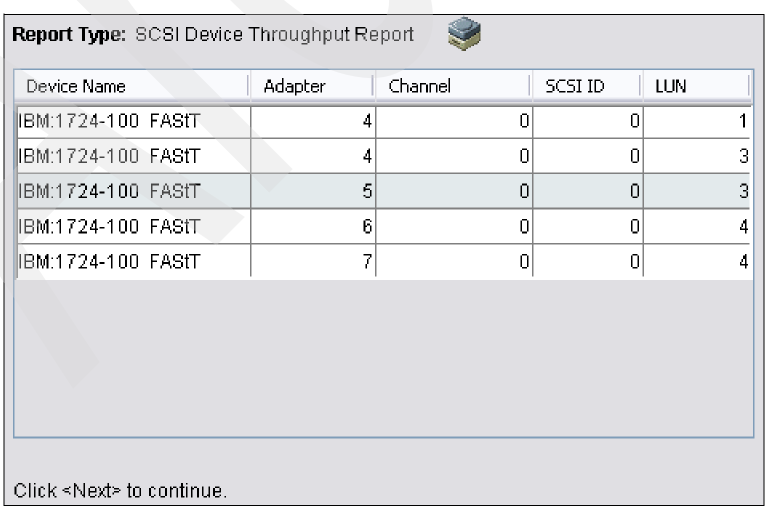



*Figure 7-13 Selecting a LUN for report*

The report shows the usage of this LUN in the specified time period, as seen in Figure 7-14. For more information about how LUNs in IBM Virtualization Engine TS7510 are used, refer to Appendix A, “Sizing and performance examples” on page 281.

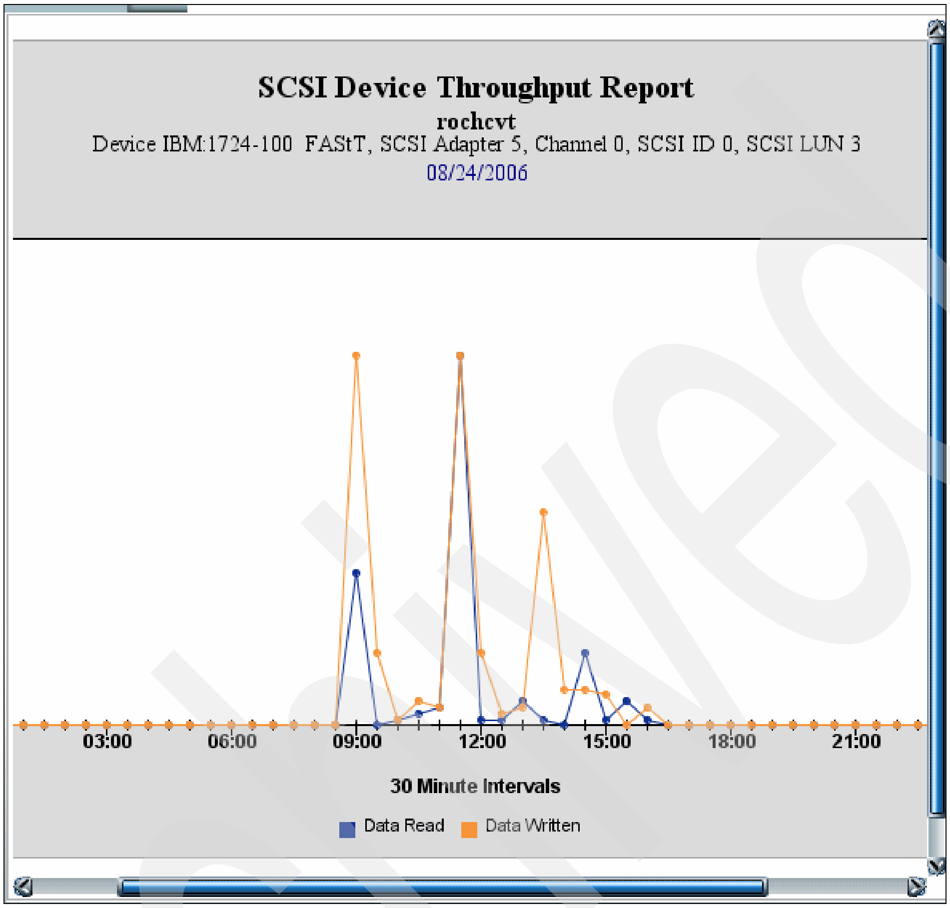



*Figure 7-14 LUN usage report*

### 7.1.4 SCSI/Fibre Channel Throughput Report

This report shows the usage of the selected FC port in 3954 Model CV5. An example of such a report is shown in Figure 7-15.

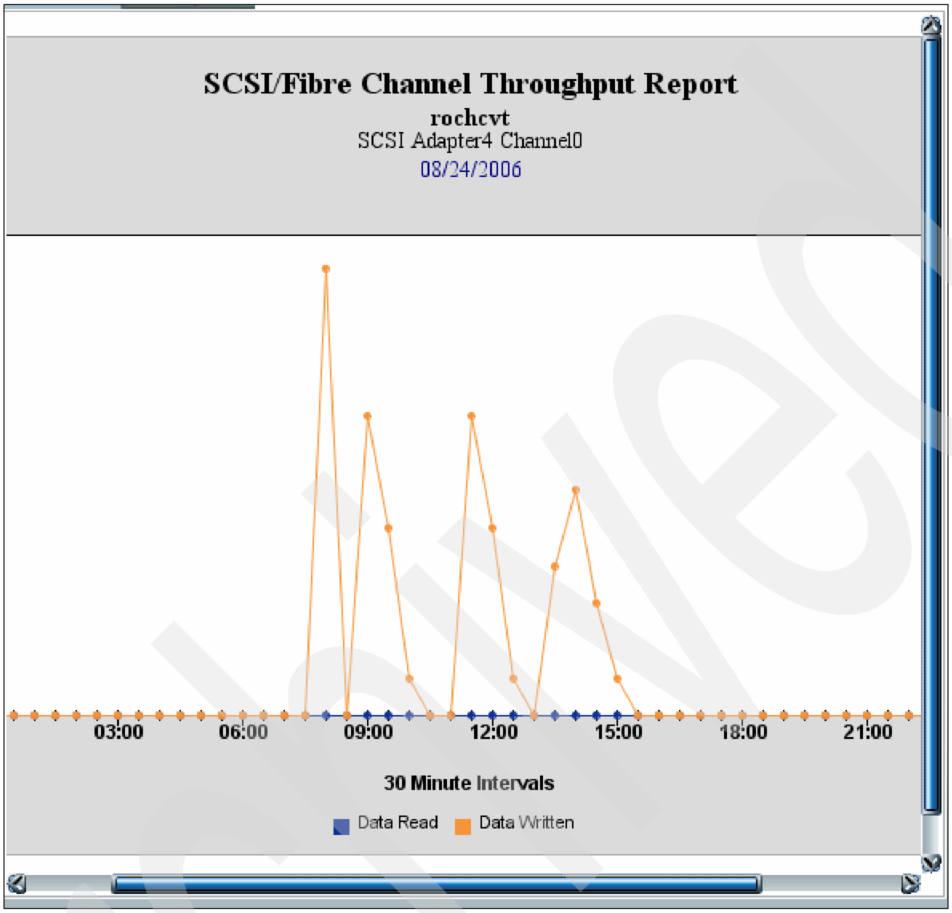



*Figure 7-15 Usage of a FC port in CV5*

> **Attention:** Only FC ports that are set up as initiators show input/output (I/O) activity in the SCSI/Fibre Channel Throughput Report.

## 7.2 Event Log, SNMP alerts, CallHome function

With IBM Virtualization Engine TS7510, you have powerful possibilities to monitor events that occur in the device, and so diagnose and prevent potential failures: You can monitor Event Log, and you have the option to set up Simple Network Management Protocol (SNMP) alerts, or use the CallHome function. In this section, we describe these possibilities.

### 7.2.1 Event Log

Event Log in IBM Virtualization Engine TS7510 contains information about occurrences that happened during the operation of IBM Virtualization Engine TS7510. An Event Log can be monitored from Virtualization Engine for Tape Console.

To monitor an Event Log, perform the following steps:

1. In the left panel in Virtualization Engine for Tape Console, click the DNS host name of IBM Virtualization Engine TS7510. After you click it, the right panel shows information about IBM Virtualization Engine TS7510, as shown in Figure 7-16.

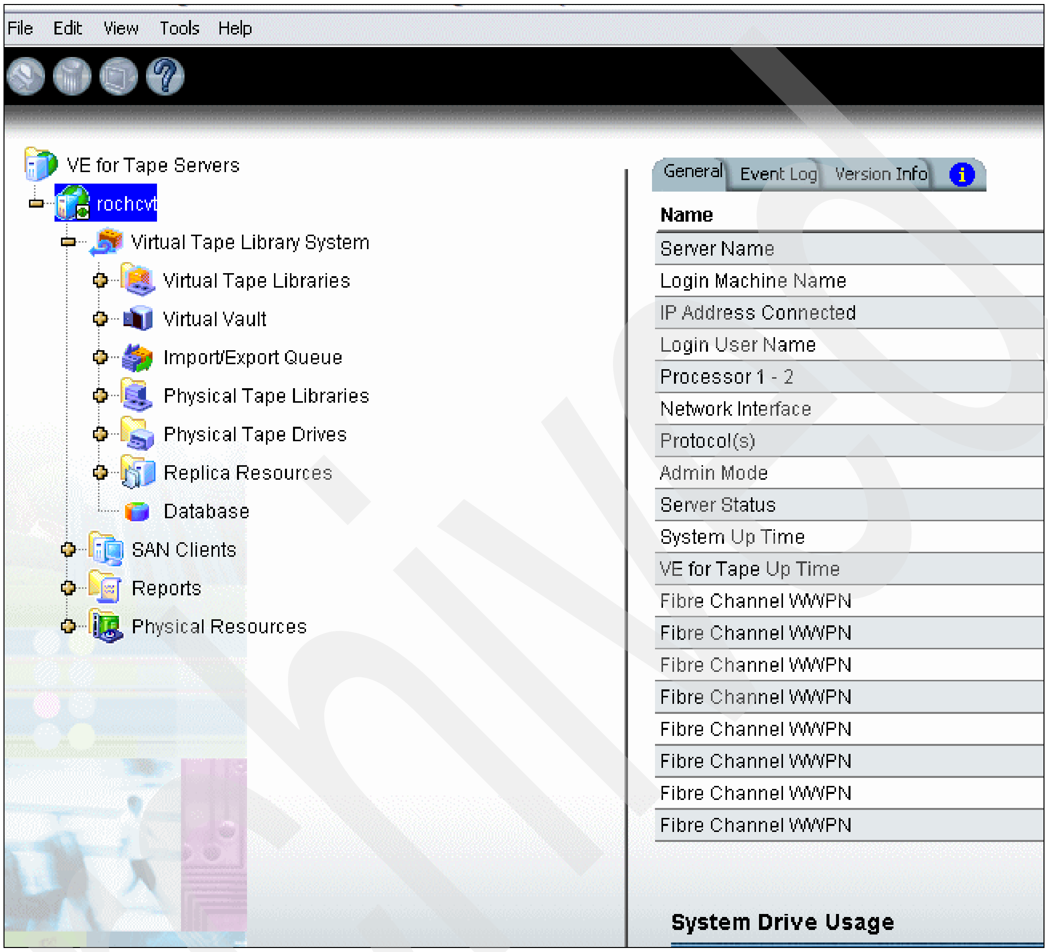



*Figure 7-16 Navigating to Event Log*

2. In the right panel, click the **Event Log** tab. This opens the Event Log as shown in Figure 7-17.

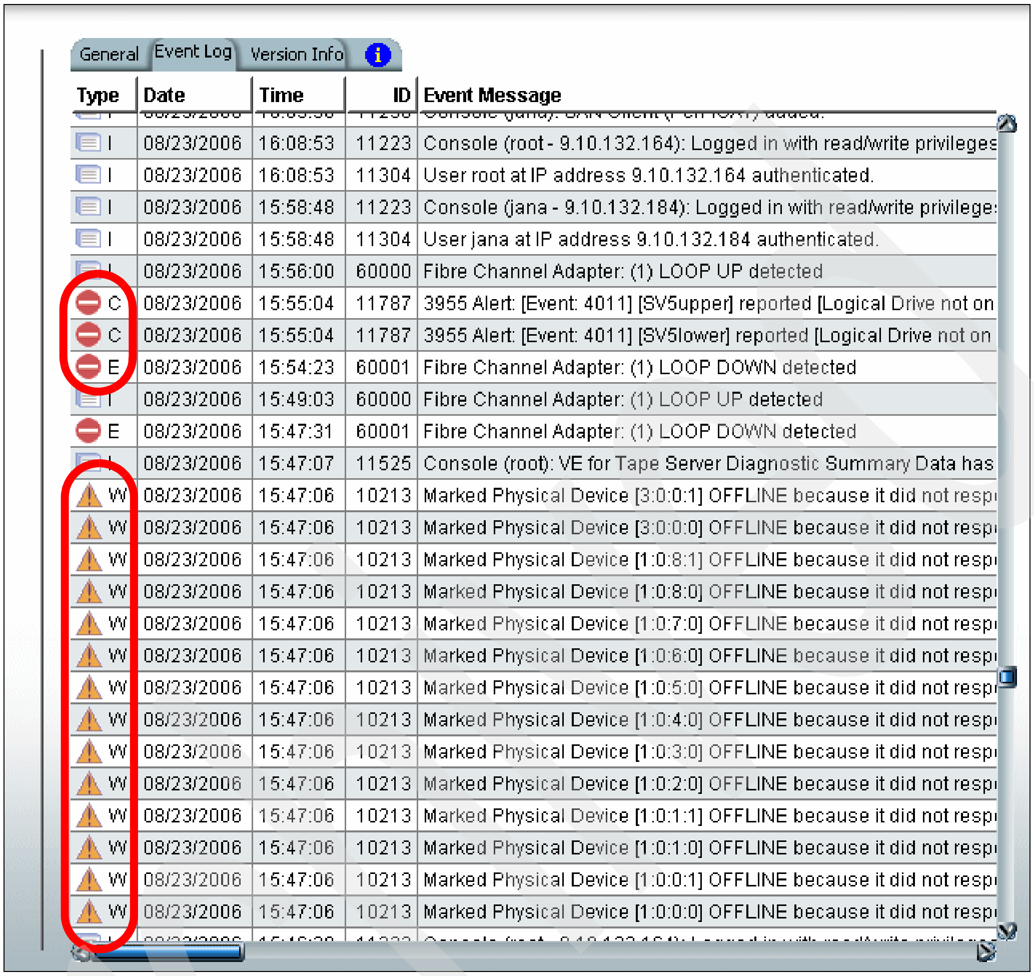



*Figure 7-17 Event Log*

## Event Log filtering

An Event Log contains different kinds of messages including informational messages (I), warning messages (W with exclamation mark), error messages (E with “stop” icon), critical messages (C with “stop” icon), and so on. See the icons circled in Figure 7-17 on page 266. If you want to display just some of message types, filter the entries in Event Log. For this:

1. Right-click the IBM Virtualization Engine TS7510 name in the left panel, and select **Event Log** from the pull-down list, as shown in Figure 7-18. Click **Filter** from the pull-down menu when you expand Event Log.

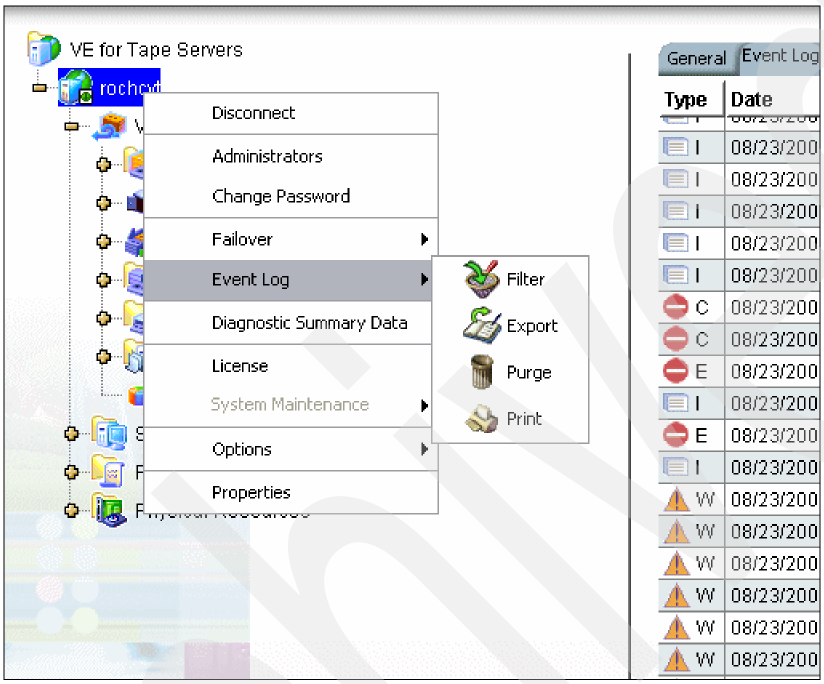



*Figure 7-18 Filtering Event Log*

2. You are presented a panel where you can select the types of events and range of items being displayed. After selecting, click **Apply,** then click **OK**. In our example, we selected only error and critical messages to be displayed. We also selected a date range from August 22 to August 29. Our example is shown in Figure 7-19.

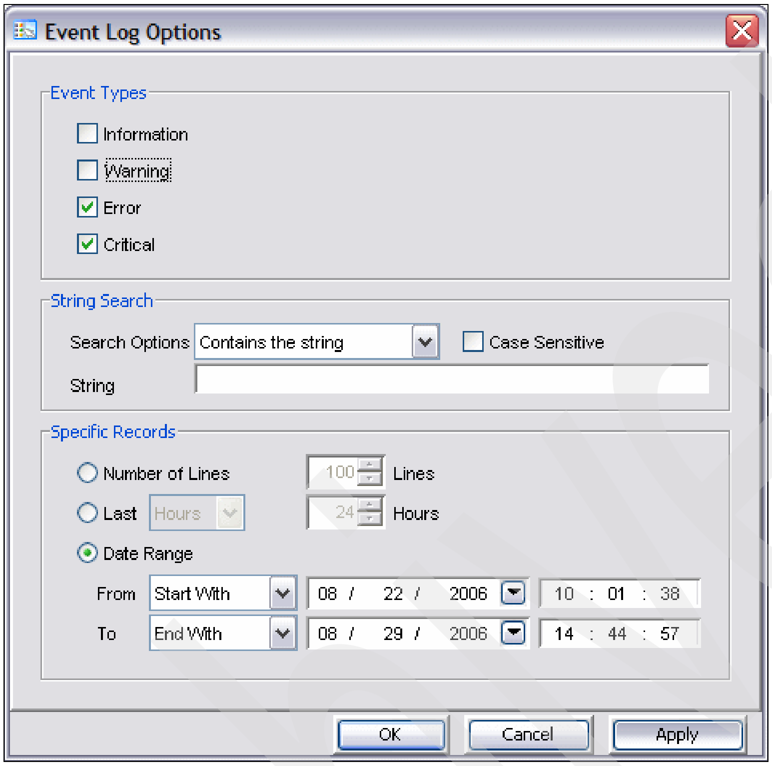
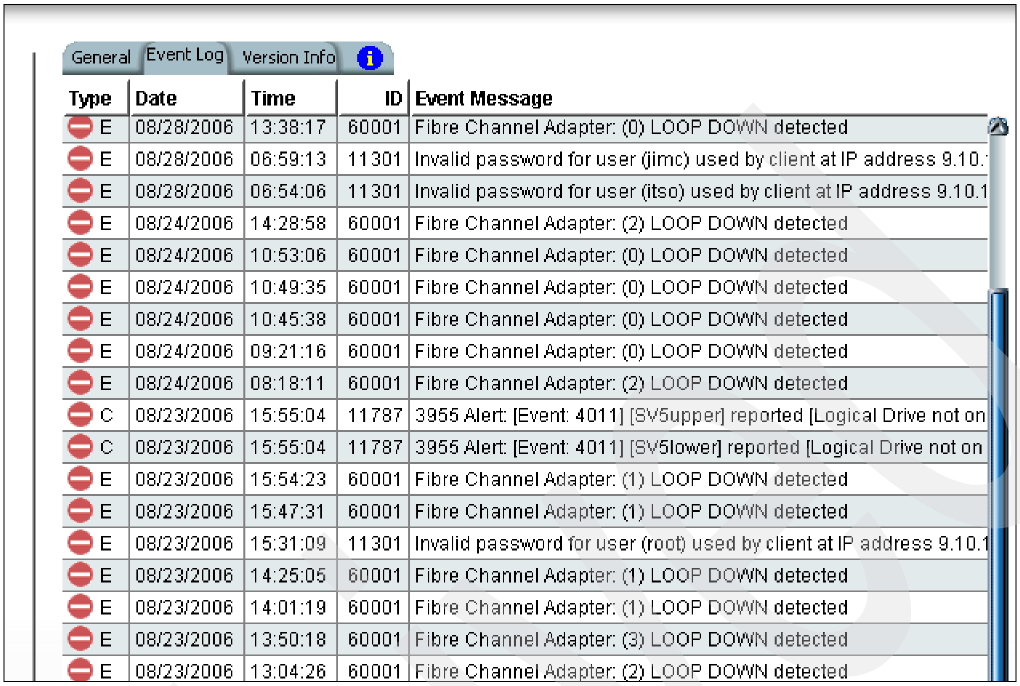



*Figure 7-19 Selecting item to display in Event Log*

As can be seen in Figure 7-20, only error and critical messages in the Event Log are now displayed.



General | Event Log | Version Info

| Type | Date | Time | ID | Event Message |
|---|---|---|---|---|
| E | 08/28/2006 | 13:38:17 | 60001 | Fibre Channel Adapter: (0) LOOP DOWN detected |
| E | 08/28/2006 | 06:59:13 | 11301 | Invalid password for user (jimc) used by client at IP address 9.10. |
| E | 08/28/2006 | 06:54:06 | 11301 | Invalid password for user (itso) used by client at IP address 9.10.1 |
| E | 08/24/2006 | 14:28:58 | 60001 | Fibre Channel Adapter: (2) LOOP DOWN detected |
| E | 08/24/2006 | 10:53:06 | 60001 | Fibre Channel Adapter: (0) LOOP DOWN detected |
| E | 08/24/2006 | 10:49:35 | 60001 | Fibre Channel Adapter: (0) LOOP DOWN detected |
| E | 08/24/2006 | 10:45:38 | 60001 | Fibre Channel Adapter: (0) LOOP DOWN detected |
| E | 08/24/2006 | 09:21:16 | 60001 | Fibre Channel Adapter: (0) LOOP DOWN detected |
| E | 08/24/2006 | 08:18:11 | 60001 | Fibre Channel Adapter: (2) LOOP DOWN detected |
| C | 08/23/2006 | 15:55:04 | 11787 | 3955 Alert: [Event: 4011] [SV5upper] reported [Logical Drive not on |
| C | 08/23/2006 | 15:55:04 | 11787 | 3955 Alert: [Event: 4011] [SV5lower] reported [Logical Drive not on |
| E | 08/23/2006 | 15:54:23 | 60001 | Fibre Channel Adapter: (1) LOOP DOWN detected |
| E | 08/23/2006 | 15:47:31 | 60001 | Fibre Channel Adapter: (1) LOOP DOWN detected |
| E | 08/23/2006 | 15:31:09 | 11301 | Invalid password for user (root) used by client at IP address 9.10.1 |
| E | 08/23/2006 | 14:25:05 | 60001 | Fibre Channel Adapter: (1) LOOP DOWN detected |
| E | 08/23/2006 | 14:01:19 | 60001 | Fibre Channel Adapter: (1) LOOP DOWN detected |
| E | 08/23/2006 | 13:50:18 | 60001 | Fibre Channel Adapter: (3) LOOP DOWN detected |
| E | 08/23/2006 | 13:04:26 | 60001 | Fibre Channel Adapter: (2) LOOP DOWN detected |

*Figure 7-20 Filtered display of Event Log*

If you want to export Event Log to your PC, print it on a printer or purge it. Click the IBM Virtualization Engine TS7510 name in the left panel, select **Event Log** in the pull-down menu, and select a required function in the pull-down list expanded from Event Log. You can see these options in Figure 7-18 on page 267.

## 7.2.2 SNMP alerts

The customers who have implemented SNMP in their IT environment can decide to monitor events signalled by the IBM Virtualization Engine TS7510 by generating SNMP alerts at certain critical events.

To set up SNMP monitoring, you configure Remote Supervisor Adapter (RSA) port in the 3954 Model CV5 for SNMP. After SNMP is configured, an SNMP alert will be generated at each critical event during IBM Virtualization Engine TS7510 activity. The event data is sent to an identified SNMP server.

For more information about how to set up to send SNMP alerts in IBM Virtualization Engine TS7510, refer to *Remote Supervisor Adapter II SlimLine* and *Remote Supervisor Adapter II User's Guide*.

**Note:** The RSA port 3954 Model CV5 can be configured for SNMP alerts; or it can be configured for Simple Mail Transfer Protocol (SMTP) mail used by CallHome. It is the customer's decision how to configure the RSA port. That is, they can choose no automated notification or can choose to monitor either via SNMP alerts or CallHome.

## 7.2.3 CallHome

CallHome is a utility in IBM Virtualization Engine TS7510 that proactively identifies potential failures and automatically notifies system administrators via an SMTP e-mail item details of the specific failure or condition.

Because this is a getting started document, we cannot go into significant detail about this function.

In this section, we provide some overview information sufficient to indicate the power of the built-in CallHome function. For more information about how to set up the CallHome function, refer to Chapter 5, “Installation and basic setup” on page 67.

When CallHome is enabled, it creates an SMTP e-mail item when a specific critical event is written to the Event Log. Using preconfigured scripts (called *triggers*), CallHome monitors a set of predefined critical components, such as SCSI drive errors or if a device becomes offline. When an event is triggered, CallHome uses its built-in Diagnostic Summary feature to capture the appropriate information details and include that information in the e-mail item.

The detailed information includes the Event Log information and a snapshot of the current configuration and environment of the IBM Virtualization Engine TS7510.

When you set up CallHome, you specify the SMTP user ID information and can optionally edit changes to the preconfigured trigger scripts. If you are an experienced user of this function in the IBM Virtualization Engine TS7510, you can also add your own elements to be monitored and included in an e-mail item.

To specify to CallHome:

1. Right-click your IBM Virtualization Engine TS7510 host name and select **CallHome** from the pull-down options list. You are presented with a window similar to the one shown in Figure 7-21.

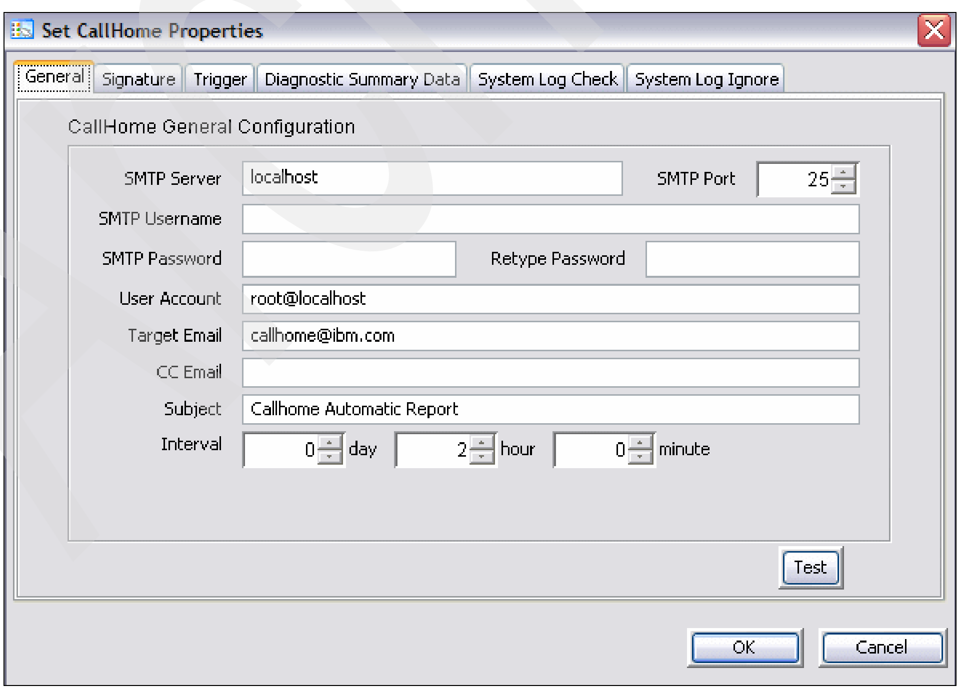



*Figure 7-21 CallHome setup: General*

Enter the SMTP e-mail information.

2. Review the other properties tabs to further define your CallHome when an event has been triggered. You have several detailed event properties tabs of information available to accept as defaults or to modify. This includes the IBM preconfigured trigger events and the Diagnostic Summary information.

   Figure 7-22 shows the event trigger scripts already defined with most of them preselected. Figure 7-23 on page 272 shows the Diagnostic Summary data items available with some of them already selected for you.

   In Figure 7-22, you can see the already enabled trigger scripts in the CallHome - Triggers Properties window. You can select or deselect each event script and add a new trigger if you are knowledgeable enough to do that.

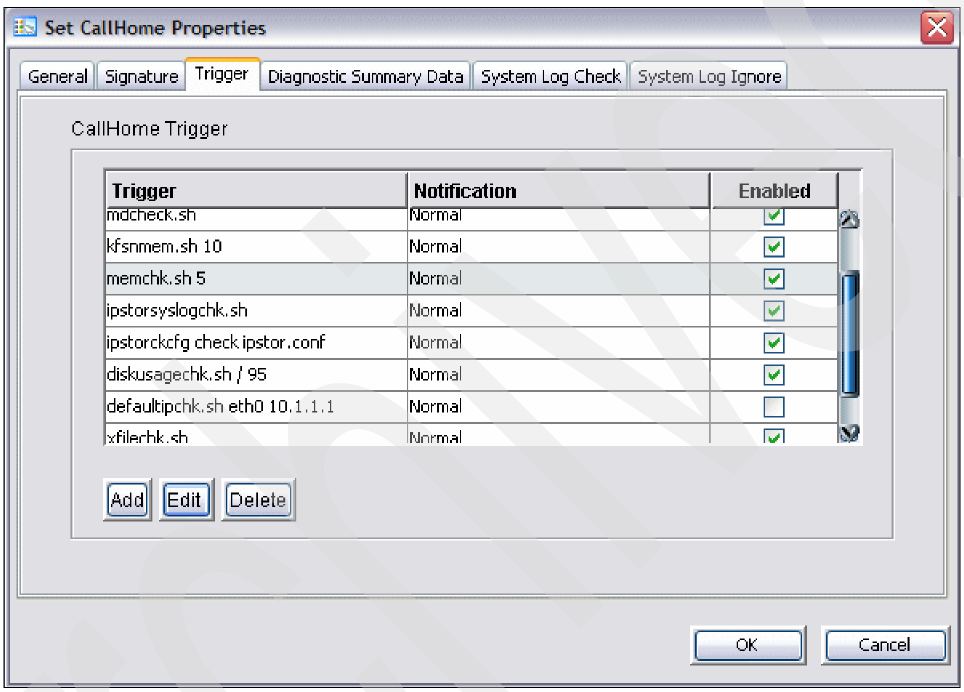



*Figure 7-22 CallHome: Trigger event filtering*

3. When you have finished setting up the triggers, select the Diagnostic Summary Data tab to see a window like the one shown in Figure 7-23.

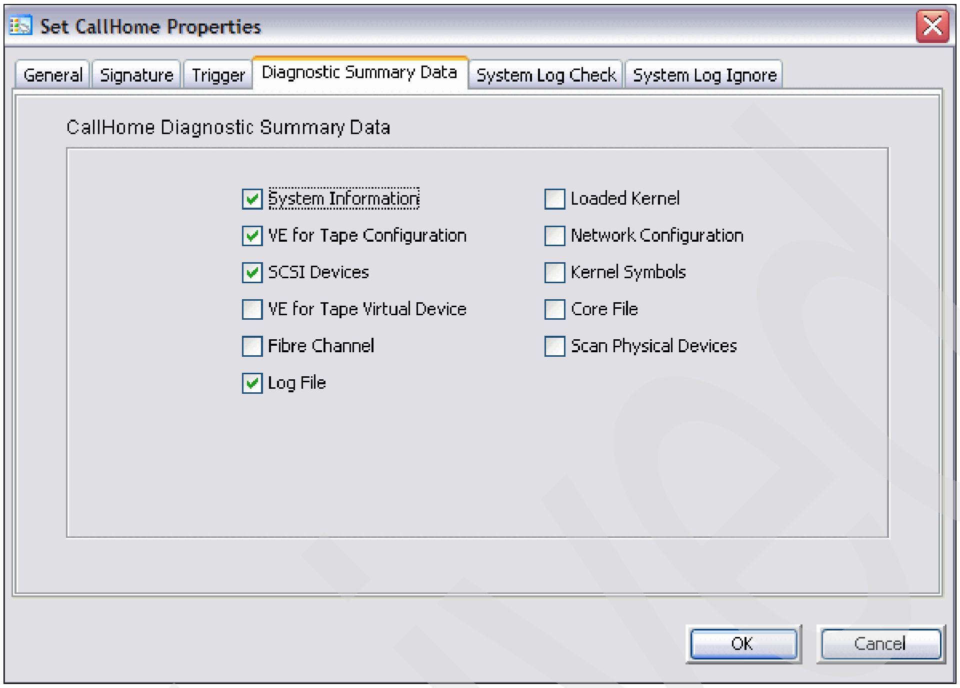



*Figure 7-23 CallHome: Diagnostic Summary Data*

You see that the diagnostic information is already preselected. You can select additional information to be included in the SMTP e-mail, depending upon your expertise with the IBM Virtualization Engine TS7510.

a. Review the System Log Check and System Log Ignore properties.

b. When you have finished, click **OK** and you have set up CallHome.

## 7.3 Problem determination

This section provides information about the tools for problem determination. First, we describe IBM Virtualization Engine TS7510 problem determination tools and then we describe System i problem determination tools. Finally, we provide some cases of problem determination.

### 7.3.1 IBM Virtualization Engine TS7510 problem determination tools

If your IBM Virtualization Engine TS7510 has some problem related to hardware, refer to the *IBM Virtualization Engine TS7510 Hardware Installation, Setup, and Problem Determination Guide*, GC26-7766. The manual describes the details of problem determination. The following sections are problem determination tools related to software. You can use the tools while you encounter some problem using virtual tape library.

## Event Log

The Event Log contains a record of significant occurrences that occur during the operation of the IBM Virtualization Engine TS7510 server. The Event Log can be viewed in the Virtualization Engine for Tape Console.

1. Select the IBM Virtualization Engine TS7510 server on Virtualization Engine for Tape Console.
2. Select the **Event Log** tab in the right pane. See Figure 7-24.

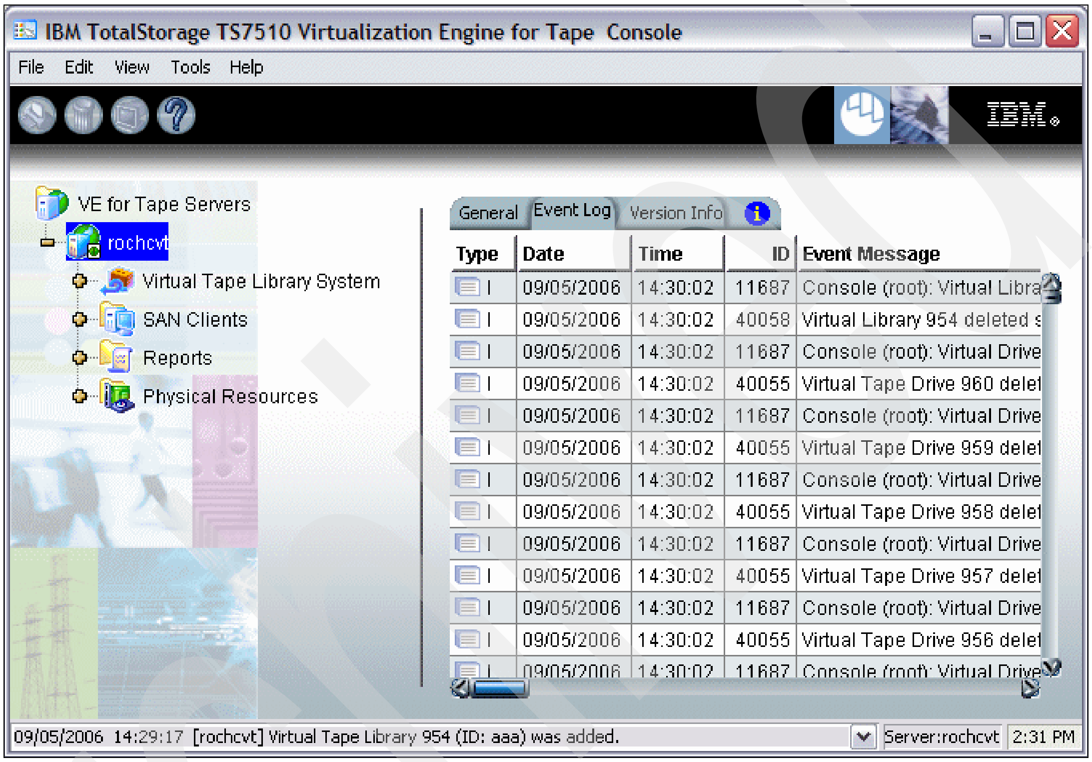



*Figure 7-24 IBM Virtualization Engine TS7510: Event Log*

More information about the use of the TS7510 reports to display the Event Log can be found in 7.2.1, “Event Log” on page 264.

> **Note:** When you right-click and select Event Log, this enables you to do the following additional functions:
>
> - Filtering Event Log
> - Exporting Event Log
> - Printing Event Log
> - Purging Event Log

## RSA remote console

RSA provides remote console function. See 5.2.5, “RSA configuration” on page 79. Remote console enables you to access text console, graphical user interface (GUI), and BIOS settings on 3954 Model CV5 via Ethernet network. It is useful to determine some problem related to Linux OS, network, Fibre Channel and also hardware error.

### *FAStT Storage Manager client*

Fibre Array Storage Technology (FAStT) Storage Manager client software application is used to access the TS7510 Cache Controller 3955-SV5 and attached TS7510 Cache Modules 3955-SX5. Access to FAStT Storage Manager is accomplished via the RSA port or by installing the FAStT Storage Manager client on the TS7510 Management Console.

See “FAStT Management Client” on page 61. The FAStT Storage Manager Client is used to determine problem.

**Note:** We recommend that you use RSA remote console and FAStT Storage Manager client with direction from IBM Support, when you require problem determination.

## Diagnostic data for technical support

Gathering diagnostic data is useful for your technical support team to help solve system problems. Each file contains technical information about your server, such as server messages and a snapshot of your server’s current configuration and environment. You should not create diagnostic data unless you are requested to do so by your technical support representative.

To create a diagnostic data file:

1. In the Virtualization Engine for Tape Console, right-click your IBM Virtualization Engine TS7510 server and select **Diagnostic Summary Data**.
2. Based on the discussion with your Technical Support representative, select the options you want to include and set the diagnostic summary file name, as shown in Figure 7-25.

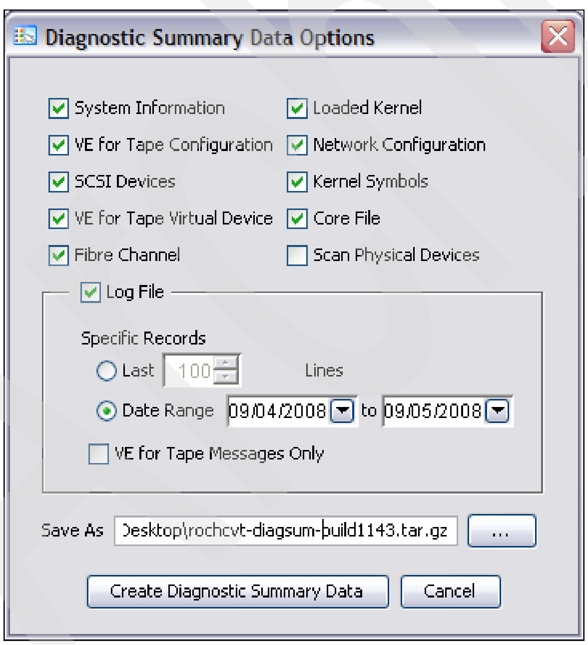



*Figure 7-25 IBM Virtualization Engine TS7510: Diagnostic Summary Data Options*

## 7.3.2 i5/OS problem determination tools

The following are the tools provided by i5/OS. The tools are also used in problem determination for physical tape resources.

### JOBLOG

If you find some problem during backup, first you must check the joblog of the backup job. The joblog might contain information that helps you to determine the cause of a backup problem. Many of these logs contain messages that can help you understand what the system has done concerning your backup functions.

- *Display Job Log* (*DSPJOBLOG*): If the job is interactive, use the DSPJOBLOG command to see the joblog.
- *Work with Active Jobs* (*WRKACTJOB*): If the job is running now, use WRKACTJOB command to see the status of the backup job.
- *Work with Submitted Jobs* (*WRKSBMJOB*): If the job was submitted, use the WRKSBMJOB command to see spool file of the submitted backup job.

### QSYSOPR

The system operator's message queue, QSYSOPR, is a good place to look for information about hardware software errors. Most of the error messages are logged to the QSYSOPR message queue. If the virtual tape library fails to back up, the QSYSOPR message queue logs an error message that indicates the reason for the failure. Issue DSPMSG QSYSOPR command to see QSYSOPR messages.

Of course, the WRKPRB command is useful to see some problems. The WRKPRB command shows descriptions of system problems, both system-detected and user-perceived. You can work with a problem, work with alerts, or work with the text you added to the problem record.

### Work with Hardware Resources (WRKHDWRSC) command

Work with Hardware Resources (WRKHDWRSC TYPE(*STG)) command shows the detection of tape library and tape device. After i5/OS detect tape library, TAPMLBXX device description is created (SYSVAL QAUTOCFT=1 is required). Then you can see TAPMLBXX device, as shown Figure 7-26.

```
        Work with Storage Resources

  Type options, press Enter.
    7=Display resource detail   9=Work with resource

  Opt  Resource        Type-model  Status              Text
       CMB09            2844-001   Operational         Combined function IOP
         DC04           5704-001   Operational         Tape Controller
         TAPMLB02       3584-032   Operational         Tape Library
```

*Figure 7-26 WRKHDWRSC TYPE(*STG) command*

You can see the tape device by selecting TAPMLBXX device with **9=Work with resource**. See Figure 7-27. You can verify that TAPMLB devices and TAP devices are operational.

```
     Work with Storage Controller Resources

Type options, press Enter.
  5=Work with configuration descriptions   7=Display resource detail

Opt  Resource        Type-model  Status              Text
     TAPMLB02         3584-032   Operational         Tape Library
       TAP11          3580-003   Operational         Tape Unit
       TAP12          3580-003   Operational         Tape Unit
```

*Figure 7-27 WRKHDWRSC TYPE(*STG) command: Tape device*

## System Service Tools

System Service Tools (SST) displays hardware information in detail. If the WRKHDWRSC command does not show tape libraries and tape devices correctly, try to do SST for problem determination. SST displays TAPMLBXX devices and TAP devices and also shows the tape drive serial number.

If you want to know the WWPN of the Fibre adapter from the operating system, you must use SST. The following method shows how to display the WWPN of the Fibre adapter.

1. Start SST with the STRSST command and log on DST user.
2. Select **1. Start a service tool** → **7. Hardware service manager** → **2. Logical hardware resources** → **1. System bus resources**. SST now shows Logical Hardware Resources on System Bus, as shown Figure 7-28.

```
      Logical Hardware Resources on System Bus

Type options, press Enter.
  2=Change detail    4=Remove    5=Display detail    6=I/O debug
  7=Display system information
  8=Associated packaging resource(s)     9=Resources associated with IOP

                                                               Resource
Opt Description                        Type-Model  Status          Name
    HSL I/O Bridge                      28E7-      Operational     BC09
     Bus Expansion Adapter              28E7-      Operational     BCC14
      System Bus                        28B7-      Operational     LB12
       Multi-adapter Bridge             28B7-      Operational     PCI11D
        Combined Function IOP           2844-001   Operational     CMB14
 9      Combined Function IOP           2844-001   Operational     CMB09
```

*Figure 7-28 SST: Logical Hardware Resources on System Bus*

3. Select the IOP that has Fibre adapter with **9=Resources associated with IOP**. The Logical Hardware Resources Associated with IOP screen opens. See Figure 7-29.

```
      Logical Hardware Resources Associated with IOP

Type options, press Enter.
  2=Change detail    4=Remove    5=Display detail    6=I/O debug
  7=Verify           8=Associated packaging resource(s)

                                                               Resource
Opt Description                    Type-Model  Status          Name
    Combined Function IOP           2844-001   Operational     CMB09
 5   Storage IOA                    5704-001   Operational     DC04
      Tape Library                  3584-032   Operational     TAPMLB02
       Tape Unit                    3580-003   Operational     TAP11
       Tape Unit                    3580-003   Operational     TAP12
       Tape Unit                    3580-003   Operational     TAP13
```

*Figure 7-29 SST: Logical Hardware Resources Associated with IOP*

4. Select **Storage IOA with 5=Display detail.** You can see the Auxiliary Storage Hardware Resource Detail as shown in Figure 7-30. You can see the WWPN of the Fibre adapter.

```
      Auxiliary Storage Hardware Resource Detail

Description . . . . . . . . . . . . :   Storage IOA
Type-model  . . . . . . . . . . . . :   5704-001
Status  . . . . . . . . . . . . . . :   Operational
Serial number . . . . . . . . . . . :   1F-9420250
Part number . . . . . . . . . . . . :   0000000P4295
Resource name . . . . . . . . . . . :   DC04
Worldwide port name . . . . . . . . :   10000000C93FC5AC
```

*Figure 7-30 SST: Auxiliary Storage Hardware Resource Detail*

### 7.3.3 The case of problem determination

Most cases of problem determination are described in *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769 (Chapter 10, "Troubleshooting"). If you encounter the following problems, check this manual. In the following sections, we describe some unique cases of problem determination related to i5/OS.

- General Management Console operations
  - Management Console is unable to connect to a TS7510 Virtualization Engine server
  - Requested operations cannot be performed from the Management Console
  - Management Console operations are very slow
- Physical resources
  - TS7510 Virtualization Engine Management Console does not show physical storage devices as expected

- Logical resources
  - Virtual tapes are displayed as offline on the Management Console
  - Tape expansion does not work
  - Client cannot see tape library or drive as provisioned by TS7510 Virtualization Engine
  - Client sees the tape library or drive but cannot access it
- Import/Export does not work as expected

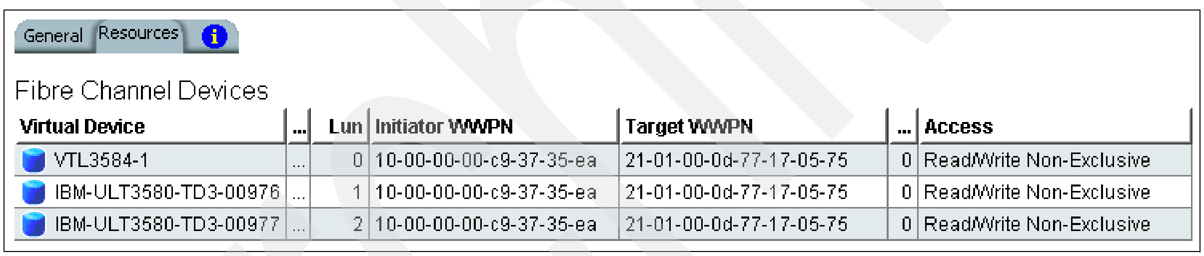
### i5/OS cannot see virtual tape libraries or virtual tape drives

This case is related in *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769, (Chapter 10, "Troubleshooting"). Client cannot see tape library or drive as provisioned by TS7510 Virtualization Engine.

- Hardware check
  - Check the physical connection between i5/OS and the IBM Virtualization Engine TS7510.

    Verify the Fibre adapter on both i5/OS and the IBM Virtualization Engine TS7510 that all lights are green and blinking.
- IBM Virtualization Engine TS7510 check
  - Verify that the pair of initiator WWPN and target WWPN is correct.

    Open your SAN client of i5/OS on Virtualization Engine for Tape Console and select the **Resources** tab, as shown in Figure 7-31. You can verify that the adapters holding the WWPNs are correctly connected and also verify that SAN zoning does not prevent the connection.




| Virtual Device | ... | Lun | Initiator WWPN | Target WWPN | ... | Access |
|---|---|---|---|---|---|---|
| VTL3584-1 | ... | 0 | 10-00-00-00-c9-37-35-ea | 21-01-00-0d-77-17-05-75 | 0 | Read/Write Non-Exclusive |
| IBM-ULT3580-TD3-00976 | ... | 1 | 10-00-00-00-c9-37-35-ea | 21-01-00-0d-77-17-05-75 | 0 | Read/Write Non-Exclusive |
| IBM-ULT3580-TD3-00977 | ... | 2 | 10-00-00-00-c9-37-35-ea | 21-01-00-0d-77-17-05-75 | 0 | Read/Write Non-Exclusive |

*Figure 7-31 IBM Virtualization Engine TS7510: Fibre Channel Devices*

- i5/OS partition check
  - Check that System Value QAUTOCFG is 1=On.

    If QAUTOCFG is not 1=On, i5/OS detects the resources but does not create device descriptions.
  - Check resources from SST.

    See "System Service Tools" on page 276. You can verify the resources using SST screen. If you cannot see any resources on the correct Fibre adapter, you might have to perform IOP-reset to recognize the new tape library. Contact IBM Support and get the directions to perform IOP-reset.

## i5/OS fails to back up data to virtual tape library

This case is related in *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769, (Chapter 10, "Troubleshooting"). Client sees the tape library or drive but cannot access it.

- i5/OS partition
  - Check the i5/OS joblog and messages for your backup jobs.

    See "JOBLOG" on page 275, and "QSYSOPR" on page 275. First, you have to check the log of the backup job, QSYSOPR message queue, and WRKPRB output.
  - Verify that TAPMLB and TAP devices are showing the correct status.

    Use the WRKMLBSTS command to see the status of TAPMLB. Verify that TAPMLB device is varied on and the TAP devices are operational. See the example in Figure 7-32.

    If some TAP devices are varied on, the TAP devices are not operational. You must vary off the TAP devices.

```
      Work with Media Library Status

Type options, press Enter.
  1=Vary on   2=Vary off   3=Reset resource       4=Allocate resource
  5=Allocate unprotected   6=Deallocate resource   8=Work with description

      Device/                                                   Job
Opt     Resource     Status                Allocation           name
      TAPMLB02      VARIED ON
        TAP11       OPERATIONAL            UNPROTECTED
        TAP12       OPERATIONAL            UNPROTECTED
        TAP13       OPERATIONAL            UNPROTECTED
```

*Figure 7-32 WRKMLBSTS command*

A

# Sizing and performance examples

In this appendix, we discuss the facts that influence performance of the TS7510 with i5/OS. Some of these apply generally to the TS7510 connected to any operating system. Our content includes disk storage sizing and examples of save performance test results.

This appendix includes performance measurements of IBM Virtualization Engine TS7510 within an i5/OS V5R4 i5/OS partition run during this residency. The tests were done informally through cooperation among i5/OS and TS7510 development, the IBM Redbook residents and IBM System i performance assessment people who produce the *System i Performance Capabilities Reference* manual. We used our own devised test cases as well as a subset of test cases that are used to provide information for the save and restore chapter of the *System i Performance Capabilities Reference, i5/OS Version 5, Release 4* manual.

Our performance test coverage was a reasonable combination of single larger files and a mix of many small files as these are the typical scenarios that provide the range of highest throughput (single large file) and lower throughput (many small files) when doing save and restore functions. At the time this IBM Redbook was published, there were no plans to do additional performance testing and documentation of TS7510 and it/OS performance.

> **Performance disclaimer:** The information in this appendix is presented "as is" and as such, does not guarantee similar results in customer unique save and restore scenarios. The information is presented to assist you in determining reasonable performance expectations unique to your own environment.

# General performance discussion

Performance of external storage device, and related sizing guidelines are always an important subject, in planning, implementation, and maintenance of the device. They are especially important when an external storage device is connected to System i partition running critical i5/OS production workload.

When saving to or restoring from a virtual tape library (VTL), the operating system issues tape device input and output operations are performed with the disk configuration within the Virtualization Engine TS7510. Therefore, the performance of virtual tape drives actually depends on factors that influence external disk performance. The most important of these being the number of disk arms and number of FC adapters used. We discuss each of them in more details. But even before that, we briefly describe data flow between an i5/OS partition and IBM Virtualization Engine TS7510.

## Data flow

When a block of data is written to a virtual tape in TS7510, or read from a virtual tape, it is transferred from i5/OS memory to the input/output processor (IOP), then to the input/output adapter (IOA), and through SAN connection to the TS7510. A write operation is acknowledged as soon as the data reaches the memory in CV5. Then, the data is transferred to the disk system consisting of SV5 and SX5, first to the cache in SV5, and finally to the disk drives.

An example of the data flow (indicated by the orange arrow) is shown in Figure A-1.

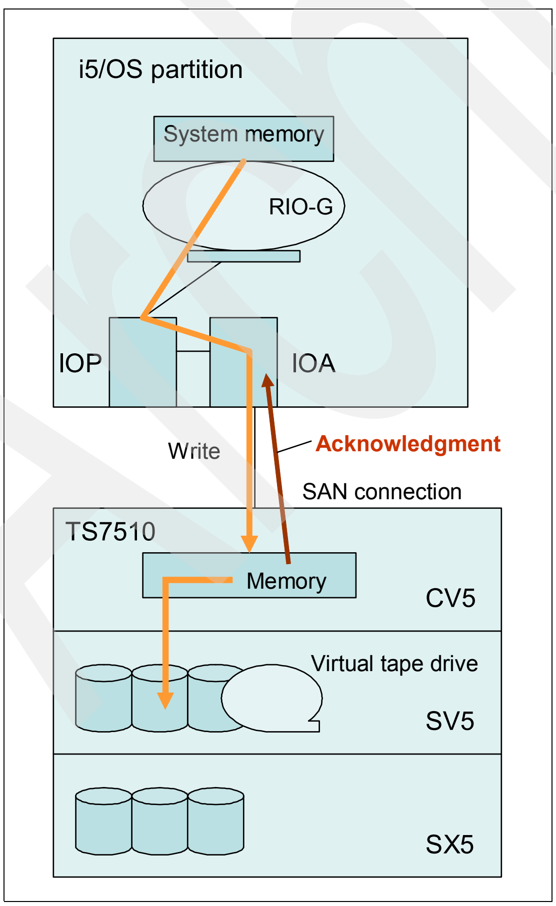



*Figure A-1 Data flow to a TS7510 disk drive*

The IOA shown can be a Fibre Channel tape adapter feature #2765, #5704, or #5761. The terms *RIO-G* and *HSL-2* can be used interchangeably; they represent the same loop technology.

## Number of disk arms used in IBM Virtualization Engine TS7510 at save and restore

The disk drives within a Virtualization Engine TS7510 reside in two 3955 Model SV5s and optionally in up to fourteen 3955 Model SX5s. Each 3955 Model SV5 and 3955 Model SX5 contains 14 Serial Advanced Technology Attachment (SATA) technology disk drives of size 250 GB, which are divided in two Redundant Array of Independent Disks 5 (RAID-5) arrays of seven disk drives. Both 3955 Model SV5s, and the two 3955 Model SX5s in an expansion frame contain two *hot spare* disk drives. This can be seen in Figure A-2, which shows a maximum disk configuration.

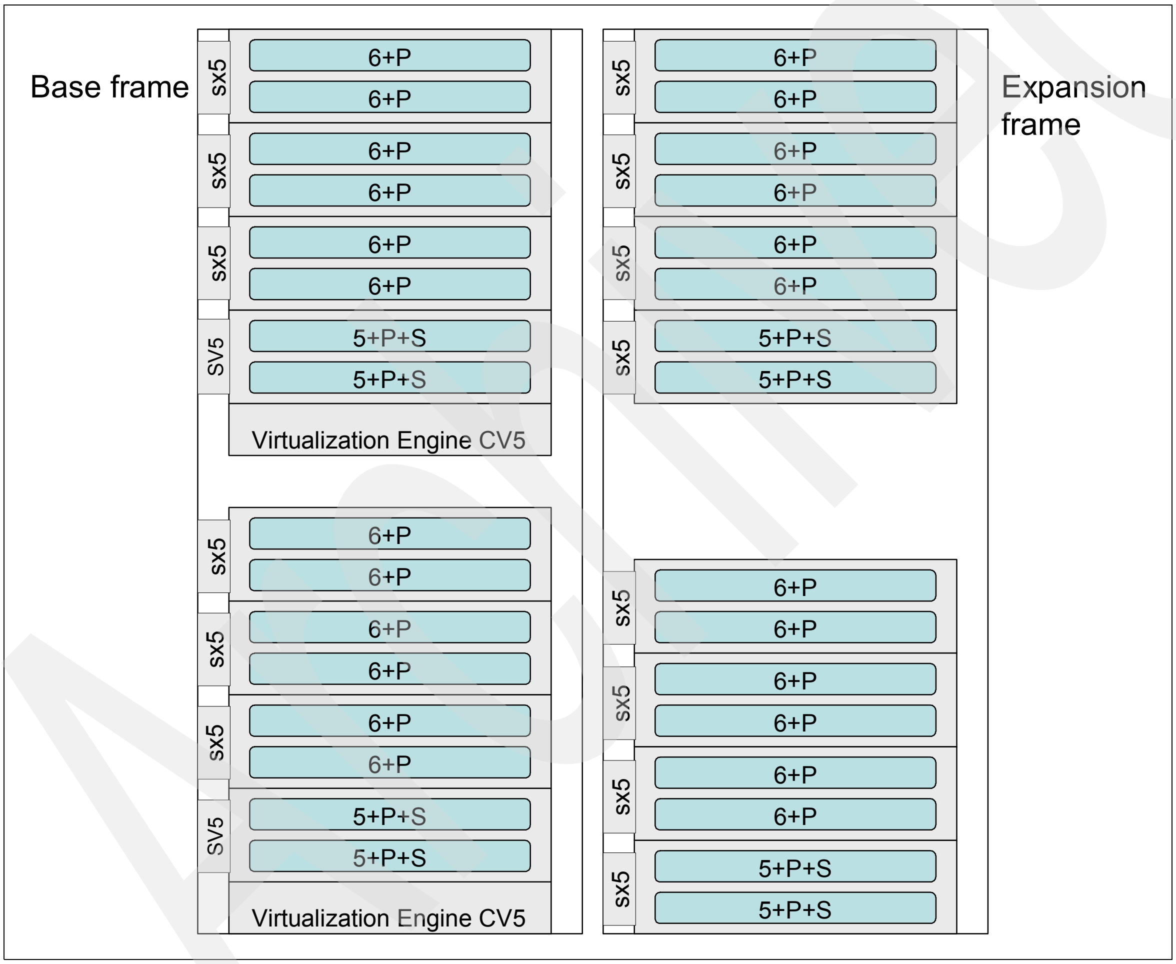



*Figure A-2 Disk drive arrays in IBM Virtualization Engine TS7510*

The following logical volumes (LUNs) - *logical disks*, are defined from RAID-5 arrays within a 3955 Model SV5:

- One 8 GB - Boot LUN for Virtualization Engine
- Two 1 GB LUNs for repository of Virtualization Engine software
- One 1152 GB LUN for virtual tapes
- One 1162 GB LUN for virtual tapes

This is shown in Figure A-3.

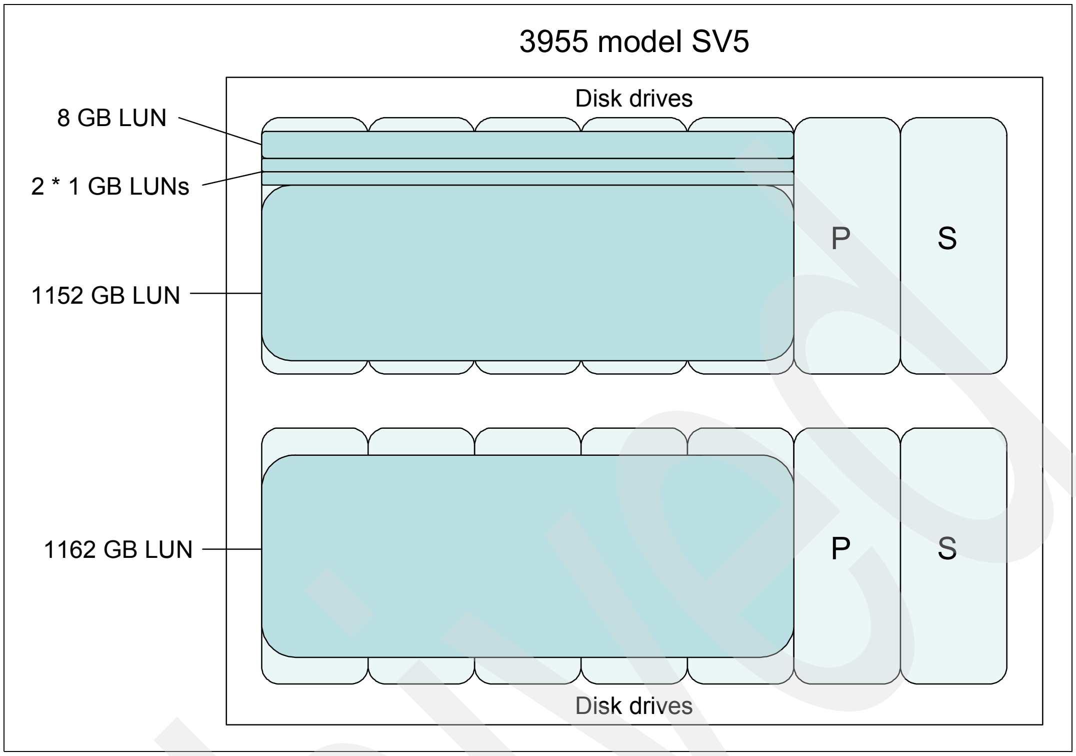



*Figure A-3 LUNs in 3955-SV5*

Each *big LUN* (1152 GB, 1162 GB) is used for virtual tape drives in a RAID-5 array. Therefore, it uses either five disk drives or five disk drives as described next.

In each 3955 Model SX5 with spare disk drives, there are two LUNs of size 1162 GB for virtual tapes, each LUN using five disk arms from one RAID-5 array. In each 3955 Model SX5 without spare disk drive, there are two LUNs of size 1497 GB for virtual tapes, each LUN using six disk arms from one RAID-5 array.

When a virtual tape is created by the user, the TS7510 software assigns 5 GB disk space by default. You can change this default value to more disk space. As saves are performed to a virtual tape, its size dynamically increases in increments of 5 GB or 7 GB depending on specified type of tape device being emulated by your virtual tape definition.

When a virtual tape is mounted the first time, it is assigned disk space from one LUN. While this tape is further used and more than the default size (we assume 5 GB in this document) is required, the initial size is incremented using disk space from the same LUN, until this LUN is filled with data. If even more disk space is needed for a virtual tape after the LUN has been filled, disk space from another LUN is used.

When a virtual tape is mounted the first time, the algorithm in the TS7510 picks up a LUN for disk assignment is designed to keep the number of virtual tapes per LUN as equal as possible. This is done independently of the VTL to which the tape belongs.

We expect that a virtual tape will frequently use disk space from only one LUN most of the time, therefore five or six disk arms will be used during save to or restore from a virtual tape.

At the same time, other virtual tapes may use disk space from the same LUN. In times of high I/O rates from multiple saves being performed during the same time, this can impact performance.

## The number of Fibre Channel ports used

The following two types of Fibre Channel ports are used when saving to or restoring from a virtual tape:

- Fibre Channel (FC) adapter in the System i partition running i5/OS: This adapter is generically also referred to as an input/output adapter (IOA). They provide 2 Gb/sec or 4 Gb/sec, depending on the type of IOA (2765/5704 = 2 Gbps, 5761 = 4 Gbps).
- Fibre channel (FC) port within the IBM Virtualization Engine TS7510 3954 Model CV5: They provide 2 Gb/sec.

Technically, up to 16 VTLs can be assigned to one IOA under i5/OS and all VTLs from one IBM Virtualization Engine TS7510 can be assigned to all FC ports in that TS7510. However, for performance reasons, you should restrict these assignments to fewer VTLs per i5/OS owned IOA and fewer FC ports in a IBM Virtualization Engine TS7510 per VTL. We discuss more on this subject later in this appendix where we discuss sizing guidelines for assigning IOAs and FC ports.

# Sizing the IBM Virtualization Engine TS7510

Because the IBM Virtualization Engine TS7510 may be used in very complex environments (multiple operating systems and multiple saves or restores running at the same time), it is important to have a clear picture of what backups will be done at which time, to properly size for them.

It is also important to know the amount of data saved, and if parallel (concurrent) saves will be used. After the schedule of backups is clear, we recommend that you roughly estimate how long each backup will take, and figure out which will be the most busy period. You then have to size the IBM Virtualization Engine TS7510 for the most busy period. Also, we recommend that you determine which is the maximum duration time of backup that the customer can afford. If needed, consider the i5/OS capability to perform parallel save to two tape drives from the same save job to decrease the duration of time to complete the save. In 3.9, “Examples of using TS7510 with i5/OS” on page 44, we present how to plan for some customer cases.

Sizing should be done for the following elements and functions of the IBM Virtualization Engine TS7510:

- Number of virtual tape drives
- Number of IBM Virtualization Engine TS7510
- IOAs in i5/OS, and the number of virtual tape libraries
- Number of virtual tapes
- FC ports in IBM Virtualization Engine TS7510
- Number and size of virtual tapes

Further in this chapter, we describe sizing for each of the listed elements.

After sizing the elements and the functions listed above, consider the resources required for exporting virtual tapes to a physical tape library, the replication function, and the high-availability option of the IBM Virtualization Engine TS7510.

Decide on your IBM Virtualization Engine TS7510 configuration based on values obtained for sizing all of the considerations we have covered.

The flow of the steps for sizing a IBM Virtualization Engine TS7510 for an i5/OS partition is shown in Figure A-4.

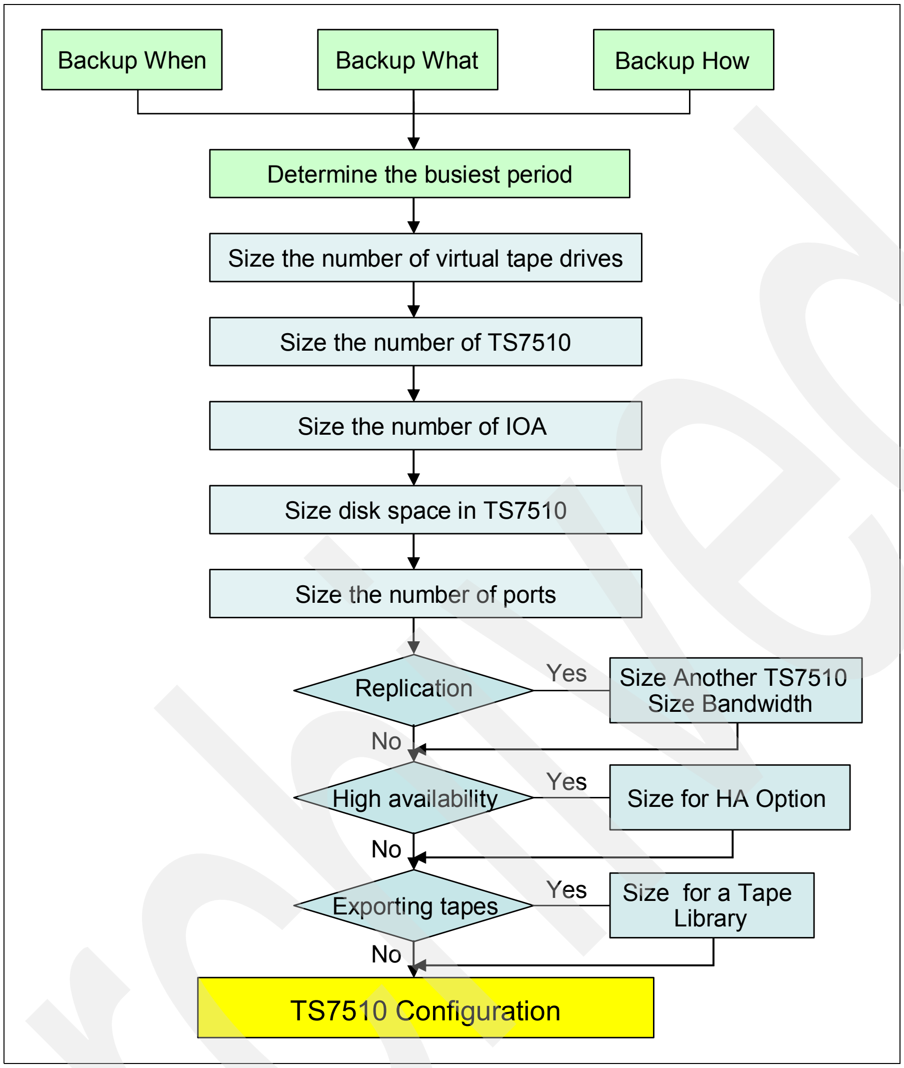



*Figure A-4 Sizing steps for the TS7510 with i5/OS partition*

## Sizing the number of virtual tape drives for peak workloads

After you determine how many tape drives are needed for each save, we recommend that you look for the period when the most tape drives needed.

According to the example shown in 3.9.1, “Example 1: Four i5/OS partitions saving entire system in different time periods” on page 44, we decided that parallel save will be done for systems B and D, therefore two tape drives are needed for each save of system B and D. The total number of tape drives needed on each day is shown in the Table A-1.

*Table A-1 Peak terabytes of data saved each weekday per system*

| | 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 | 1.5 TB | 1.5 TB |
| No. drives | 2 | 2 | 2 | 2 | 2 | 4 | 5 |
| Total size | 0.4 TB | 0.4 TB | 0.5TB | 1.5 TB | 1.5 TB | 2.8 TB | 3.5 TB |

As can be seen in Table A-1, five virtual tape drives are required in the busiest period, which is Sunday. Therefore, in this example, we sized for five virtual tape drives.

As can be seen in the graphs shown in Figure A-5 on page 288 (save writes) and Figure A-6 on page 288 (restore reads), four virtual tape drives achieve up to approximately 350 GB per hour.

Later in this appendix, in "Save and restore performance measurements using i5/OS" on page 293, we describe performance results of several workloads. One of the test measurements shows a Large Database File workload delivers about 350 GB per hour. Another workload - User Mix saves at about 300 GB per hour. Therefore, in general, you can consider using 300 GB to 350 GB per hour when estimating the time needed for backup.

However, if you are planning backups of workloads significantly different from our Database File or User Mix workloads, you may want to consider the measurements of our i5/OS workloads described in "Save and restore of different workloads, comparing to other tape devices" on page 294.

For more information about i5/OS workloads used for performance measurements in this IBM Redbook, refer to "Workloads used for the IBM Redbook test benchmarks" on page 294.

## Sizing the number of IBM Virtualization Engine TS7510 systems

Measurements of total throughput of IBM Virtualization Engine TS7510 with different number of virtual tape drives were performed in IBM Storage Systems development. They were performed for read operations and write operations for both base configuration (1 node) and high-availability configuration (2 nodes). In this testing, four FC ports in CV5 were used for host connection. Virtual tape drives were connected so that each virtual tape drive was assigned to a particular FC port in CV5, and the drives were evenly split across all available ports. The throughput achieved at a certain number of tape drives in these tests, is shown in the graphs in Figure A-5 (peak write rates) and Figure A-6 (peak read rates).

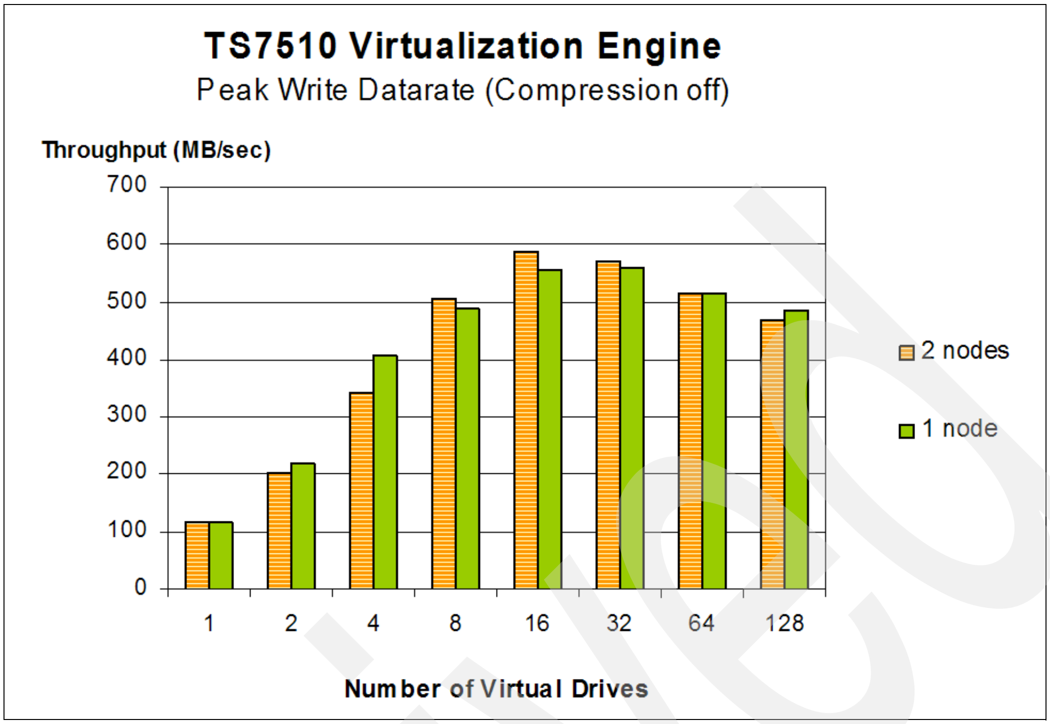



*Figure A-5 Write peak data rate in TS7510*

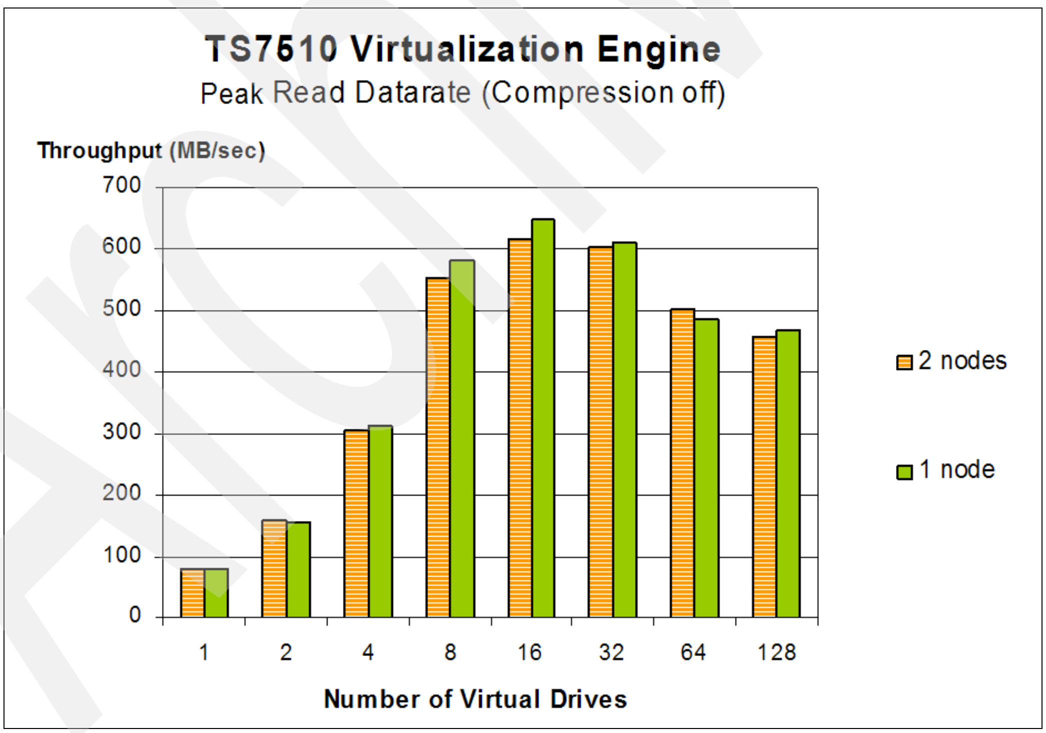



*Figure A-6 Read peak data rate in TS7510*

As can be seen in these graphs,16 is the optimal number of virtual tape drives to be active at the same time in a IBM Virtualization Engine TS7510. If more tape drives are needed to work at the same time, it is a good idea to consider more than one IBM Virtualization Engine TS7510.

This consideration is valid regardless of how many VTLs are defined, and how the virtual tape drives are spread across VTLs.

## Sizing the number of IOAs and VTLs

When two virtual tape drives are connected to one IOA (FC adapter), each tape drive achieves the data rate of up to 350 GB/h in saving Large Database File workload. Almost the same rate is achieved when two tape drives are connected through the same IOA, as can be seen in Figure A-9 on page 299 saving concurrently the Large Database File. Therefore, you may want to attach two virtual tape drives to one FC IOA within an i5/OS partition.

This consideration is valid for both IBM System i 2 Gbps adapters (#2765, #5704) and 4 Gbps adapters (#5761) in a System i partition, because 3954 Model CV5 contains 2 Gb FC ports, and thus the available bandwidth between any IOA and an FC port in CV5, is 2 Gb.

Because each IOA must have a control path defined in a VTL, and only one control path is possible per VTL, size for one VTL on each IOA. However, if you decide to use multiple virtual tape drives attached to one IOA, you can consider multiple VTLs on that IOA.

We also recommend that you consider the usage of tapes when sizing VTLs, because each VTL is registered in Backup Recovery and Media Services (BRMS) as a tape library containing its own tapes.

## Sizing the disk capacity in IBM Virtualization Engine TS7510

When sizing the required disk space in 3955 Model SV5 and 3955 Model SX5, 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 TS7510. 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 TS7510 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 TS7510 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 which is kept for less than 2 weeks must be restored in 1 hour.
  - Mail which is kept for longer than 2 weeks can be restored in 3 hours.

We recommend sizing disk space within IBM Virtualization Engine TS7510 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:

  Formula: (daily amount of backup data) x (number of days the backup is kept) = disk capacity required for current backup environment

  Example: 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:

  Formula: (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: 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

- If cumulative incremental backup is done every day, and full backup is done every week:

  Formula: (weekly amount of backup data) x (number of weeks the backup is kept) +

  (amount of last cum. increment) x 3 = disk capacity required for current backup environment

  > **Note:** In this case, we recommend keeping the last cumulated (the biggest) incremental backup, to apply to the last full backup. To be on the safe side, we suggest that you keep it for 3 days.

  Example: A customer saves weekly 1.4 TB as full backup, and saves daily cumulative incremental backup. The last cumulative incremental backup in the week is 500 GB. He keeps the saved data for 3 weeks. Disk capacity required for current backup environment is as follows:

  1.4 TB x 3 + 500 GB x 3 = 5.7 TB

We also recommend taking into account the possible monthly growth of data to be saved and restored. For this, calculate first the amount of disk space required for monthly growth by the following formula:

Formula: (disk capacity required for current backup environment) x (% monthly data growth) = amount of disk space required for monthly growth

Next, approximate the required disk space to accommodate current backup environment and monthly growth, based on a decision for how many months should disk space in the TS7510 be sufficient:

Formula: (disk capacity required for current backup environment) + (number of month disk space should be sufficient) x (amount of disk space required for monthly growth) = required disk capacity including monthly growth

Example: Customer's disk capacity required for current backup environment is 5.7 TB. The customer plans 3% of monthly data grow, and he wants disk space in IBM Virtualization Engine TS7510 to be sufficient for 12 months.

Amount of disk space required for monthly growth is as follows:

5.7 TB x 3% = 0.17 TB

Required disk capacity including monthly growth is as follows:

5.7 TB + 12 x 0.17 TB = 7.74 TB

> **Tip:** The TS7510 offers much flexibility in handling the amount of data that *fits* on a virtual tape volume. Up to a maximum of available disk storage, the original size of a virtual volume can be extended. This is in direct contrast to the physical limits of each real tape media. This significantly eases the task of managing your backups.

## Example of sizing disk capacity in IBM Virtualization Engine TS7510

In this example, we size the required disk space in IBM Virtualization Engine TS7510 for the case described in Example 1 in 3.9.1, "Example 1: Four i5/OS partitions saving entire system in different time periods" on page 44.

The customer plans to use IBM Virtualization Engine TS7510 for four i5/OS partitions, his backup scheme is shown in Table A-2. The customer plans current configuration of IBM Virtualization Engine TS7510 for 6 months including monthly growth.

*Table A-2 Example backup sizes and schedule*

| | Monday | Tuesday | Wednes-day | Thursday | Friday | Saturday | Sunday | Time to keep data | Monthly growth |
|---|---|---|---|---|---|---|---|---|---|
| System A | 0.2 TB | 0.2 TB | 0.3 TB | 0.3 TB | | | 0.7 TB | 14 days | 2% |
| System B | | | | | | 1.3 TB | 1.3 TB | 14 days | 3% |
| System C | 0.2 TB | 0.2 TB | 0.2 TB | 1.2 TB | | | | 7 days | 2% |
| System D | | | | | 1.5 TB | 1.5 TB | 1.5 TB | 21 days | 3% |

We size the required disk capacity for each i5/OS partition, as shown in the following sections.

### *System A*

Once per week full backup is taken, while during the week cumulative incremental backups are taken every day. The number of weeks to keep data and the monthly growth are shown in Table A-2.

We calculate the amount of required disk space for current backup environment by formula:

(weekly amount of backup data) x (number of weeks the backup is kept) + (amount of last cum. increment) x 3 = disk capacity required for current backup environment

Therefore, the required disk capacity for current environment is as follows:

0.7 TB x 2 + 0.3 TB x 3 = 2.3 TB

Next, we calculate disk space to accommodate monthly growth for 6 months, by formulas:

(disk capacity required for current backup environment) x (% monthly data growth) = amount of disk space required for monthly growth

And

(disk capacity required for current backup environment) + (number of month disk space should be sufficient) x (amount of disk space required for monthly growth) = required disk capacity including monthly growth

Therefore, the required disk space is as follows:

2.3 TB x 2% = 0.05 TB

2.3 TB + 6 x 0.05 TB = 2.6 TB

System A requires 2.6 TB of disk capacity.

### *System B*

Twice a week full backup is taken, and both tapes have to be retained for 2 weeks. The monthly growth is shown in Table A-2 on page 291.

Using the formula listed earlier in this section, we calculate the required disk space for current backup environment, taking into account that both tapes are retained for 2 weeks:

1.3 TB x 2 + 1.3 TB x 2 = 5.2 TB

We calculate the required disk capacity to accommodate monthly growth in 6 months, by formulas specified earlier in this section:

5.2 TB x 3% = 0.16 TB

5.2 TB + 6 x 0.16 TB = 6.2 TB

Therefore, the required disk space on System B is 6.2 TB of disk capacity.

### *System C*

Once a week full backup is taken, and three times a week incremental backup is taken. The number of weeks to keep data and the monthly growth are shown in Table A-2 on page 291.

For calculating the required disk space for current backup environment, we use the following formula:

(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

Therefore, the required disk capacity is as follows:

1.2 TB + 0.2 TB x 10 = 3.2 TB

We calculate the required disk capacity to accommodate monthly growth in 6 months, by formulas specified earlier in this section:

3.2 TB x 2% = 0.06 TB

3.2 TB + 6 x 0.06 TB = 3.6 TB

System C requires 3.6 TB of disk capacity.

#### *System D*

Three times a week full backup is taken, and one tape has to be retained for 3 weeks. The monthly growth is shown in Table A-2 on page 291.

We calculate the required disk space for current backup environment using the formula specified earlier in this section. Therefore, the required disk space is:

1.5 TB x 3 = 4.5 TB

We calculate the required capacity to accommodate monthly growth in 6 months using formulas listed earlier in this section:

4.5 TB x 3% = 0.14 TB

4.5 TB + 6 x 0.14 TB = 5.3 TB

System D required 5.3 TB of disk capacity.

#### *Total required capacity*

The total required disk capacity for four partitions including the monthly growth is as follows:

2.6 TB + 6.2 B + 3.6 TB + 5.3 TB = 17.7 TB

Therefore, we estimate that IBM Virtualization Engine TS7510 with five 3955 Model SX5s will be required.

## Save and restore performance measurements using i5/OS

This section describes the performance test results of save and restore workloads (also referred to as *benchmarks*) that we completed during the IBM Redbook residency. An exhaustive set of performance testing on the TS7510 is beyond the scope of this IBM Redbook. We were limited in the number of performance test configurations and scenarios that could be run. However, this section should give you useful insights into realistic performance expectations using the TS7510 with V5R4 i5/OS.

Our test results indicate there is no “clear, best performance” virtual tape solution. Rather, you have to review our test results, consider the test workloads we used and their results, and apply them to your working environment. You have to consider the functional attributes of each solution as well its performance characteristics.

The TS7510 offers the *single tape resource* for backup and recovery of multiple operating systems or partitions wanting to perform saves or restores at the same time versus *moving* a high speed tape among partitions or systems according to some prescheduled time sequence. Its flexibility would rate higher than its GB per hour capacities.

We describe the workloads and their results under two main categories:

- Save and restore of different workloads, comparing to other tape device, real high speed tape drives supported by i5/OS, i5/OS internal virtual tape support, and external TS7510 virtual tape drives.
- Concurrent saves to multiple virtual tape devices on the TS7510. This testing was done to provide some way of setting throughput rate expectations when multiple saves within a single partition or multiple saves via multiple i5/OS partitions are done at the same time to the same TS7510. Because we had only one i5/OS partition available, we tested only multiple concurrent save and restore jobs running at the same time.

The workloads used in both categories of testing are a subset of those used and described in the *System i Performance Capabilities Reference i5/OS Version 5, Release 4*, January 2007 or later, manual. These workloads are described first, and then the results of the two categories of performance testing.

## Workloads used for the IBM Redbook test benchmarks

The following workloads were selected from those used in the *Performance Capabilities Reference* manual, Save and Restore chapter. These offer a reasonable coverage of typical i5/OS save and restore workloads. They consist of different object types and sizes being saved and restored. The workloads we used are:

**Large Database File 64GB** The large database file workload is a single database file, the members are of size 64 GB.

**Network Storage Space** This Integrated File System (IFS) workload consists of a Linux storage space of approximately 6 GB total sampling size (number of bytes saved and restored)

**User Mix 12 GB** The User Mix 12 GB workload is contained in a single library and made up of a combination of source files, database files, programs, command objects, data areas, menus, query definitions, and so on. User Mix 12 GB contains 49,500 objects.

**Source File 1 GB** This workload contains 96 source files with approximately 30,000 members.

**IFS MD MO** The IFS workload Many Directories Many Objects (MD MO). This consists of 6 directory levels, where each directory level contains 10 directories resulting in a total of 111,111 directories and 111,111 stream files. The stream files have 32 KB of allocated space, 24 KB of which is data. The workload has approximately 5 GB total sampling size (number of bytes saved and restored).

## Save and restore of different workloads, comparing to other tape devices

Saves and restores of the i5/OS workloads listed in the previous section were done to the IBM Virtualization Engine TS7510 installed in the Rochester development lab. For the tests in this section, the virtual tape library within the IBM Virtualization Engine TS7510 was connected to one IOA in the System i partition running i5/OS V5R4, and one FC port in 3954 Model CV5. Save and restore were done to (from) one virtual tape drive in the virtual tape library.

Save and restore functions were performed for each workload using an IBM System i5 570 model running V5R4 i5/OS in partition with two processors, 20 GB main memory, and 136 disk drives in the system ASP. All i5/OS disks were 15K RPM disks attached to a 2757 disk controller (IOA), which in turn was attached to 2844 IOP. At the time these tests were performed, this is represents the fastest System i5 disk technology hardware next to replacing the 2757 disk controller with the slightly faster 2780 disk controller.

Figure A-7 shows the number of bytes in GB/hour of i5/OS workloads saved to five types of devices:

- Real 3592-E05 tape drive
- Real 3580 Ultrium-3 (LTO-3) tape drive
- i5/OS virtual tape objects contained within a 5-disk (DASD) user ASP

  We used a 5-disk user ASP to approximate the physical disk configuration used by the TS7510, which defaults to using either a 5-disk or 6-disk LUN as described elsewhere in this IBM Redbook.
- TS7510
- i5/OS virtual tape objects contained within a 22-disk user ASP

  We used a 22-disk user ASP to demonstrate the throughput scalability advantage available under i5/OS virtual tape support. In an environment where i5/OS virtual tape support is part of a high speed save requirement, where throughput speed is of primary importance, you would typically, assuming a sufficient number of disk drives, assign more than 5 or 22 disks to a user ASP and get improved i5/OS virtual tape throughput compared to our test results.

As with any high performance save or restore environment under i5/OS, you must also place the System i tape adapter on a different physical I/O bus from the one on which your disk drives are configured for maximum throughput. That is, we minimize high disk I/O rates and high tape I/O rates at the same time causing bottlenecks. In our scenarios, this would apply to our tests using real 35xx tape devices and the TS7510.

Read the tape test results legend left to right, top to bottom to correlate with the graph bars. That is, the first column in each grouping is the 3592 E05, the second column is the 3580, the third column is the 5-disk ASP i5/OS virtual tape, and so on.

For example, in Figure A-7, the fourth vertical bar above 64 GB, Network Server (NWS), and other tests, represents the GB/HR for “TS7510 Save” and the fifth vertical bar represents the GB/HR for “i5 Virtual Tape (22 DASD ASP) Save.”

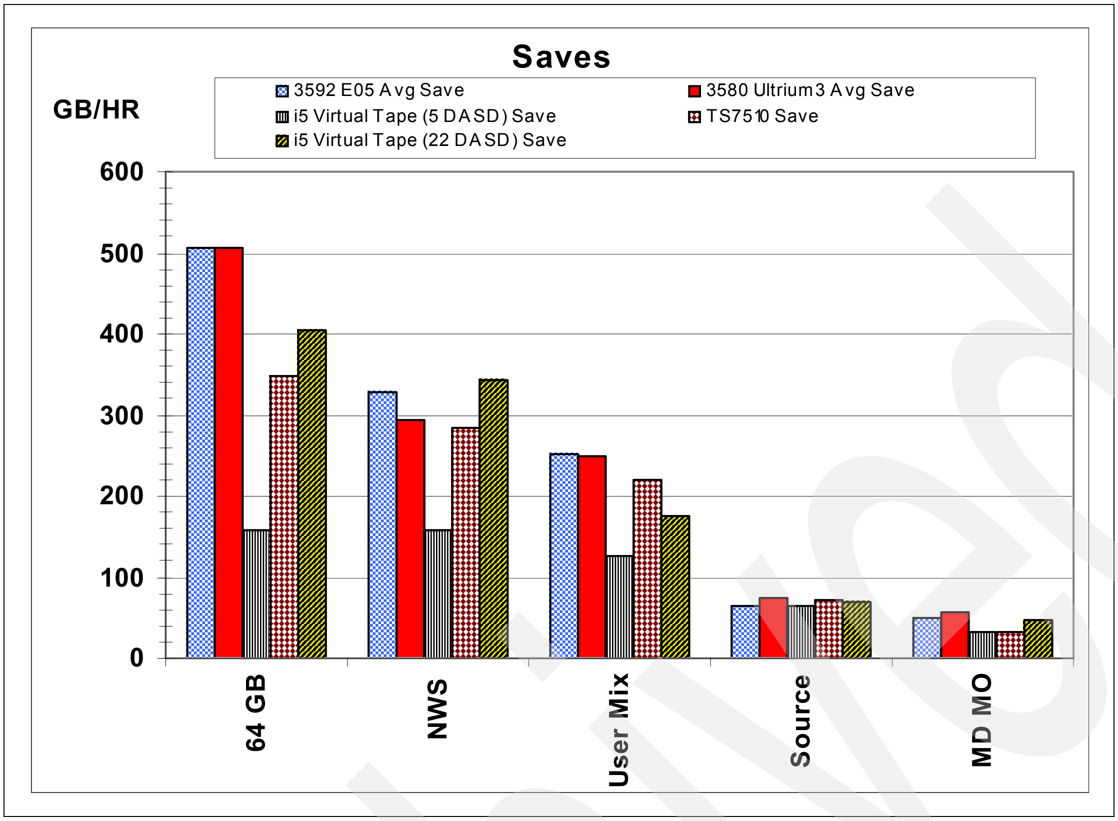



*Figure A-7 Comparing save times of virtual tape devices and real tape devices*

Remember, at the start of "Save and restore of different workloads, comparing to other tape devices" on page 294, we describe the base i5/OS hardware configuration used for these tests, including the 136 disk drives configured in the system ASP.

For the save scenario of our five workloads, note the following. Review the descriptions of the five test workloads under "Workloads used for the IBM Redbook test benchmarks" on page 294 to determine how your workload environment correlates with our configuration and the five test scenarios that we ran.

- As you would expect, the overall throughput is reduced as the number of objects increases per number of characters being saved. That is, there is more i5/OS object processing relative to the amount of data characters being saved.
- In general, the real IBM high speed tape devices demonstrate the best throughput, though there is the exception for the NWS workload test, where the i5/OS virtual tape support with a 22-disk ASP had the best throughput.

  If you can assign additional disk drives above 22 to a user ASP, you can achieve even higher throughput rates using i5/OS virtual tape in your backup processes. However, when setting up to use i5/OS virtual tape support there are several "pieces" to consider and set up correctly to achieve very high save GB/hr rates, and you have to consider management of your disk storage space consumed.

  For more complete i5/OS virtual tape performance test results and considerations, refer to the *System i Performance Capabilities Reference, i5/OS V5R4*, manual, dated January 2007 or later.

  This document can be found on the Web at:

  `http://www.ibm.com/servers/eserver/iseries/perfmgmt/resource.html`

Figure A-8 shows the number of bytes in GB/hour of i5/OS workloads achieved performing restore operations on the same workloads and five kinds of “devices” that we used in the save performance tests.

Read the tape test results legend left to right, top to bottom to correlate with the graph bar. That is, the first column in each grouping is the 3592 E05, the second column is the 3580, the third column is the 5 disk ASP i5/OS virtual tape, and so on.

Note that the GB per hour scale for restore test results is much higher (top speed is approximately 900 GB/hr) than the scale used with the save test results (top speed is approximately 500 GB/hr).

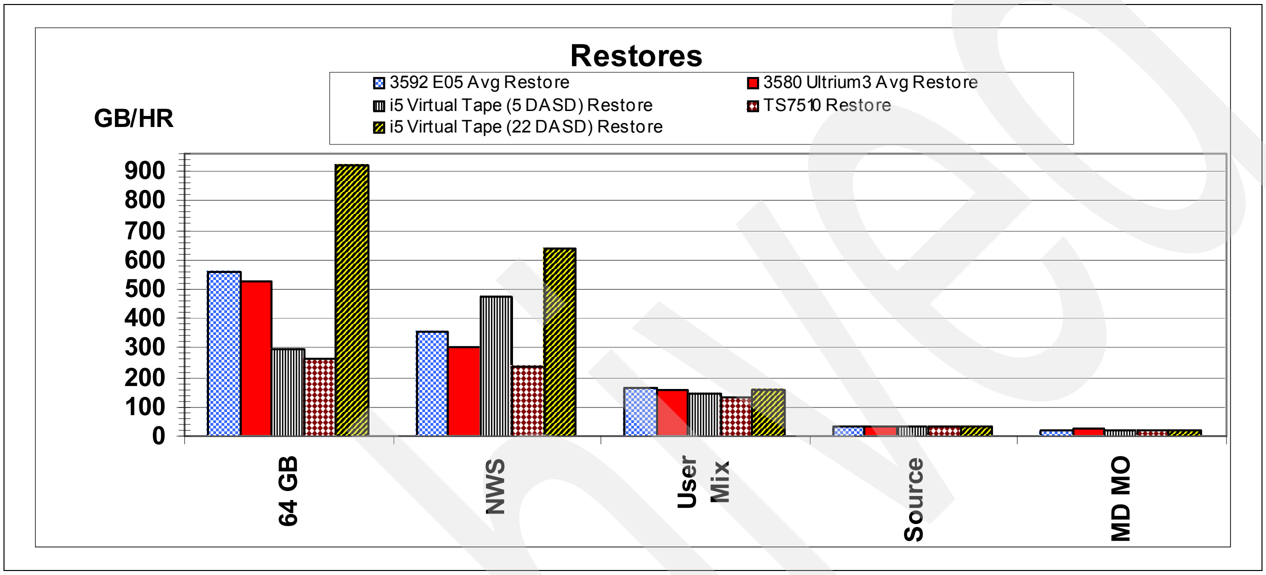



*Figure A-8 Comparing restore times of virtual tape devices and real tape devices*

For the restore scenario of our five workloads, note the following:

- The 22-disk ASP i5/OS virtual tape restore has significantly higher throughput in the 64 GB and NWS workloads with the relatively fewer objects being processed, compared to the number of characters being restored.
- The real tape restore I/O rates in the 64 GB and NWS workloads are relatively close, but slightly faster, than their corresponding save rates.
- At the highest number of objects per amount of data being restored (Source and MD/MO workloads) level, the throughput values are almost identical.

This section discussed relative throughput for a suite of “typical save and restore workloads” when performing a single save function. Remember, you must always consider that your save or restore workload environment may differ significantly from the sample scenarios we have used here.

The next section discusses performance results examples when doing multiple saves at the same time and multiple restores at the same time. In our scenarios, this means multiple jobs running at the same time within the same i5/OS partition. We were not able to perform performance tests at the same time using more than one partition.

## Concurrent saves to multiple virtual tape drives

We expect that many customers will want to use the same TS7510 to back up multiple i5/OS partitions at the same time. The TS7510's bandwidth can be shared across multiple hosts and multiple virtual tape drives. This is in contrast to a physical tape device where it is difficult or impossible to share with multiple hosts/backup applications during the same time period.

Consider also, if a “slow” application is using a physical tape drive, the rest of the tape’s performance bandwidth is not usable. That is not the case with the virtualization of the TS7510 physical resources or i5/OS virtual tape support.

Given the scope of our residency for this IBM Redbook, we ran only the saving of the Large Database File 64 GB workload that was used in “Save and restore of different workloads, comparing to other tape devices” on page 294 concurrently. Given our resource constraints, this is the best we could do to help you set appropriate expectations for this concurrency in your specific environments.

We had access to only one i5/OS partition, therefore we submitted batch jobs to run concurrently, repeating the tests with different combinations of IBM System i5 IOAs, ports, and TS7510 LUNs.

Our experience demonstrated that the number of LUNs available for the concurrent save and restore operations was the most important factor affecting aggregate throughput that could be achieved. Each virtual tape library uses disk space from one LUN.

When saving concurrently to two virtual tape drives, it is possible that both tapes may use disk space from the same LUN, or each virtual tape may use disk space from a different LUN.

Performance of concurrent saves is much better when we save to tapes from different LUNs, rather than saving to tapes from the same LUN. The reason for this is each LUN in an SV5 or SX5 uses a different array of five or six HDDs (five or six Hard Disk Drives = five or six disk arms). When concurrently saving to tapes on different LUNs, five disk arms are used for each tape, enabling each job to use five different disk arms for each save.

It is left for a future update of the TS7510 to enable more flexible configuration of the number of disk drives assigned to a LUN.

When the virtual tape drives reside on the same LUN, and five disk arms are used for both jobs performing reasonably high tape I/Os per second, the total aggregate throughput is demonstrably less than when using multiple LUNs.

Note that throughput can be further improved if the LUNs are assigned to different controllers within the SV5, and even better if the LUNs are assigned to a different SV5. We did not have that hardware configuration during the residency to demonstrate this.

We also measured performance of concurrent saves to three tapes. Similar to our experiences with two tapes, results show that saving to three tapes on three different LUNs is much faster than saving to three tapes on the same LUN or on two different LUNs.

Each virtual tape drive is assigned disk space from a particular LUN when it is *mounted the first time*, because at that time it uses only disk space from that LUN. Only in rare cases when that LUN fills up with data will the virtual tape start to use disk space from another LUN. Therefore, it is important to ensure that the tapes used for concurrent save were assigned disk space from different LUNs when they were first mounted.

When you mount a virtual tape, you do not have explicit control of which LUN is associated to that tape. You can, however, increase the probability of a different LUN being used for each mounted tape. You do this by mounting two or three virtual tapes devices *at the same time*. This increases the probability that the IBM Virtualization Engine TS7510 LUN assignment algorithm will assign each tape to a different LUN. This is because the algorithm spreads tapes as equally as possible across LUNs. Once you know which set of tapes use space from different LUNs, always use this set of tapes for concurrent saves.

### Concurrent save to 2 tape drives

The graph in Figure A-9 shows save and restore aggregate rates (throughput rates of two jobs summed together) in GB/hour for our large 64 GB file, using two virtual tape drives. The graph shows an average rate for two large files saved at the same time and then restored at the same time using different combinations of IOAs, ports, and LUNs.

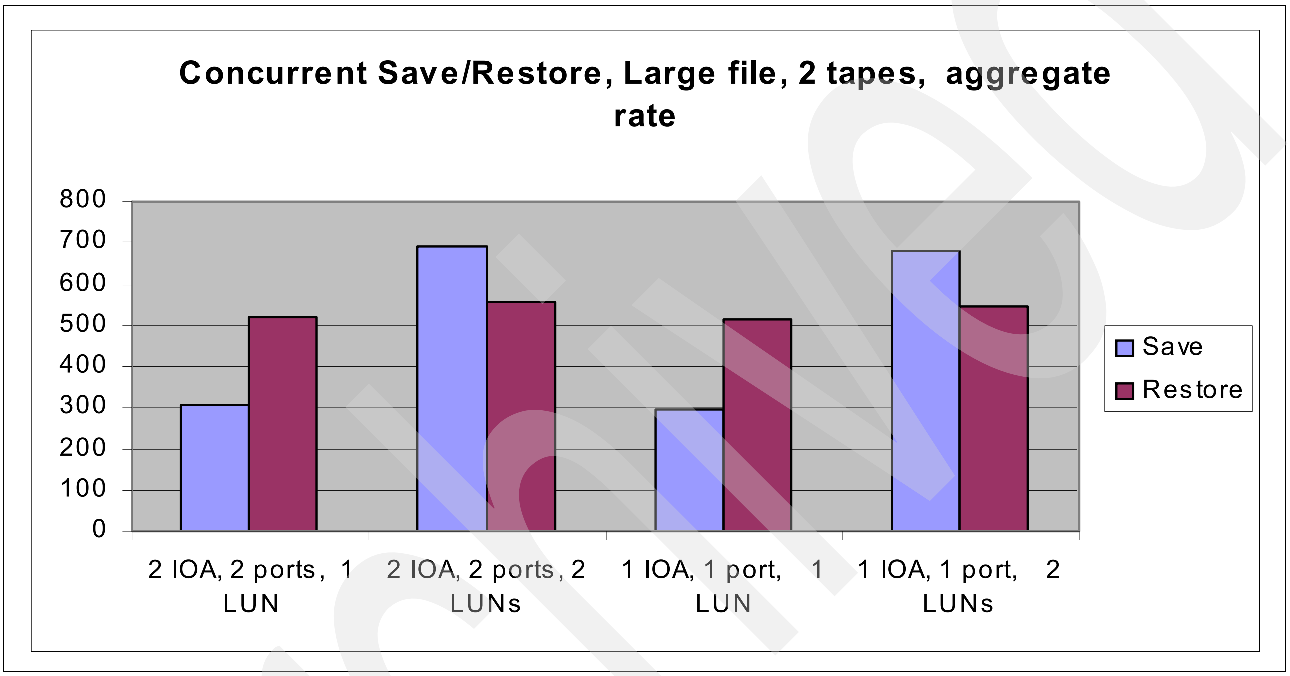



*Figure A-9 Two concurrent jobs aggregate throughput: save and restore*

When saving two large files via two separate jobs concurrently to two virtual tapes using disk space from two different LUNs within the TS7510, we achieved the aggregated save rates in the 300 GB/hr to almost 700 GB/hr range. Note that for saves, the two blue bars using two LUNs show approximately the same throughput. This was regardless of whether we use one IOA and one FC port in a CV5 for each tape drive, or we use one IOA and one FC port in a CV5 for both tape drives.

For two concurrent saves, we can share IOA and FC port in the CV5 between the two tape drives without any significant impact on performance. You can clearly see the importance of using different LUNs for concurrent save operations. In our limited test scenario, the multiple LUNs aggregate throughput rate was approximately 2x the single LUN rates.

With concurrent restore, we achieved aggregate throughput rates in the 500 GB/hr to approximately 550 GB/hr range, regardless of whether one or two IOA, FC ports in CV5, or LUNs are used.

Using different LUNs does not appear to affect restore throughput. We explain this the following way.

Restore consists of reads from virtual tape drive, reads being done from LUNs in RAID-5 array of HDDs. RAID-5 penalty influences write performances when saving to virtual tape, but it does not play any role with reads from virtual tape (restore). Therefore, in contrast to saves, using separate LUNs does not spread I/O operations over many disk arms.

**Tip:** To determine how many LUNs are used when saving to multiple virtual tape drives, use the reports in the IBM Virtualization Engine TS7510. This is described in 7.1.2, "Creating, viewing, and exporting reports" on page 251 and 7.1.3, "SCSI Device Throughput Report" on page 262.

Here is an example. We want to find out how many LUNs were used when saving to two virtual tape drives. To achieve this, we use the SCSI Device Throughput Report in the IBM Virtualization Engine TS7510 for the day on which save was done. We produce this report for each LUN, and observe which LUNs were used at the time of the save.

In our example, both save and restore were running on August 31, between 9:30 a.m. and 11:00 a.m. Figure A-10, Figure A-11 on page 301, Figure A-12 on page 302 and Figure A-13 on page 303 show writes/sec and reads/sec to all the LUNs on August 31. As can be seen from Figure A-10 through Figure A-13 on page 303, two of the LUNs show input/output activity between 9:30 a.m. and 11:00 a.m.: LUN 4 on adapter 6 in the DS4100, and LUN 4 on adapter 7 in the DS4100. This allows us to see that two different LUNs were used for our save to two tapes.

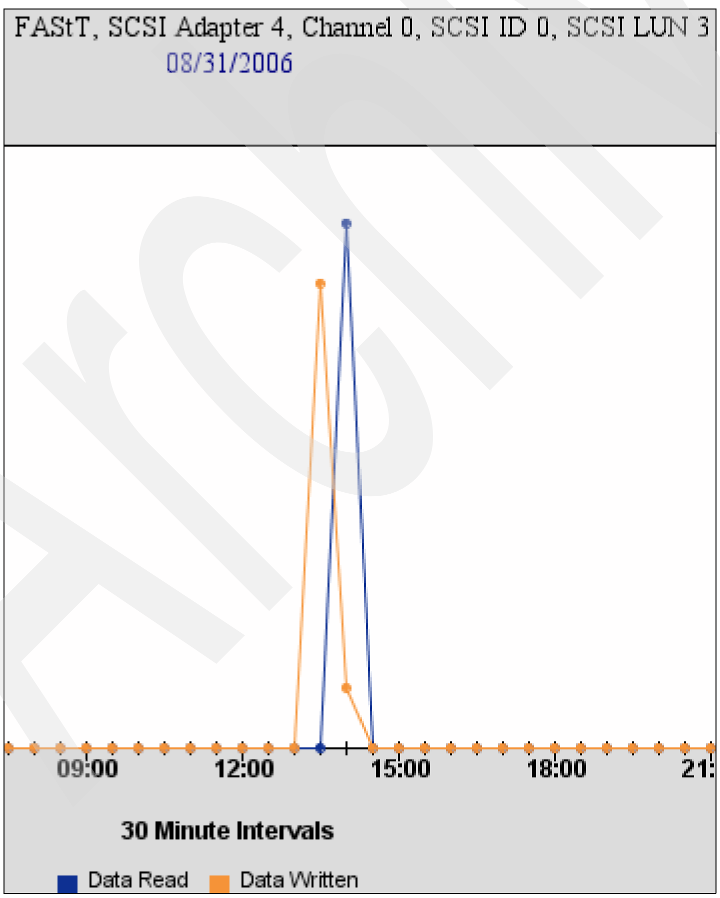



*Figure A-10 Report of LUN-1*

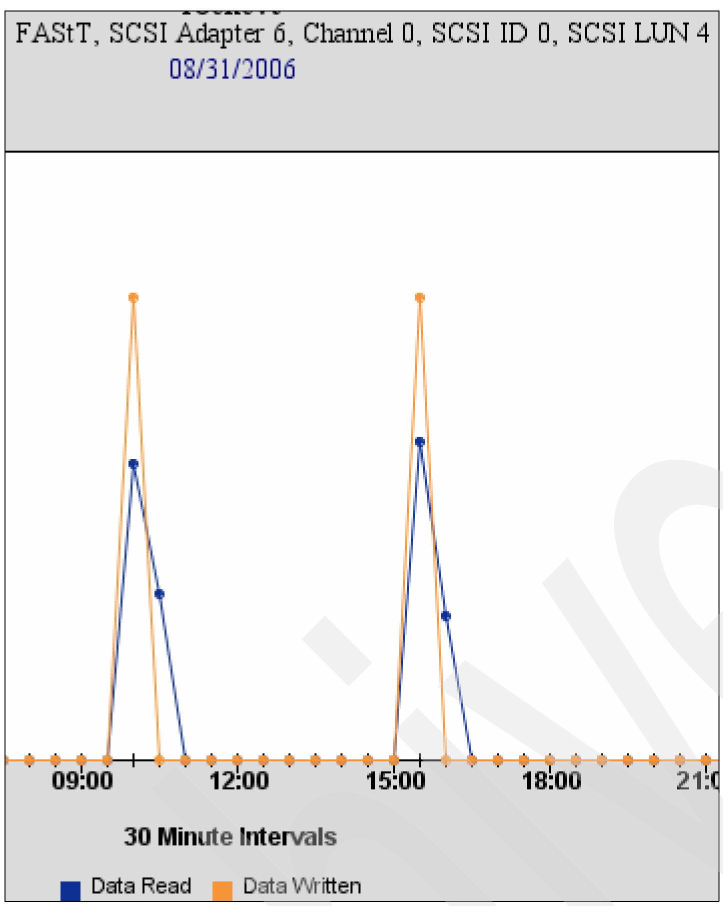



*Figure A-11 Report of LUN-2*

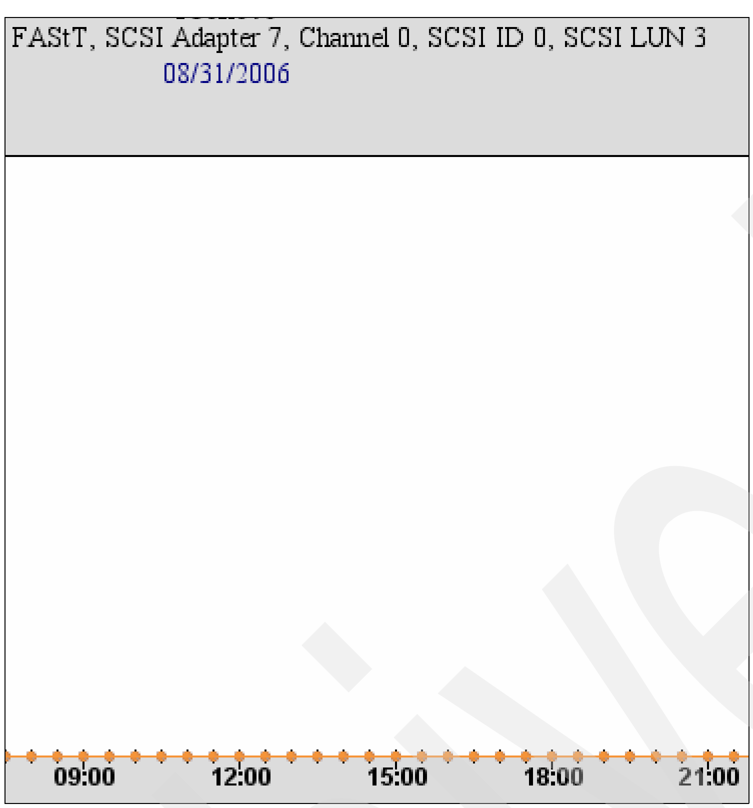



*Figure A-12 Report of LUN-3*

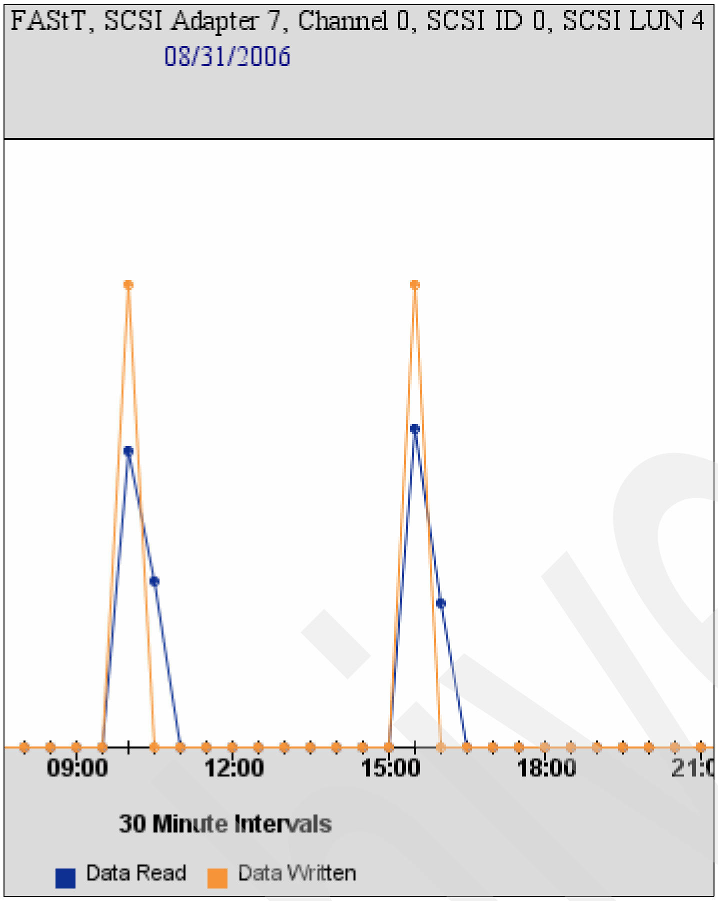



*Figure A-13 Report of LUN-4*

In more complex environments, it will take more work to investigate how may LUNs were used for saves and restores. In those cases, consider also using the TS7510 Server Throughput Report. We show an example of how to do this in 7.1.2, "Creating, viewing and exporting reports" on page 221.

## Concurrent save to three virtual tape drives

The graph in Figure A-14 on page 304 shows save and restore aggregate rates (throughput rates of three jobs summed together) in GB/hour for our large 64 GB file, using three tape drives. The graph shows an average rate for three large files saved at the same time and then restored at the same time using different combinations of IOAs, ports, and LUNs.

You can see the aggregate throughput rates for three saves - three LUNs increases nicely over two saves - two LUNs, approximately 1000 GB/hr compared to approximately 700 GB/hr.

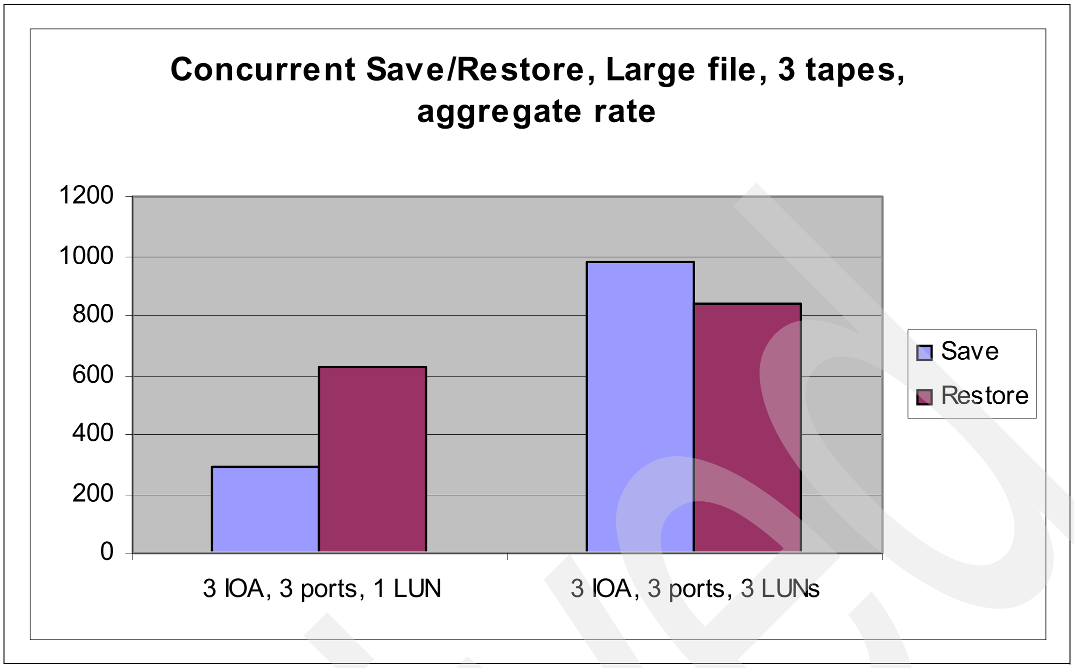



*Figure A-14 Three concurrent jobs aggregate throughput: Save and restore*

When saving three large files via three separate jobs concurrently to three virtual tapes using disk space over three different LUNs within the TS7510, we achieved the aggregated save rates in the 250 GB/hr to almost 1000 GB/hr range.

Note the improved restore rates for using three concurrent restores compared to two concurrent restores regardless of the number of LUNs used.

While the graph in Figure A-14 shows aggregate save and restore rates for three concurrent jobs, Table A-3 shows the rates achieved by each job.

*Table A-3 Three concurrent saves, individual job throughput*

| | Job 1 | Job 2 | Job 3 |
|---|---|---|---|
| Save to 3 tapes on 1 LUN | 97 GB/hour | 97 GB/hour | 97 GB/hour |
| Restore from 3 tapes on 1 LUN | 149 GB/hour | 238 GB/hour | 239 GB/hour |
| Save to 3 tapes on 3 different LUNs | 315.7 GB/hour | 322.3 GB/hour | 340.0 GB/hour |
| Restore from 3 tapes on 3 different LUNs | 274.9 GB/hour | 274.5 GB/hour | 288.0 GB/hour |

Similar to concurrent saves to two virtual tape drives, we expect that the most important factor with saving to three tapes drives, is using tapes on different LUNs. This increases performances for about 200%, compared to using all three virtual tapes on one LUN.

## Performance test summary

We ran a reasonable mixture of save and restore workloads that have stood "the test of time" by being documented in the *System i Performance Capabilities Reference* manual. While your save and restore environments and requirements might differ, hopefully you can use our test results and observations to estimate performance in your environment. Consider the following:

- Single large file versus many small objects performance expectations: This is an expected consideration regardless of the real or virtual device being used. The more objects, the more overhead in handling file access, security, and tape label processing.
- For the single large file save and restore scenario used in our example tests, the highest speed real tape devices supported by i5/OS delivers better performance than either virtual tape solution. Internal Rochester laboratory tests show that, if configured with sufficient disk units, the i5/OS virtual tape support is capable of better throughput than any real tape device supported on i5/OS.

  The results of the 22-disk devices ASP test using i5/OS virtual tape support clearly indicate this possibility. However, a significantly higher number of disks than 22 were assigned to the i5/OS virtual tape ASP to achieve the values as shown in the *System i Performance Capabilities Reference i5/OS Version 5, Release 4* manual, dated January 2007 or later. As stated earlier, this document can be found under the Resource Library link at the performance management Web site:

  `http://www.ibm.com/eserver/iseries/perfmgmt`
- Price/performance trade-offs and setting up a higher degree of disaster recovery protection offered by the various real and virtual tape devices are a customer responsibility. The use of the TS7510 can be a viable part of your backup and recovery process when multiple jobs, hardware platforms, and operating systems or multiple partitions have to perform save or restore operations during *the same time period*.
- For best save throughput rates during concurrent save jobs, using a different LUN for each virtual tape delivers the best performance on the TS7510.

  Over time the TS7000 product family will provide more specific user control of LUN configuration (assigned disk drives) and faster hardware components. Current development plans call for the next release of TS7510 software, containing additional functions that will be able to be upgraded to, while preserving your existing configurations. At this time, it is too soon to speculate on the process for upgrading from the current TS7510 to the next advancement in TS7510-based hardware or software technology.
- With concurrent saves to two or three virtual tape drives with tapes from different LUNs, the rate of each save is about the same as rate of backup to one virtual tape drive.
- The performance measurements of saving open systems data to virtual tape drives, which are shown in Figure A-5 on page 288 and Figure A-6 on page 288, show that when concurrently saving to up to four tape drives, each save performs about as good as save to one tape drive. But when concurrently using more than four virtual tape drives, performance of each save will not achieve performance of one save to one tape drive, due to sharing bandwidth through controllers in the SV5.

  Regarding this, we recommend estimating the duration of concurrent saves and restores as follows:

  – When using up to four virtual tape drives, each save will perform at about the same rate as save to one virtual tape drive.

- i5/OS virtual tape performance is quite acceptable and can deliver outstanding throughput provided a sufficient number of disk drives are assigned to the ASP used for the virtual tape configuration objects. This is on an i5/OS partition by partition basis.
- The TS7510 comes into consideration when multiple systems, partitions, and operating systems are part of your environment.

B

# BRMS packaging overview

This appendix provides a short overview of Backup Recovery and Media Services (BRMS) capabilities and packaging of these capabilities.

## BRMS overview

As discussed in the earlier chapters in this book, i5/OS's strategic backup management product, BRMS (5722-BR1) consolidates all your backup tasks. It manages your media, automates your backups, and simplifies recovery. It provides detailed reporting on what was saved and what was not saved. It produces detailed instructions about the recovery process.

BRMS supports V5R4 i5/OS virtual tape support and, with the availability of the RPQ, supports the IBM Virtualization Engine TS7510 virtual tape hardware solution.

Figure B-1 is a representation of the base, network, and hierarchical storage components of BRMS. The text bullets within each block illustrate the functions addressed by each component.

You can see BRMS comes with three packaging options:

- Base support
- Networking support
- Hierarchical Storage Management (HSM) support

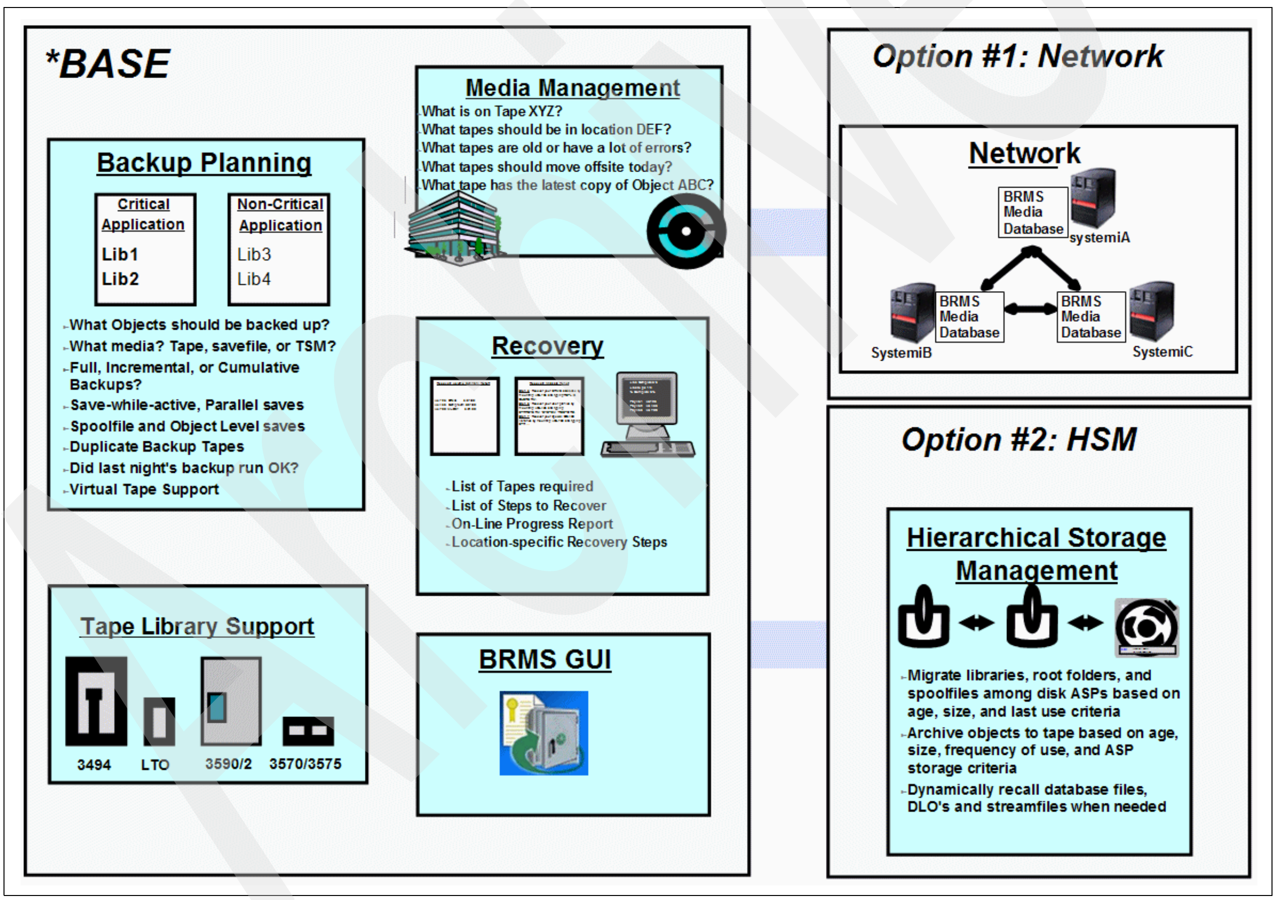



*Figure B-1 BRMS functions and component overview*

The BASE option is always required. It allows you to perform all supported save and restore functions to tape media, save files, Tivoli Storage Management (TSM) servers, and virtual tapes. For scheduling functions, BRMS interfaces to either the i5/OS job scheduler or an alternative job scheduling application. The preferred application from IBM is Advanced Job Scheduler for iSeries, 5722-JS1.

Both BRMS and the Advanced Job Scheduler for iSeries products can be integrated into the iSeries Navigator interface on a managing PC workstation as plug-ins.

The NETWORK function is optional and separately priced. By placing multiple IBM System configurations in a BRMS network, you can share BRMS policies, media information, and storage locations across the network group. This allows you to manage backups across all of your systems in a consistent manner. It also optimizes the use of your media.

Remember that these “systems” can also be one or more i5/OS partitions on each IBM System i model in the BRMS network.

The HSM function is optional and separately priced. HSM automatically and transparently manages customer data across a storage hierarchy. The storage hierarchy can consist of high performance disk, compressed disk, and tape libraries. Through the BRMS user-defined policies, HSM can migrate or archive and dynamically retrieve infrequently used data or historical data up or down a hierarchy of storage devices.

As illustrated elsewhere in this book, there are i5/OS command and iSeries Navigator graphical user interfaces (GUI) to BRMS functions with several V5R4 i5/OS level enhancements.

For in-depth review of changes and functionality, refer to either the information center, or to the manual *Backup Recovery and Media Services for iSeries: Version 5*, SC41-5345. This can be found online at:

http://publib.boulder.ibm.com/infocenter/iseries/v5r4/topic/books/sc415345.pdf

# Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this IBM Redbook.

## IBM Redbooks

For information about ordering these publications, see "How to get IBM Redbooks" on page 313. 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 Library Guide for Open Systems*, SG24-5946
- *IBM SAN Survival Guide*, SG24-6143
- *iSeries in Storage Area Networks A Guide to Implementing FC Disk and Tape with iSeries*, SG24-6220
- *Fibre Array Storage Technology A FAStT Introduction*, SG24-6246
- *i5/OS V5R4 Virtual Tape: A Guide to Planning and Implementation*, SG24-7164
- *IBM Virtualization Engine TS7510: Tape Virtualization for Open Systems Servers*, SG24-7189
- *Implementing Domino 7 for i5/OS*, SG24-7311(backing up Domino information using BRMS)
- *The LTO Ultrium Primer for IBM eServer iSeries Customers*, REDP-3580
- *Introducing IBM TotalStorage FAStT EXP100 with SATA Disks*, REDP-3794


## Other publications

These publications are also relevant as further information sources:


- *Remote Supervisor Adapter II SlimLine and Remote Supervisor Adapter II Installation Guide* (search http://www.ibm.com with "remote supervisor adapter II.")
- *Remote Supervisor Adapter II SlimLine and Remote Supervisor Adapter II User's Guide* (search http://www.ibm.com with "remote supervisor adapter II.")
- *IBM Virtualization Engine TS7510 Hardware Installation, Setup, and Problem Determination Guide,* GC26-7766
- *IBM Virtualization Engine TS7510 Introduction and Planning Guide*, GC26-7767
- *IBM Virtualization Engine TS7510 User's Guide*, GC26-7769
- *IBM Virtualization Engine for Tape TS7510 Installation Roadmap*, GC26-7778
- *Backup and Recovery V5R4*, SC41-5304-08
- *Backup Recovery and Media Services for iSeries: Version 5*, SC41-5345



## Online resources

These Web sites are also relevant as further information sources:

- IBM System i Information Center

  http://publib.boulder.ibm.com/iseries/

- For more information about the IBM real tape drive technologies and products available refer to:

  http://www.ibm.com/servers/storage/tape

- For more information about the IBM virtual tape technologies and products available, refer to:

  http://www-03.ibm.com/servers/storage/tape/virtualization/index.html/

- Technical support Web site:

  http://www.ibm.com/servers/eserver/iseries/service/brms/domino.html

- IBM System i Support: Fixes

  http://www-03.ibm.com/servers/eserver/support/iseries/fixes/index.html

- Performance Management for IBM System i

  http://www.ibm.com/eserver/iseries/perfmgmt

- System i integration with BladeCenter and System x

  http://www-03.ibm.com/systems/i/bladecenter

- Links to IBM services and training sites:

  – IBM Rochester AS/400 Solution Center

    http://www-1.ibm.com/services/us/index.wss/offering/its/a1001549

  – IBM Services site for your geography to determine whether there are local services available. The IBM Training Finder is at:

    http://www.ibm.com/products/finder/us/finders?pg=trfinder

- VXA Alliance group

  http://www.vxa.com

- Exabyte Web site for documentation:

  http://www.exabyte.com

- PuTTY Download Page

  http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html

- HP storage products Web site

  http://www.hp.com/products

- Industry LTO technology Web site:

  http://www.lto-technology.com

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## Q



## R

## W

IBM Virtualization Engine TS7510: Getting Started with i5/OS and Backup Recovery and Media Services

(0.5” spine)
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250 <-> 459 pages

# IBM Virtualization Engine TS7510 Getting Started with i5/OS and Backup Recovery and Media Services

**Expanding i5/OS virtual tape integration**

**A virtual tape option for multiple partitions**

**Letting Backup Recovery and Media Services do it for you**

This IBM Redbook provides a getting started level of information about supporting the IBM Virtualization Engine TS7510 under i5/OS, primarily using the Backup Recovery and Media Services (BRMS), 5722-BR1, management product. BRMS is the primary backup and recovery management product for i5/OS.

This book cannot make you an expert in i5/OS backup and recovery or in the use of BRMS. It also cannot make you an expert in full usage and management of the IBM Virtualization Engine TS7510 capabilities. More complete coverage of the TS7510 is included in the IBM Redbook *IBM Virtualization Engine TS7510: Tape Virtualization for Open Systems Servers*, SG24-7189.

However, this book does provide sufficient information and examples to get you up and running with the IBM Virtualization Engine TS7510 attached to an i5/OS partition or system using BRMS. This book also helps you to understand where the IBM Virtualization Engine TS7510 can fit into your complete set of backup and recovery processes where multiple systems or servers, or logical partitions have to save data to a common repository. The TS7510 helps you to minimize your backup window, facilitates data sharing among the multiple systems, and helps you to minimize your total cost of ownership (TCO) in the backup and recovery area.

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