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Storage solutions

Version 5 Release 3

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> **Note**
>
> Before using this information and the product it supports, be sure to read the information in "Notices," on page 77.

Contents

Storage solutions

As your company produces a greater volume of information, and as the value of that information grows, the methods you use to protect and preserve it become vital corporate strategies. Storage has gone from being a feature of a server to being an entity unto itself. It performs several valuable functions within your enterprise, including the following:

- **Availability.** Your storage solution must enable you to access your data when you need it, without exception. In some settings, such as a hospital, access to data can mean the difference between life and death.
- **Integrity.** Your data must be in exactly the same condition when it returns to you as it was when it was stored. That means it must be safe from corruption, loss, and outside attack.
- **Recoverability.** Your storage solution should ensure that you can recover your data in the event of a natural disaster, such as a fire, flood, or tornado.

The purpose of this topic is to step you through the world of iSeries^(TM) storage and help you make choices about which storage technologies are right for your company now, and which may be useful in the future. The topics in this section include the following:

"What's new for V5R3" on page 2
See what is new for V5R3.

"Print this topic" on page 2
Print a PDF of this topic.

"How the iSeries views storage" on page 3
This topic describes how objects are stored on your iSeries server and lays the groundwork for the other topics in this section.

"Disk" on page 3
This topic describes how disk storage on the iSeries works and describes how it can be configured and used for different storage purposes.

"Tape" on page 5
≫ This topic describes the advantages and limitations of using tape for storage. It makes some recommendations about when tape is a good choice and when you should consider other media. It also provides planning, setup, management, and troubleshooting information for stand-alone tape devices and tape libraries.≪

"Optical storage" on page 60
≫ This topic provides an overview of optical storage and virtual optical storage on the iSeries server. It discusses the advantages and disadvantages of using optical as a storage media and makes recommendations for when optical can be the media of choice. It provides information for setting up and using a virtual optical device on an iSeries server.≪

"Storage area networks" on page 74
This topic describes what storage area networks are and how they can be used to provide centralized storage. It discusses advantages and disadvantages and links you to more detailed information.

For additional information that is specific to storage for backup and recovery purposes, see Getting your media ready to save your server.

For detailed information about the storage components described in this topic, see IBM^(R) Total Storage .

What's new for V5R3

For V5R3, the "Tape" topic has been expanded to include information for using tape cartridges, stand-alone tape devices, and tape libraries.

Also, the "Optical storage" topic has been expanded to include information about writing to a virtual image.

New information for the "Tape" topic
- "Tape" on page 5

New information for the "Optical storage" topic
- "Optical storage" on page 60

How to see what's new or changed

To help you see where technical changes have been made, this information uses:
- The ≫ image to mark where new or changed information begins.
- The ≪ image to mark where new or changed information ends.

≫ To find other information about what's new or changed this release, see the Memo to Users. ≪

Print this topic

To view or download the PDF version, select Storage solutions (about 1517 KB).

Saving PDF files

To save a PDF on your workstation for viewing or printing:
1. Open the PDF in your browser (click the link above).
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How the iSeries views storage

The iSeries$^{(TM)}$ server has a unique way of addressing storage. It views the disk space on your server and your server's main memory as one large storage area. This way of addressing storage is known as **single-level storage**. The following diagram shows how single-level storage works:

When you save a file, you do not assign it to a storage location; instead, the server places the file in the location that ensures the best performance. It may spread the data in the file across multiple disk units, if that is the best option. When you add more records to the file, the system assigns additional space on one or more disk units.

Disk

Disk storage is the storage that is usually internal to your iSeries$^{(TM)}$ server; however, it can also be attached externally to it. You can group your disk drives into logical subsets called **disk pools** (also known as auxiliary storage pools or ASPs). One reason to do this is to provide a level of protection for your data. If one disk unit fails, you only have to recover the data stored in the disk pool that the failed disk unit was a part of.

Disk pools also enable you to set disk space aside for a particular purpose, application, or data type. For example, you may create a disk pool for backups done to save files. You can then move these save files to tape or other media when it is convenient for you. The following diagram shows a disk pool that is composed of disk units 1, 4, 5, 7, and 11.
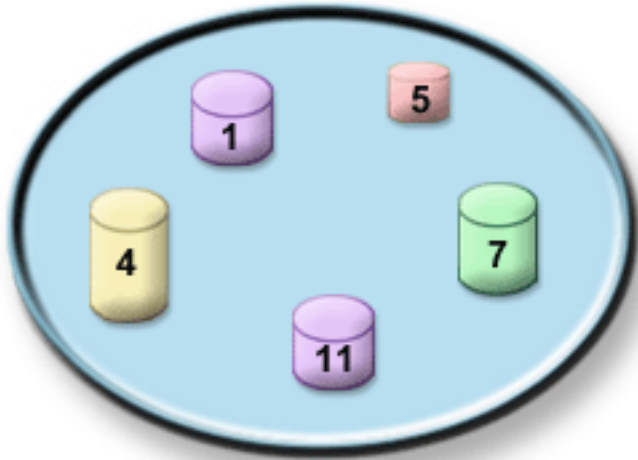
For detailed information about disk pools, disk pool types, and examples of how to use disk pools for different purposes, see Disk pools. For information about how to configure disk units and disk pools, see Manage disk pools.

Independent disk pools are disk pools that can be brought online or taken offline without any dependencies on the rest of the storage on a system. This is possible because all of the necessary system information associated with the independent disk pool is contained within the independent disk pool. Independent disk pools offer a number of availability and performance advantages in both single and multiple system environments. For detailed information, see Using independent disk pools.

Besides disk pools, there are a few other ways to protect your disk units and the data on them. **Mirrored protection** protects your data by keeping a copy of the data on two separate disk units. When a disk-related component fails, the system may continue to operate without interruption by using the mirrored copy of the data until the failed component is repaired. **Device parity protection** is a hardware function that enables your server to reconstruct data in the event of a disk failure. It is important to remember that these disk protection methods are not a guarantee against failure or data loss. You still need to have a good backup and recovery strategy in place in order to truly protect your data. For detailed information about the disk protection methods described here, see Plan for disk protection.

Compared to tape or optical, disk is a more expensive storage option. However, the data on disk is more quickly accessible than on tape or optical. It is important to balance the cost of storing data on disk with the speed and convenience with which you can access that data. For example, if you have older data that you access infrequently, you may want to consider storing it on tape or optical, rather than on disk. Likewise, current information that you access frequently might be worth the cost of disk storage because you can access it quickly. This type of storage strategy is called **hierarchical storage management**. The following diagram shows the different layers of hierarchical storage management:

High Performance Disk

Compressed Disk

Optical

Tape

Performance

Cost
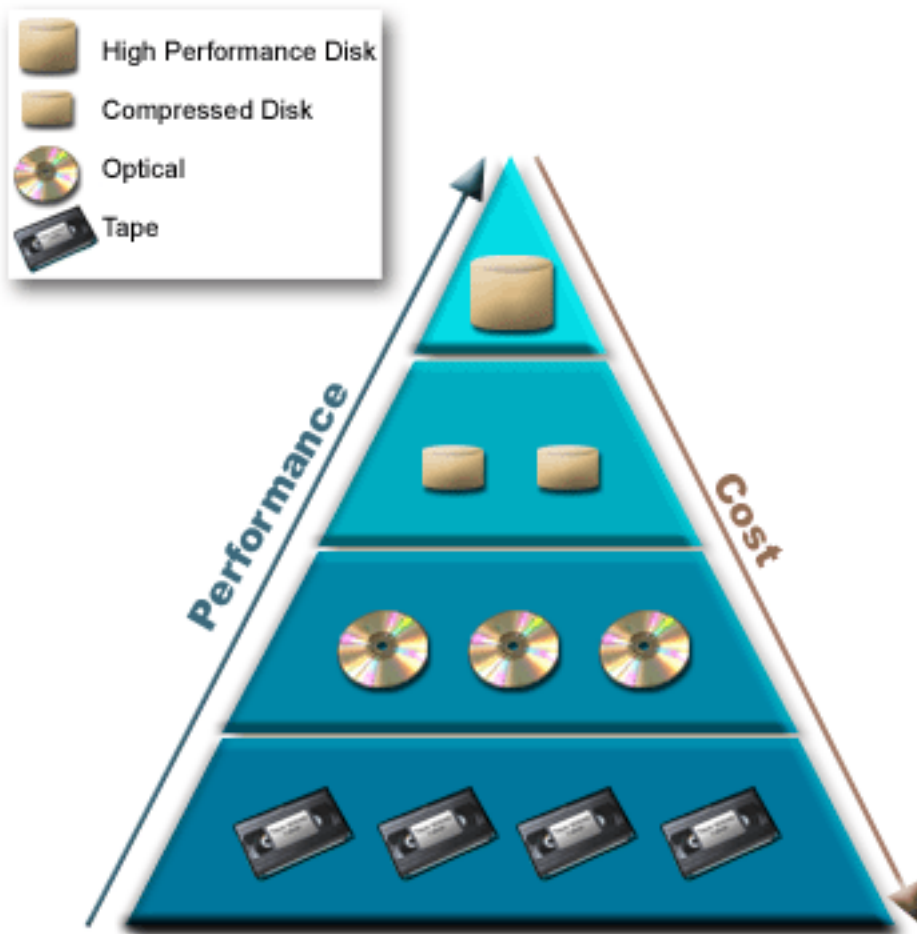
It is not always the same data that resides in the high performance storage components. Data is moved among the different layers according to the current system needs. The key to successful and seamless hierarchical storage management lies in the management and distribution of data across the different

layers. For detailed information, see Hierarchical Storage Management .

Tape

Tape is probably the most common form of removable storage media for the iSeries(TM). It has been around for some time, so it has been widely adopted and continues to be popular.

Tape provides several advantages over other storage methods, including the following:
- **Cost.** Tape is very cost effective, when compared to disk. While the cost of disk storage is falling, the cost of tape is also falling on a per-gigabyte basis.
- **Security.** It is easy to keep your data secure by securely storing backups or copies at an off-site location. This also guards against on-site data corruption from viruses, fire, natural disasters, accidental deletions, and other data-loss incidents.
- **Reusable.** You can rotate your tapes for backups, which means that you have more than one set of tapes. When one set expires, you can write over the data on it and use the media again.
- **Capacity.** As the amount of data you create grows, you can increase your capacity by simply adding additional tape volumes.

While there are many advantages to using tape, there are also some drawbacks:

- **Durability.** Tape is reusable, but tapes do wear out over time and require replacement. If they are not replaced when needed, your data can be compromised.
- **Sequential access to data.** Tapes give you access to the data on them in the order in which that data was recorded. If you are looking for a particular item on a tape, it might take some time to locate it.

The following topics provide information for single tape drives, tape autoloaders, tape libraries, and cartridges. You can use this information to plan for, set up, use, maintain, and troubleshoot a tape solution.

Concept and planning
- "Types of tape solutions"
- "Comparison of offline storage" on page 12
- "Plan for a tape solution" on page 13

Installing and configuring
- "Install stand-alone tape devices" on page 22
- "Install tape libraries" on page 24
- "Configure tape libraries" on page 24

Use and maintenance
- "Use tape devices" on page 29
- "Maintain tape resources" on page 43
- "Example: Manage tape resources" on page 51

Troubleshooting
- "Troubleshoot tape resources" on page 58

Types of tape solutions

You can group types of tape solutions into two broad categories: single tape devices and automated tape devices.

Single tape devices

Single tape devices enable you to enjoy the benefits of tape media with your iSeries$^{(TM)}$ server. They are excellent for smaller companies that may not have much data to back up or to retrieve. If a full backup of your server fits on a single tape, you can perform unattended backups with a single tape device. However, once your backup exceeds one tape, someone needs to be present to switch the tapes in the drive as the backup runs.

Many tape devices support data compression, which increases the apparent capacity of your media by encoding the data to use less space. The data is compressed and decompressed by the hardware each time it is read or written on your tape device and is not apparent to applications.

Automated tape devices

These topics contain information about what tape automation is and how it can help you manage your data and more efficiently carry out your backup strategy. The two types of tape automation are:
- "Automatic cartridge loaders" on page 7
- "Tape libraries" on page 7

For more information about types of tape solutions, you can also see Tape Offerings 🔅 . «

Automatic cartridge loaders

» Automatic cartridge loaders provide automation solutions for small to medium size environments. Automatic cartridge loaders can hold multiple cartridges and perform unattended backups. Though they have fewer automation capabilities than tape libraries, you can use tape management software to support automated, centrally scheduled, policy-managed backup and storage operations.

There are two ways that you can use tape cartridges with an automatic cartridge loader:

Manual mode
You insert tape cartridges one at a time.

Auto mode
You can preload multiple tape cartridges. A tape cartridge automatically loads when the previous cartridge is unloaded.

You can find examples of automatic cartridge loaders at Tapes Supported on iSeries^(TM) 🔅 . «

Tape libraries

» Tape libraries can help you perform unattended save and restore operations, archival and retrieval operations, spool archiving, and other tape related tasks. Tape libraries are often used with some form of automation software, and are capable of supporting multiple systems across different platforms and large quantities of cartridges. In these environments, a media management application often maintains the cartridge inventory and handles most of the tape library tasks. However, you can also use tape libraries without a media management application. In these environments the tape library can still support some automated tape functions.

The following topics introduce the major elements of a tape library and the related information required for implementing a tape library solution.

"Tape library types and major components"
Use this topic to learn about the major components of a typical tape library configuration, and how they relate to OS/400^(R).

"Tape library operating modes" on page 8
This topic provides a description of the tape library operating modes.

"Common configuration types for tape libraries" on page 9
This topic provides a description of several common configurations for tape libraries.

Cartridge concepts for tape libraries
This topic explains how cartridges work with tape libraries. «

Tape library types and major components: »

The following figure illustrates the parts of a tape library. The figure represents some typical tape libraries, but does not describe all possible configurations.
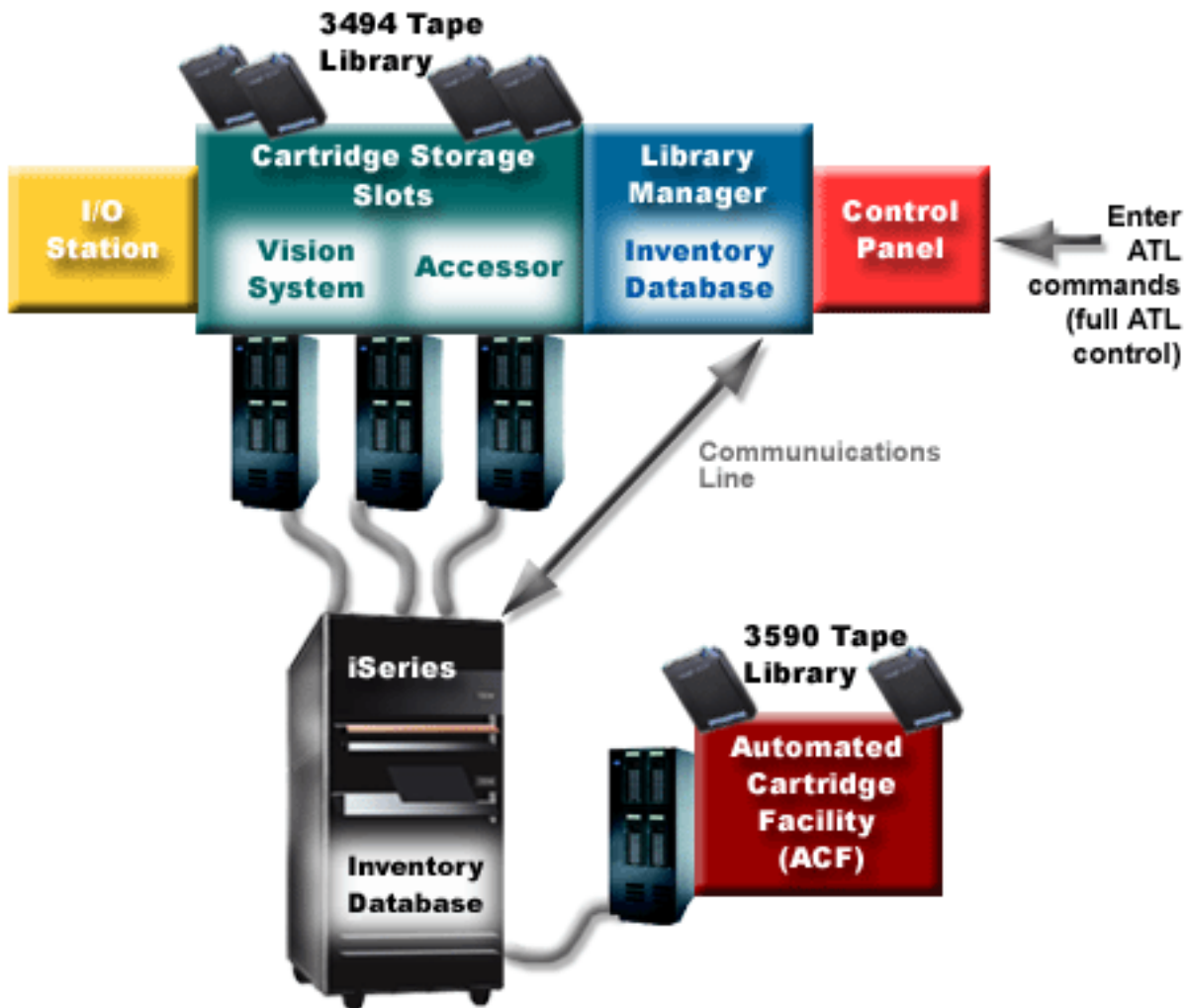
Tape library operating modes: Most tape library devices support three basic modes of operation. The terminology that is used to describe these operational modes varies with the type of tape library, but the concepts are the same. The operating modes are the following:

Manual mode
When a tape library is in manual mode it behaves like a stand-alone tape device. You must load all cartridges manually. See "Set up a tape library as a stand-alone device" on page 38 for more information about using a tape library as a stand-alone device.

Automatic cartridge loader mode
When a tape library is in this mode it behaves like a stand-alone tape device with an automatic cartridge loader. When a cartridge is unloaded, the next cartridge is loaded until all cartridges have been used.

Library mode
In library mode, a tape library provides full tape automation.

See the operator's manual for your tape library for specific information for configuring these modes on your tape library.

Common configuration types for tape libraries: ≫ The iSeries^(TM) server is connected to the tape drive through a parallel channel, SCSI, or Fiber Channel interface. A 3494 tape library requires a separate connection, either through an EIA-232 line or through a local area network (LAN), to communicate with the library manager.

When more than one drive of the same type within a tape library is connected to the same OS/400^(R) partition, the drives are pooled together to form a single logical library.

iSeries servers commonly support the following tape library configurations:

Single iSeries connected to a dedicated tape library
An iSeries server can connect to one or more drives within a tape library.

Multiple iSeries servers or logical partitions connected to the same tape library
For a tape library with multiple drives, it is possible to attach multiple iSeries servers or logical partitions to the same tape library.

Multiple system types connected to the same tape library
Different types of host servers, such as iSeries servers and pSeries^(R) servers, can share automated tape libraries.

When more than one system or logical partition is connected to the same tape library it is recommended that you use a tape management application, such as BRMS, to manage and secure the tape cartridges. For more detailed information about BRMS, see the Backup, Recovery and Media Services topic and the Backup, Recovery and Media Services ⬦ Web site. ≪

Cartridge concepts for tape libraries: ≫ Working with tape cartridges is an important and routine part of operating your tape library. This topic shows you how your library relates to tape cartridges.
- "Cartridge status"
- "Cartridge categories" on page 10
- "Cartridge identifiers and volume identifiers" on page 11

≪

Cartridge status: ≫ The following list describes the possible types of status for a cartridge in relation to a tape library.

Inserted
The cartridge has been moved into the media library device and has been placed in the inserted category. The cartridge is not available until you add it to a usable category.

Available
The cartridge exists in a usable category and is available for use.

Mounted
The cartridge exists in a usable category and is currently in a tape resource. The tape resource might not be attached to this system. This situation is common for large 3494 configurations. If a cartridge is mounted in a device that is not attached to this system, the system returns an error when the cartridge is requested.

Duplicate
The cartridge identifier exists more than once in the inventory. Only one entry is established for the cartridge identifier. This error should not occur on the 3494 because the Library Manager software does not allow duplicate cartridge identifiers in the device.

When a 3590 with an automated cartridge loader is operating in random mode and has the GENCTGID(*VOLID) parameter in the device description, this error can happen often. You must remove one of the duplicate cartridge identifiers before the tape library can use the other cartridge.

Not Available
The 3494 Library Manager software has determined that the cartridge is not available for use. A possible reason can be that it has been lost or misplaced in the inventory.

Error
The cartridge is in error. See the QSYSOPR message queue to determine why the cartridge is in error.

Ejected
The cartridge has been removed or is in the process of being removed.

"Cartridge categories" has more detailed information about the inserted category. «

Cartridge categories: » A **category** is a logical grouping of cartridges. A category allows you to refer to a group of cartridges by category name instead of the individual cartridge identifiers.

Categories are intended for tape libraries like the 3494 where there is a library manager function that uses categories to provide security and special functions.

Categories are as follows:

Inserted
The cartridge has been moved into the tape library device and has been placed in the Inserted category. The cartridge is not available until you add it to a usable category.

Not shared
The cartridge has been assigned to a category that is only available to the server defined as the primary owner. Only tape library devices with Library Manager software that contains category information (3494, for example) and has access to multiple systems can ensure that the cartridge is used only by the primary owning system.

Shared
The cartridge has been assigned to a category that is available to all iSeries(TM) servers attached to the tape library device.

Ejected
The cartridge has been removed from the inventory and is waiting for physical removal or waiting for the convenience station or high capacity output area to be cleared.

Convenience
The cartridge has been assigned to the convenience category. The convenience category is designed for the user who just needs to use a tape quickly and get it out of the tape library device. A tape in the convenience category will be ejected (removed) after it has been mounted and then unloaded. The ejecting process takes place when a user specifies the end option (ENDOPT) parameter of *UNLOAD. The cartridge is not ejected when OS/400(R) unloads the tape resource for another request.

Alternate restart
The cartridge has been assigned to the alternate restart category. This category is provided by OS/400 for tape cartridges that can be used for a load source (D-mode) IPL. The tapes in this category must be maintained by the user. OS/400 does not guarantee or verify that the tape cartridges have the appropriate data on them.

Non-labeled
The cartridge has been assigned to the non-labeled category. Tapes in this category must be non-labeled tapes. A non-labeled tape is a tape volume with no logical volume identifier.

System generated
The cartridge is assigned to the system-generated category. All cartridge identifiers are assigned to this category when the tape library device description has the GENCTGID parameter set to *SYSGEN. This function allows tape library devices with no bar code reader to bypass all system category checks on the cartridge for fast use of cartridges. Cartridges cannot be added or changed to this category.

User-defined

Note: If you are using BRMS, you should not attempt to use user-defined categories.

User-defined categories can be created and deleted. These categories allow users to create their own logical groupings of tape cartridges. The Create Tape Category (CRTTAPCGY) and Delete Tape Category (DLTTAPCGY) commands are used for this function. The Display Tape Category (DSPTAPCGY) command displays a list of user-defined and system-defined categories on a given system.

Categories and the system name

Category names are of the form *name sysname*, where the *name* is the category name and *sysname* is name of the system that owns the category. If you change the system name, the cartridges in the associated categories and the not shared category are unavailable until you create a category with the previous system name. It is highly recommended that you remove all cartridges from the tape library or change them to the shared category prior to changing the system name. See "Reassign cartridges when the system name changes" on page 37 for more information about changing the system name.

Categories for tape libraries without a library manager

For tape libraries without a library manager, categories have a limited purpose. The security that the tape library manager provides does not exist. Cartridges that are added to a category on one system are not necessarily in the same category on other attached systems. Therefore, when you operate tape libraries that do not have a library manager, only the following categories apply:

* Inserted
* Ejected
* Convenience
* Shared

The not-shared category does not prevent other systems from accessing the cartridges. The remaining categories do not apply for tape libraries without library managers. Categories that are created for nonlibrary manager tape libraries are only known to the system where they are created and not across all attaching systems. For these types of tape libraries, the cartridges must be added to each system and then managed across all the systems by the tape management software. ≪

Cartridge identifiers and volume identifiers: ≫ Every cartridge and volume ID can contain the characters A through Z, 0 through 9, $, @, #. Only the first 6 characters are recognized by OS/400[(R)]; therefore, the uniqueness of the cartridge identifier must be within the first 6 characters of the name. The first 6 characters of the cartridge identifier must match the volume identifier for the tape.

Special generated cartridge identifiers exist for the tape libraries that do not have a bar code reader, that are missing the bar code label, or when the bar code reader cannot read the label. These identifiers are as follows:

NLT*xxx*

Non-Labeled Tape - This cartridge contains data written in non-Standard Tape Label format.

CLN*xxx*

Cleaning - This cartridge has been identified as a cleaning tape.

BLK*xxx*

Blank - This cartridge contains no data.

UNK*xxx*

Unknown - This cartridge was not identifiable.

IMP*xxx*

Import - Refers to a cartridge that is in an input/output station of the tape library.

SLT*xxx*

Slot- Refers to the cartridge by slot number. If the device description is created with the GENCTGID parameter set to the *SYSGEN mode then, the cartridges in the tape library inventory appear as SLT*xxx* where *xxx* is the slot number. «

Comparison of offline storage

» Offline storage is data that you save on media that is separate from the server. The most common forms of offline storage are tape media and optical media. Although optical media is becoming more prevalent, tape media is the most common media. Another option that you can use is virtual optical media. You can use virtual optical media to save to a virtual image, which is stored on your disk units. You can then copy that image to a CD or DVD, or distribute it over your network. «

It is important that you understand the differences among these different forms of media while you decide which one is right for you. The following table describes some of the differences:

Characteristic	Comparison
Access to data	Optical and virtual optical storage provide random access, whereas tape provides access to data sequentially.
Capacity	The lowest capacity tape has a similar capacity to DVD-RAM, but midrange and high capacity tapes typically have 10 to 25 times the capacity of optical.
Compression	The server uses **software** compression to save compressed data to your optical media. This process takes considerable processing unit resources and may increase your save and restore time. Most tape media devices use **hardware** compression, which is typically faster.
Cost	Because you can store a larger amount of data on tape, tape has a lower cost per gigabyte.
Data transfer rates	Data transfer rates for tape tend to be higher than for optical media, particularly if you use tape drive compression.

Characteristic	Comparison
Number of media passes or mounts	Optical media can be mounted anywhere from 50 000 to 1 million times, depending on the type of media used. The number of media passes supported by tape varies, but is typically lower than optical media.
Reusability	Not all optical media is rewritable. Some optical media are write-once media, which means that once they are written to, they cannot be reused. Tape is reusable.

Plan for a tape solution

≫ When you plan for a tape solution, you need to consider the following:

- Whether to use tape management software
- The capabilities of the tape solution
- Possible connection configurations with your iSeries^(TM) server
- Physical requirements for the tape solution

Tape management software

- "Tape resource management with BRMS"

Capabilities of the tape solution

- "Comparison of tape solutions" on page 14
- "Eight-millimeter cartridge and tape unit compatibility" on page 16
- "Quarter-inch cartridge and tape unit compatibility" on page 17
- "Half-inch and Magstar^(R) MP cartridges and tape unit compatibility" on page 19
- "LTO cartridges and tape unit compatibility" on page 19

Connection configurations with your iSeries server

- "Multiple iSeries^(TM) servers sharing a tape library" on page 20
- "Multiple tape libraries on an iSeries server" on page 20
- "Multiple tape drives in a 3494 Tape Library Dataserver" on page 21
- "Configurations of different platforms with the 3494 Enterprise Tape Library" on page 22

You can navigate to the physical planning information for your specific tape device from the Tapes Supported on iSeries 🌐 Web site. ≪

Tape resource management with BRMS

Backup, Recovery and Media Services (BRMS) is a licensed program that helps you implement a disciplined approach to managing your backups, and provides you with an orderly way to retrieve lost or damaged data.

The combination of BRMS with a tape library provides a total solution for all your tape automation requirements. Using tape automation and BRMS, you can design and carry out a solution that shows the results in the following ways:

- **Reduce operational costs**
  Less manual intervention is required to operate tape units because most of your tape operation is automated and unattended.
- **Improve system availability**
  BRMS enables you to streamline your backups by reducing the time that is required for tape mounting and backup operations.

- **Reduce capital cost**

  Archiving and retrieving functions enable you to increase the quantity of online (on-disk) data that can be moved to less expensive tape media.

- **Improve service**

  You can experience faster and more accurate responses to your tape-related requests. You can gain more control of your tape management operation.

- **Reduce management cost**

  Day-to-day operations, such as tape and disk capacity management, are more automated and simplified.

For more detailed information about BRMS, see the Backup, Recovery and Media Services topic and the

Backup, Recovery and Media Services Web site.

Comparison of tape solutions

The following table compares the different single tape devices, autoloaders, and tape libraries that the iSeries(TM) server supports.

Product name	Description	Media	Storage	Data transfer	Drives
Single tape devices					
IBM(R) Magstar(R) 3570 Tape Subsystem Model C00	The 3570 Model C00 is a compact, high-capacity storage device.	1 cartridge	7 GB (21 GB compressed) per cartridge	7 MB per second (MB/s) (15 MB/s compressed)	1
IBM 3580 Ultrium External Tape Drive	The 3580 is an external tape device that complies with Linear Tape-Open (LTO) specifications.	1 cartridge	Ultrium 1: up to 100 GB (200 GB compressed) Ultrium 2: up to 200 GB (400 GB compressed)	Ultrium 1: Up to 15 MB/s (30 MB/s compressed) Ultrium 2: Up to 35 MB/s (70 MB/s compressed)	1
IBM TotalStorage(R) Enterprise Tape Drive 3592	The 3592 is a tape device that provides both fast access to storage and high-capacity storage.	1 cartridge	300 GB (900 GB compressed) per cartridge	40 MB/s	1
IBM 7206 Model VX2 External VXA-2 Tape Drive	The 7206 Model VX2 is a higher capacity, cost-effective alternative to DDS tape technology.	1 cartridge	1 - 80 GB (160 GB compressed) per cartridge	6 MB/s (12 MB/s compressed)	1
IBM 7207 Model 122 4 GB External SLR5 QIC Tape Drive	The 7207 Model 122 is a quarter inch tape device.	1 cartridge	4 GB (8 GB compressed) per cartridge	1 - 380 KB per second (KB/s) (760 KB/s compressed)	1
IBM 7208 Model 342 External 8mm Tape Drive	The 7208 Model 342 is an external tape device. It is backward compatible with ability to read 7 GB, 5 GB, and 2.3 GB 8mm tape formats.	1 cartridge	20 GB (40 GB compressed) per cartridge	Up to 3.0 MB/s (6 MB/s compressed)	1

Product name	Description	Media	Storage	Data transfer	Drives
IBM 7208 Model 345 External 8mm Tape Drive	The 7208 Model 345 is an external tape device. It is backward compatible with ability to read 7 GB, 5 GB, and 2.3 GB 8mm tape formats.	1 cartridge	60 GB (150 GB compressed) per cartridge	Up to 12.0 MB/s (20 MB/s compressed)	1
Tape libraries					
IBM 3490E Model F*xx* Tape Subsystem	The 3490E F series is a family of high-performance, high reliability streaming tape devices.	1 to 10 cartridges	Up to 800 MB (2.4 GB compressed) per cartridge	Sustained rate of up to 6.8 MB/s with a maximum SCSI burst rate of 20 MB/s.	1 to 4
IBM TotalStorage Enterprise Tape Library 3494	The 3494 is a modular, flexible storage solution. It is expandable from 1 to 16 library frames and can handle from 160 up to 6240 tapes.	1 - 6240 cartridges	Varies according to drives	Varies according to drives	1 to 76
IBM Magstar 3570 Tape Subsystem	The 3570 Models C01, C02, C11, and C12 provide a midrange tape storage solution.	20 cartridges	7 GB (21 GB compresses)	7 MB/s (15 MB/s compressed)	C01 and C11: 1 C02 and C12: 2
Magstar 3575 Tape Library Dataserver	The 3575 Models are compact, high-capacity, integrated storage devices that are available as stand-alone units.	1 to 324 cartridges (depending on model)	7 GB	Up to 324 GB per hour	1 to 6 (depending on model)
IBM TotalStorage LTO Ultrium Tape Autoloader 3581	The 3581 is an automation solution that complies with LTO specifications.	1 to 7 cartridges	Up to 100 GB (200 GB compressed) per cartridge. Total storage of 700 GB (1.4 TB compressed).	Up to 15 MB/s (30 MB/s compressed)	1
IBM TotalStorage LTO Ultrium Tape Library 3582	The 3582 is an ideal automation solution for handling the storage needs of small to medium sized environments.	1 - 24 cartridges	Up to 200 GB (400 GB compressed) per cartridge. Up to 4.8 TB (9.6 TB compressed) per library.	Up to 35 MB/s (70 MB/s compressed)	1 - 2

Product name	Description	Media	Storage	Data transfer	Drives
IBM TotalStorage Ultrium 3583 Scalable Tape Library	The 3583 provides for a wide range of backup, archival, and disaster-recovery data storage needs. It complies with Linear Tape-Open (LTO) specifications.	18, 36, 54, or 72 cartridges	100 GB (200 GB compressed) per cartridge compressed. Up to 7.2 TB (14.4 TB compressed) per library.	Up to 15 MB/s (30 MB/s)	1 - 6
IBM TotalStorage Ultrium 3584 UltraScalable Tape Library	The 3584 provides for a wide range of backup, archive, and disaster recovery data storage needs. It complies with Linear Tape-Open (LTO) specifications.	1 - 6881 cartridges (depending on model)	Up to 2752 TB with maximum compression (depending on model)	Up to 35 MB/s (70 MB/s compressed)	1 to 192 (depending on model)
IBM TotalStorage Enterprise Tape System 3590	The 3590 is an enterprise-class tape solution that provides the highest levels of performance and reliability of any IBM tape subsystem.	1 - 10 cartridges	Up to 60 GB (180 GB compressed) per cartridge	Up to 14 MB/s	1
IBM 7329 SLR100 Autoloader	The 7329 is a high-capacity tape autoloader with the ability to provide unattended backups.	1 to 8 cartridges	Up to 50 GB (100 GB compressed) per cartridge	5 MB/s (10 MB/s)	1

For more information about these tape solutions see the following Web sites:

- Tapes Supported on iSeries
- Tape Offerings

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Eight-millimeter cartridge and tape unit compatibility

≫The iSeries[(TM)] supports the following tape units:

- 7206 Model VX2
- 7208 Models 002, 012, 222, 232, 234, 342, and 345
- 9427 Models 210, 211
- Feature code 4585 80 GB VXA-2
- Feature code 4685 80 GB VXA-2
- Feature code 6390

The 7206 Model VX2 and 7208 Models 002, 012, 222, 232, 234, 342, and 345 are external tape units for the iSeries server.

Feature codes 4585, 4685, and 6390, are 8mm tape units that are internal to the iSeries server.

The following table shows which tape cartridges are compatible with 8mm tape units.

Tape unit	Cartridge part number	Capacity	Compression	Length
4585 4685 7206-VX2	19P4876	80 GB	160 GB	230 m (754 ft.)
7208-002	21F8575	2.3 GB		112 m (367 ft.)
7208-012	21F8575	5 GB	10 GB	112 m (367 ft.)
6390 7208-222	87G1603	7 GB	14 GB	160 m (524 ft.)
7208-232	21F8575	5 GB	10 GB	112 m (367 ft.)
7208-234	87G1603	7 GB	14 GB	160 m (524 ft.)
7208-342[1]	59H2678	20 GB	40 GB	170 m (557 ft.)
7208-345	09L5222	60 GB	150 GB	225 m (738 ft.)
9427-210 9427-211	87G1603	7 GB	14 GB	160 m (524 ft.)

Note:

1. The 7208-342 can read tapes written at the 2 GB, 5 GB, or 7 GB formats. However, if a 20 GB tape is inserted after the drive has been using a lower-density tape, the 20 GB tape is ejected and the drive will post a "must-clean" message. The drive must be cleaned using the correct cleaning cartridge before it can be used again.

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Quarter-inch cartridge and tape unit compatibility

» For full read-and-write capability, follow the guidelines in the following table to determine which tape cartridges to use for each tape unit.

Capacity-and-date rate by media type and format				Read-and-write support by tape unit feature code number[1,2]						
Media type (IBM[R] P/N)	iSeries[TM] format (density)	Data compaction[3]	Capacity and data rate[4]	6380 6480	6381 6481	4482 4582 6382 6482 7207-122	4483 4583 6383 6483	4584 4684 6384 6484 7207-330	4486 4586 6386 6486	4487 4587 4687
SLR100 50GB (35L0968)	SLR100	Yes	50 GB 5.0 MB per second (MB/s)	No	No	No	No	No	No	R/W
SLR100 5GB (35L0661)	SLR100	Yes	5 GB 5.0 MB/s	No	No	No	No	R/W	No	R/W
SLR60 30GB (19P4209)	SLR60	Yes	30 GB 4.0 MB/s	No	No	No	No	R/W	No	R/W
MLR3-25 GB (59H4128)	MLR3	Yes	25 GB 2.0 MB/s	No	No	No	No	R/W	R/W	R/W
MLR1-16 GB (59H4175)	QIC5010	Yes	16 GB 1.5 MB/s	No	No	No	R/W	R/W	R/W	R
DC5010 (16G8574)	QIC5020	Yes	13 GB 1.5 MB/s	No	No	No	R/W	R/W	R/W	R

Capacity-and-date rate by media type and format				Read-and-write support by tape unit feature code number[1,2]						
Media type (IBM[R] P/N)	iSeries[TM] format (density)	Data compaction[3]	Capacity and data rate[4]	6380 6480	6381 6481	4482 4582 6382 6482 7207-122	4483 4583 6383 6483	4584 4684 6384 6484 7207-330	4486 4586 6386 6486	4487 4587 4687
SLR5-4 GB (59H3660)	QIC4DC	Yes*	8 GB 760 KB per second (KB/s)	No	No	R/W	R	R	R	R
SLR5-4 GB (59H3660)	QIC4GB	No	4 GB 380 KB/s	No	No	R/W	R	R	R	R
DC9250 (16 G8436)	QIC2DC	Yes*	5 GB 600 KB/s	No	R/W	R/W	R	R	R	No
DC9200 (16G8541)	QIC2DC	Yes*	4 GB 600 KB/s	No	R/W	R/W	R	R	R	No
DC9250 (16G8436)	QIC2GB	No	2.5 GB 300 KB/s	R/W	R/W	R/W	R	R	R	No
DC9200 (16G8541)	QIC2GB	No	2 GB 300 KB/s	R/W	R/W	R/W	R	No	R	No
DC9120 (21F8730)	QIC1000	No	1.2 GB 300 KB/s	R/W	R/W	R/W	No	No	No	No
DC9100 (16G8539)	QIC1000	No	1 GB 300 KB/s	R/W	R/W	R/W	No	No	No	No
DC6525 (21F8597)	QIC525	No	525 MB 200 KB/s	R/W	R/W	R/W	No	No	No	No
DC6320 (21F8583)	QIC525	No	320 MB 200 KB/s	R/W	R/W	R/W	No	No	No	No
DC6150 (21F8578)	QIC120	No	120 MB 120 KB/s	R/W	R/W	R/W	No	No	No	No
DC6150 (21F8578)	QIC24	No	60 MB 92 KB/s	R	R	No	No	No	No	No

1. See "Clean quarter-inch tape drives" on page 48 to correlate the feature code number of the tape unit to the front bezel of the tape unit label.

2. In the tape unit feature code columns, R/W indicates both read and write support of the associated media type and format. An R indicates read only. No indicates that the media type and format is not supported.

3. Data Compaction is a term used to describe a data recording option for compacting (or compressing) data before writing to the tape media. Selecting the data compaction option will usually result in an increase in both capacity and data transfer rate. The typical compaction ratio is 2:1, but is dependent on the type of data. Yes in the Data Compaction column means that the associated media type and format supports data compaction. Use the COMPACT parameter of the OS/400[R] SAVE command to select the data compaction option, except for those cases identified by Yes*. Yes* indicates that the compaction option is controlled entirely by the format (density) that is selected during the tape initialization operation. The COMPACT parameter of the SAVE command has no effect in these cases.

    *   QIC2DC is a compaction format (density) for the DC9250 and DC9200 media type.
    *   QIC4DC is a compaction format (density) for the SLR5-4 GB media type.

4. Cartridge capacities and data transfer rates shown are for noncompacted data, except for the QIC4DC and QIC2DC cases. For the QIC4DC and QIC2DC formats (densities), the capacities and the data transfer rates shown assume a typical 2:1 data compaction. See Note 2.

If the quarter-inch cartridge (QIC) format and the tape cartridge are not compatible, an error is message displayed. Errors that can occur are as follows:

- While selecting a QIC format that cannot be written on the tape. For example, inserting a DC6150 tape cartridge and specifying a QIC1000 format.
- While attempting to process a high-density tape cartridge in a low-density tape unit. For example, you try to process an SLR5-4 GB cartridge in a 6381 tape unit.
- While attempting to add a file and selecting a QIC format different from the format previously recorded on the tape. For example, inserting a tape cartridge recorded in QIC525 format and specifying a QIC120 format.

Half-inch and Magstar(R) MP cartridges and tape unit compatibility

The following table shows which tape units and half-inch and Magstar MP cartridges are compatible.

Tape unit	Cartridge part number	Capacity	Compression	Length
3592	18P7534	300 GB	900 GB	610 m (2001 ft.)
3590	05H4434	10 GB 20 GB 30 GB	30 GB 60 GB 90 GB	320 m (1050 ft.)
	05H3188	20 GB 40 GB 60 GB	60 GB 120 GB 180 GB	634 m (2070 ft.)
	05H3302			
	08l6091			
3490E	09G4494	800 MB	2.4 GB	335 m (1000 ft.)
3480	4479753	200 MB	Not applicable	175 m (575 ft.)
3570	05H2462	5 GB	15 GB	547 ft. (167 m)
	08L6187			
	08L6663	7 GB	21 GB	227 m (745 ft.)

LTO cartridges and tape unit compatibility

The following table shows which Linear Tape Open (LTO) Ultrium tape units and cartridges are compatible.

| Cartridge type	Tape units	Part number	Capacity	Compression	Length
Ultrium 1	IBM(R) 3580 Ultrium External Tape Drive	08L9120	100 GB	200 GB	609 m (1997 ft.)
	IBM 3581 Ultrium Tape Autoloader				
	IBM TotalStorage(R) Ultrium Scalable Tape Library 3583 (Ultrium 1)				
	IBM TotalStorage UltraScalable Tape Library 3584 (Ultrium 1)				

Cartridge type	Tape units	Part number	Capacity	Compression	Length
Ultrium 2	IBM TotalStorage Ultrium External Tape Drive 3580	08L9870	200 GB	400 GB	610 m (2000 ft.)
	IBM TotalStorage Ultrium Tape Autoloader 3581				
	IBM TotalStorage Ultrium Tape Library 3582				
	IBM TotalStorage Ultrium Scalable Tape Library 3583 (Ultrium 2)				
	IBM TotalStorage UltraScalable Tape Library 3584 (Ultrium 2)				

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Multiple iSeries(TM) servers sharing a tape library

≫The IBM(R) TotalStorage(R) Enterprise Tape Library 3494 can be shared by as many as 32 iSeries servers. Each iSeries server requires one communications line and one tape drive attachment. With BRMS controlling the 3494 tape library, the cartridges within the library can be shared among any of the attached iSeries servers when you use the common media inventory function of BRMS.

The following figure shows two iSeries servers sharing a 3494 tape library.

≪
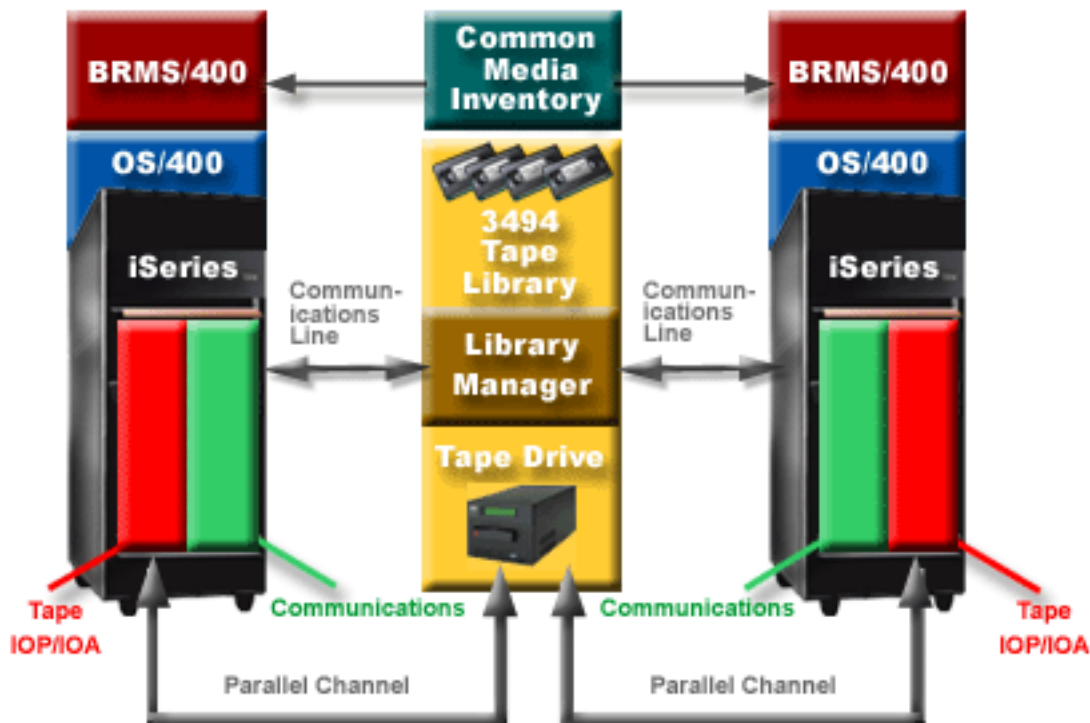
Multiple tape libraries on an iSeries server

≫The iSeries(TM) server supports attachment to multiple 3494 IBM(R) TotalStorage(R) Enterprise Tape Libraries. Each 3494 must have at least one communications line and at least one tape drive connection to the iSeries server. The number of 3494s that can be attached to an iSeries server depends on the number of tape IOP features that can be installed and supported on a given iSeries server. BRMS provides support for multiple 3494s attached to a single iSeries server. ≪

Multiple tape drives in a 3494 Tape Library Dataserver

≫ Larger iSeries^(TM) servers can reduce backup times by breaking the operation into multiple concurrent save operations to multiple devices.

Not all connections between an iSeries server and the 3494 Automated Tape Library Dataserver are valid. A single iSeries server can be connected to multiple tape drive controllers. However, a single partition in an iSeries server cannot be connected twice to the same tape drive controller, as this creates a serial number conflict and results in nonfunctional drives. This scenario might be evident during an IPL.

The following figure shows a supported configuration. The cable attaches the iSeries server to the tape drives.

Supported configuration

You can connect a single iSeries server to multiple tape drives.

3494   3494
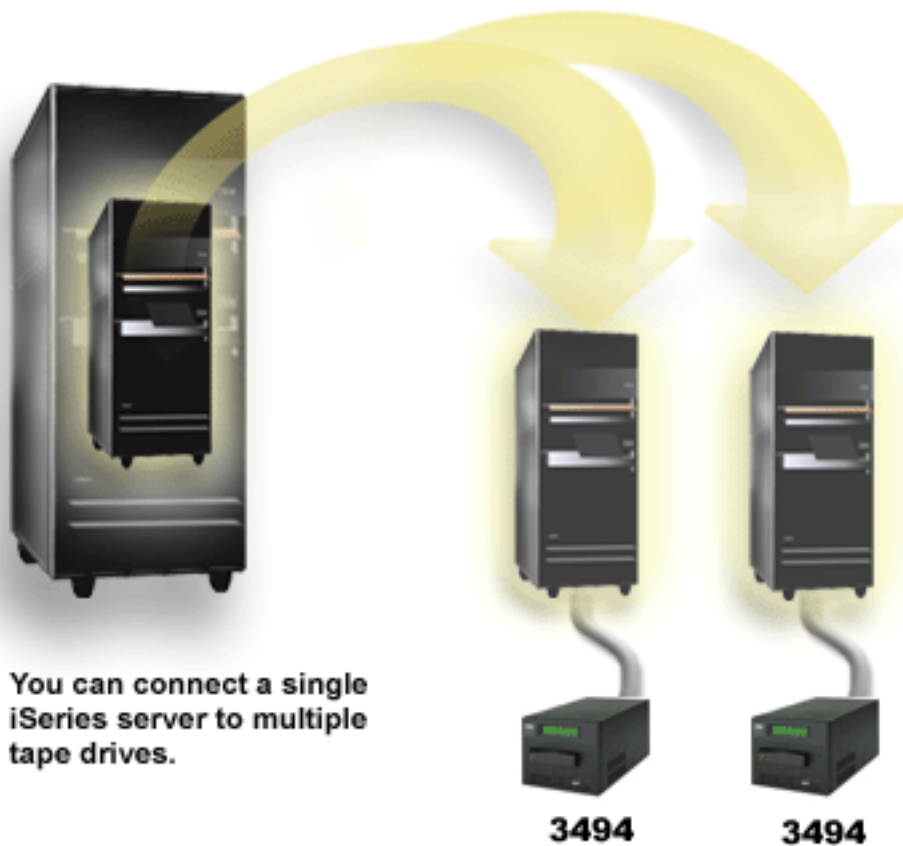
The following figure shows an unsupported configuration. The cable attaches the iSeries server to the tape drives.

Unsupported configuration

You cannot connect a single partition twice to the tape drive.

3494   3494
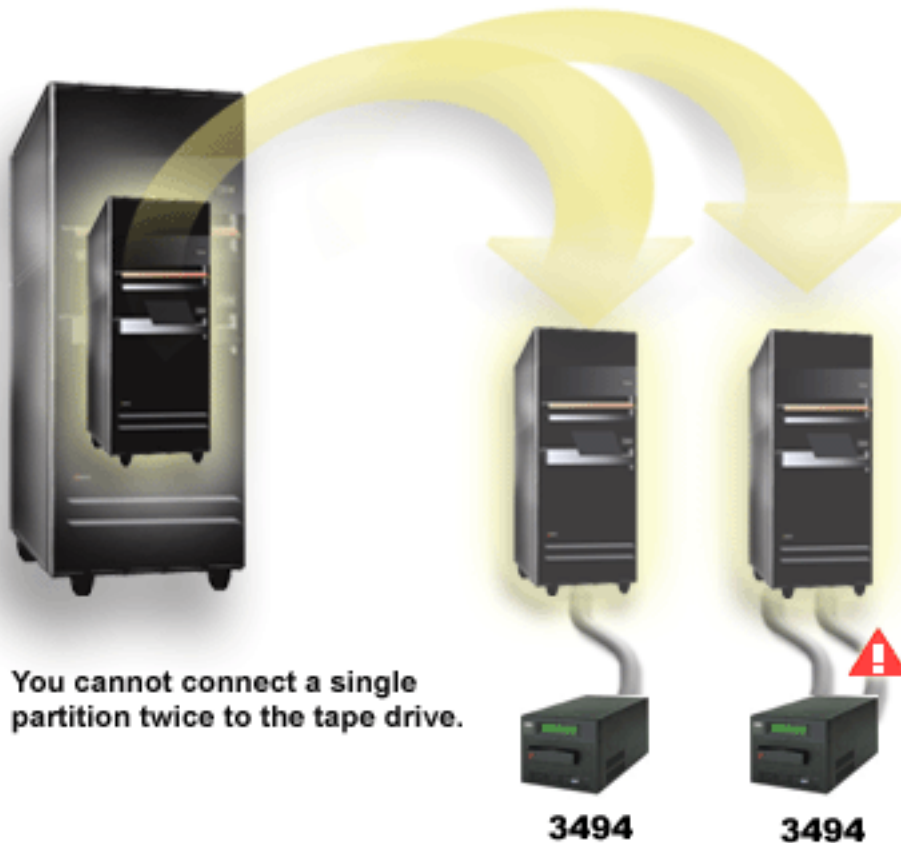
Configurations of different platforms with the 3494 Enterprise Tape Library

» The IBM[(R)] TotalStorage[(R)] Enterprise Tape Library 3494 can be shared by iSeries[(TM)] servers, pSeries[(R)] servers and ES/9000[(R)] systems for a total of 16 systems. The iSeries servers can share cartridges in the library. The other systems can share the library by partitioning the 3494 tape library, and individual cartridges can be assigned to a particular processor. This is done by assigning each cartridge to a category. «

Install stand-alone tape devices

» The instructions for installing and configuring your tape device vary based on which model of iSeries[(TM)] server you have and which type of tape device you are installing.

Installation instructions

To install your stand-alone tape device, see the following information:

- Install iSeries features
- Tape Storage Publications

Configuration instructions

To configure your tape device, see the following information:

- "Share servers with external drives" on page 23
- "Configure the SCSI address for half-inch and Magstar[(R)] MP tape units" on page 24

Share servers with external drives

≫You can attach the 3480, 3490, 3490E, 3590, or 3592 tape devices to any of the following units:

- One input/output processors on the same iSeries$^{(TM)}$ server
- Two iSeries servers
- An iSeries server and a different server

You can choose whether you want your stand-alone tape device assigned to an iSeries server when the tape device is varied on. Assigning a tape device reserves the tape device specifically for one system.

Assign a stand-alone tape device to a server

To assign a tape device to a server do the following steps:

1. Use the Work with Device Description (WRKDEVD *TAP) command to work with a tape device description.
2. Select 2 (Change) for the tape device you want to work with.
3. In the *Assign device at vary on* field, specify *YES and press Enter to assign the tape device to the system.
4. Type VRYCFG (the Vary Configuration command) to vary off the tape device.

   Note: The Vary Configuration (VRYCFG) command can be run by using the VRYCFG command or by using the Work with Configuration Status (WRKCFGSTS) command. To use the Work with Configuration Status command, type WRKCFGSTS *DEV *TAP and press Enter.
5. Type VRYCFG to vary on the tape device and assign it to a server.

If the tape device is being used by another server, a message is displayed that indicates the tape device is assigned elsewhere. The tape device must be varied off at the other server before it can be varied on at a new server.

Leave a tape device unassigned

To leave a tape device unassigned, do the following steps:

1. Type WRKDEVD *TAP (the Work with Device Description command) to work with a tape device description. In the *Assign device at vary on* field, specify *NO and press Enter to leave the tape device unassigned.

   Note: A tape device that is unassigned can be varied on to both servers. You must control the tape application programs so that the two systems do not interfere with each other. The results of failing to control the tape application programs can be unpredictable.
2. Type the following command and press Enter to vary off the tape device:

   VRYCFG CFGOBJ(TAP*xx*) CFGTYPE(*DEV) STATUS(*OFF)
3. Type the following command and press Enter to vary on the tape device:

   VRYCFG CFGOBJ(TAP*xx*) CFGTYPE(*DEV) STATUS(*ON)

Considerations for sharing a tape device between two servers

When a tape device is being shared by two iSeries servers, the tape device is only available on one server at a time. To use a drive, vary it on by using the following command and pressing Enter:

VRYCFG CFGOBJ(TAP*xx*) CFGTYPE(*DEV) STATUS(*ON)

If you do not want to vary on tape devices during future initial program loads (IPLs), type the following command and press Enter:

CHGCTLTAP CTLD(TAPCTL*xx*) ONLINE(*NO)

After doing an IPL, to vary on only the controller, type the following on any command line and press Enter:

```
VRYCFG CFGOBJ(TAPCTLxx) CFGTYPE(*CTL) STATUS(*ON) RANGE(*OBJ)
```

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Configure the SCSI address for half-inch and Magstar^(R) MP tape units

≫ For a 34xx or 35xx tape device attached to a SCSI I/O adaptor (IOA), you must set the SCSI address to 0 when the device is used for an initial program load (IPL). The SCSI address can be set to any address except 7 when the device is not being used for an IPL.

For a 34xx tape device attached to a type 2644 IOP, you must set the controller address to address 7. The device address must be set to address 0 when the device is used for an IPL. You can use address 8 when there is no device at address 0. You can set the controller and device to any value when the device is not being used for an IPL. ≪

Install tape libraries

≫ The iSeries^(TM) server automatically configures and varies on an attached tape library. For complete documentation on setting up and cabling the tape library, see the user's guide for your tape library.

- 3490E Model F Tape Subsystem
- 3494 Enterprise Tape Library
- Magstar^(R) 3570 Tape Subsystem
- Magstar 3575 Tape Library Dataserver
- IBM^(R) 3581 Ultrium Tape Autoloader
- IBM 3583 Ultrium Scalable Tape Library
- IBM 3584 UltraScalable Tape Library
- 3590 Enterprise Tape System

If you plan to use the tape library as an alternate IPL device, see "Set up a tape library as an alternate IPL device" on page 38. ≪

Configure tape libraries

≫ After you have set up the tape library and connected it to your system, the iSeries^(TM) server automatically configures it. The system creates a device description named TAPMLBxx, where xx is the next available device description number, and configures any associated tape resources (MLBRSC) and tape device descriptions (TAPxx). The system creates tape device descriptions for each tape resource. These tape device descriptions are used for stand-alone operations such as 3494 in stand-alone mode or 3590 or 3570 in auto mode.

Configure a tape library other than a 3494 tape library

To prepare your tape library for use complete the following procedure:

1. Ensure that the tape library is set to random mode. If it is not, use the device panel to set it to random mode.
2. At the character-based interface, type WRKMLBSTS and press Enter. This command allows you to work with the status of the device.
3. In the option field next to each resource, select option 4 (ALLOCATE) or option 5 (UNPROTECTED) and press Enter. This step makes the resource available to the tape library.
4. Add cartridges to the tape library. See the documentation for your media management application, or the topic "Make cartridges available to the tape library inventory" on page 39 for more information.

Configure a 3494 tape library

The 3494 tape library supports connections to multiple 3490 and 3590 tape devices within the same physical unit. When the iSeries server configures these devices, it creates a unique device description for each type of tape devices in the physical 3494 tape library, one for any 3490 tape devices and another for any 3590 devices. When either of these device descriptions is varied on, all devices of that type within that 3494 tape library will be associated with it.

To prepare the 3494 tape library ready for use complete the following procedure:

1. Ensure that the tape library is set to automated mode. If it is not, use the device panel to set it to automated mode.
2. "Create a data link" on page 26 for the 3494 tape library. Creating a data link defines the communication line associated with the tape library.
3. At a command line, type WRKMLBSTS and press Enter. This allows you to work with the status of the device.
4. In the option field next to each resource, enter option 4 (ALLOCATE) or option 5 (UNPROTECTED) and press Enter. These options make the resource available to the tape library.
5. Add cartridges to the tape library. See the documentation for your media management application or the topic "Make cartridges available to the tape library inventory" on page 39 for more information.

See the following information for more configuration tasks for tape libraries:
* "Add a tape library to a LAN"
* "Create a data link" on page 26
* "Reassign cartridges when the system name changes" on page 37

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Add a tape library to a LAN

≫ To add the LAN host to the 3494 library, you will need the LAN connection information from the iSeries(TM) server. To receive that information, use the following command:

DSPLANMLB LIND(TRNLINE) OUTPUT(*)

The command displays the following information.

Field	Description
Communication protocol	APPC
Host transaction program name	QMLD/QMLDSTRCC
Host network identifier	APPN
Host location name	SYSNAME
Host adapter address	0123456789AB

Add the LAN host to the 3494 library using the communication protocol given by the Display LAN Media Library (DSPLANMLB) command.

If you rename the Default local location name or the Local control point name on your iSeries server, the communication protocol type you use changes. You need to restart the 3494 library for these changes to take effect. ≪

Create a data link

>> The 3494 tape library requires a communications line for the library manager functions. The communication line can be RS232 ASYNC, LAN, or TCP/IP. Before the 3494 tape library can be varied on, the communication line needs to be specified in the ROBOTDEV or ROBOTHOST parameter in the tape library device description.

To create the data link between the tape library and the library manager use the Configure Device MLB (CFGDEVMLB) command. This command uses the required input parameters to configure and connect the communications line to the tape library device description and attempts to vary on the tape library.

Notes:

1. To use the LAN connection, you must also add the LAN host to the 3494 Library Manager. For complete instructions, see the 3494 documentation.

2. If your 3494 tape library has the high-availability option installed so that your 3494 tape library uses two Library Manager personal computers, you need to configure two communication lines, one for each Library Manager personal computer.

Use one of the following procedures to create a data link.

Create an RS/232 ASYNC connection

To configure a RS/232 ASYNC connection to communicate with the 3494 Library Manager, use the following command:

```
CFGDEVMLB DEV(TAPMLB01) ADPTTYPE(*RS232) RSRCNAME(CMN02)
```

The following list explains the details of this command:

DEV(TAPMLB01)
Specifies the name of the tape library device description.

ADPTTYPE(*RS232)
Indicates that this tape library is attached through an RS232 ASYNC line.

RSRCNAME(CMN02)
Specifies the resource name of the RS232 port. Use WRKHDWRSC TYPE(*CMN) to determine what resource name is used.

Note: The RS232 ASYNC line, controller and device descriptions will be created ONLINE(*NO). Do not vary them on. They will be varied on as needed by the operating system when the tape library is varied on.

Create a LAN connection using APPC

To configure a LAN connection to communicate using APPC, use the following command:

```
CFGDEVMLB DEV(TAPMLB01) ADPTTYPE(*LAN) PROTOCOL(*APPC) LIND(TRNLINE)
RMTLOCNAME(APPN.MLD01) ADPTADR(0123456789AB)
```

The following list explains the details of this command:

DEV(TAPMLB01)
Specifies the name of the media library (MLB) device description.

ADPTTYPE(*LAN)
Indicates that this MLB is attached through a LAN line.

PROTOCOL(*APPC)
Specifies that APPC will be used as the communications protocol for the LAN connection to the 3494 tape library.

LIND(TRNLINE)
Specifies the line description name for the LAN line being used. Use WRKCFGSTS CFGTYPE(*LIN) to display the list of valid LAN line descriptions. The line description for the LAN must be created before using the CFGDEVMLB command.

RMTLOCNAME(APPN.MLD01)
Refers to the name of the Library Manager that is connected through the LAN line. It is of the form *nnnnnnnn.cccccccc* where *nnnnnnnn* is the network identifier and *cccccccc* is the remote location name. If no network identifier is specified, use DSPNETA to determine the default value. Obtain this parameter from the 3494 Library Manager console using the menu options, LAN options, and LM LAN information.

ADPTADR(0123456789AB)
Specifies the LAN adapter address of the Library Manager. You can obtained the parameter from the 3494 library manager console selecting the following:
- Commands
- LAN options
- LM LAN information

Notes:
1. The LAN transaction program remains as QMLD/QMLDSTRCC and is contained in the Licensed Internal Code.
2. For APPC only, any routers between the iSeries(TM) server and the 3494 tape library need to allow SNA traffic.

To configure a LAN connection using APPC to communicate to the 3494 Library Manager, use the following command:
```
DSPLANMLB LIND(TRNLINE) OUTPUT(*)
```

For detailed information about working with this information, see "Add a tape library to a LAN" on page 25.

Create a TCP/IP connection

To configure a LAN connection using TCP/IP to communicate to the 3494 Library Manager, use the following command:
```
CFGDEVMLB DEV(TAPMLB01) ADPTTYPE(*LAN) PROTOCOL(*TCP) ROBOTHOST(MLD01) LCLINTNETA(192.168.5.10)
```

The following list explains the details of this command:

DEV(TAPMLB01)
Specifies the name of the MLB device description.

ADPTTYPE(*LAN)
Indicates that this MLB is attached through a LAN line.

PROTOCOL(*TCP)
Specifies that TCP/IP will be used as the communications protocol for the LAN connection to the 3494 tape library.

ROBOTHOST(MLD01)
Specifies the TCP/IP host name for the 3494 tape library. The host name can be a fully qualified domain and host name.

LCLINTNETA(192.168.5.10)
Specifies the local internet address of the interface that is connecting to the 3494 Library Manager. This is the interface the iSeries server will start when TCP/IP needs to be started to use the 3494 tape library.≪

Share tape library resources

≫ You can share tape library devices among multiple systems and users. You can run more jobs that use a tape library than there are resources in the library. As users send commands to the tape library, requests to use a resource are sent to a tape resource manager. The request waits until a resource becomes available. When a resource is available, the job is assigned the resource to complete that step. How the system handles the requests depends on the **Properties** in iSeries^(TM) Navigator that you specify for the tape library, or by using the Change Job Media Library Attributes (CHGJOBMLBA) command.

To specify the **Properties** for your tape library, do the following:
1. In iSeries Navigator expand **My Connections** —> **your iSeries server** —> **Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Tape Libraries**.
2. Right-click the library you want to work with and select **Properties**.
3. Select **Options**.
4. Specify the options you want:
   - Tape resource selection priority
   - Initial mount wait time
   - End of volume mount wait time

Details: tape library properties

The order in which requests are given a resource is determined by the option you specify for **Tape resource selection priority**. The length of time a request will wait for a resource to become available is controlled by the length of time you specify for the request in **Initial mount wait time** and **End of volume mount wait time**. The time you specify in these properties can also be set in the tape library device description.

The character-based interface equivalent to the properties are the following parameters of the CHGJOBMLBA command:
- Resource allocation priority (RSCALCPTY)
- Initial mount wait time (INLMNTWAIT)
- End of volume mount wait time (EOVMNTWAIT)

You can use these parameters as a default or for a particular job using the CHGJOBMLBA command or the Change Job Media Library Attributes (QTACJMA) API. These values are used when a request is first sent to the resource manager. After a request has been sent to the resource manager and is waiting to be processed, it can be monitored and changed using the Work with Media Library Resource Queue (WRKMLBRSCQ) command.

The system can automate how multiple library resources are shared. For example, assume ten save operations (SAVLIBs) are issued, with ten different cartridges, to a tape library device description (TAPMLB01). If TAPMLB01 has only four tape resources available to it, the first four requests are issued, one to each tape resource. The remaining six are placed on a queue and are issued as tape resources become available. The order in which they are placed on the queue is based on the RSCALCPTY parameter in the tape library device description. The resource manager eliminates any idle time between jobs due to early completion, from either changing data or job failure.

You can use Initial Mount Wait Time (INLMNTWAIT) value to alert you of a problem. In the previous example, the ten save operations are started at a given time and known, through estimates or benchmarking, to complete in six hours. Set the INLMNTWAIT time limit to six hours. If any of the save operations do not complete in six hours, an escape message is signaled to the jobs. A pager system can monitor for this message and page an operator to determine the necessary recovery actions.

Share tape library resources between systems

You can share tape library resources between more than one system. Tape resources can be set to ALLOCATED, UNPROTECTED, or DEALLOCATED. To better facilitate sharing between systems the UNPROTECTED status was added. When the tape resource is set to UNPROTECTED status, the tape resource is not assigned until it is needed. This prevents a tape resource from being assigned to a system that is not presently using it.

Share tape library resources between systems and on the same system

When sharing tape resources between systems and on the same system, each system has a resource manager with its queue controlled by the priority and time-out values. Between the systems, the tape resources are set to UNPROTECTED status. While sharing between systems does not have a priority concept, the UNPROTECTED status and the fact that tape resources are only assigned when they are in use allows the systems to effectively share the tape resources. The resource manager tries to get a resource by attempting to assign it. If another system has the resource, the job is placed back in the queue and waits. In a few seconds another assign is attempted. If the job now gets the resource, the tape operation continues.《

Use tape devices

》This topic provides general information about how to use your stand-alone tape device or tape library.

> **"Use tape cartridges"**
> This topic provides information for using tape cartridges in both stand-alone tape devices and tape libraries.

> **"Use stand-alone devices" on page 31**
> This topic provides usage and management information for stand-alone tape devices.

> **"Use tape libraries" on page 36**
> This topic provides usage and management information for tape libraries.

For specific information about how to operate your particular tape device, see the Tape and Optical Storage Publications 🔗 Web site.

《

Use tape cartridges

》You can use iSeries(TM) navigator to perform most cartridge functions. Use the following instructions to work with cartridges in iSeries Navigator.

Stand-alone devices

To work with cartridges in stand-alone devices, do the following steps,

1. In iSeries Navigator expand **My Connections** —> **your iSeries server** —> **Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Stand-Alone Devices**.
2. Select the your stand-alone device.

Tape libraries

To work with cartridges in tape libraries, do the following steps,

1. In iSeries Navigator expand **My Connections** —> **your iSeries server** —> **Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Tape Libraries**
2. Expand the your library.
3. Select **Cartridges**.

For a detailed description of how to work with cartridges, see the iSeries Navigator online help. You can also work with cartridges by using the Work with Tape Cartridges (WRKTAPCTG) command from the character-based interface.

The following topics have more information for using tape cartridges.
- "Duplicate tape cartridges"
- "Format tape cartridges" on page 31

《

Duplicate tape cartridges: 》You can duplicate tapes by using a tape library or a stand-alone device. Follow the instructions that describe the device you are using.

Prerequisites for duplicating a tape cartridge

For stand-alone devices, you must have two tape devices and do the following steps before you can duplicate a tape:

1. Make sure the tape devices are available (varied on).
2. Load the tape to be copied into one tape device.
3. Load the tape receiving the information in the other tape device.

For tape library devices you must have a library device with two or more tape resources or two devices, then do the following:

1. Make sure the tape library devices are available.
2. Make sure that the cartridges you want to duplicate are available for use by the tape library device.

If the tape that receives the information is new, you must "Format tape cartridges" on page 31 it before continuing.

For a tape library

To duplicate a cartridge, the cartridge must have a status of **Available** or **Mounted**. Then it is possible to do the following:

1. In iSeries(TM) Navigator, expand your server —> **Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Tape Libraries**.
2. Expand the tape library that contains the tapes you want to duplicate.
3. Select **Cartridges**.
4. Right-click the tape that you want to duplicate and select **Duplicate**. You can select multiple cartridges to duplicate.

For a stand-alone tape device

To duplicate a tape, the stand-alone device must have a status of **Available**. Then it is possible to do the following:

1. In iSeries Navigator, expand your server—>**Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Stand-Alone Devices**
2. Right-click the tape device that contains the cartridge you want to duplicate and select **Duplicate**.

≫

Format tape cartridges: ≫ Use iSeries$^{(TM)}$ navigator to format at tape cartridge. When you format a tape cartridge, a standard volume label is recorded at the beginning of the magnetic tape medium.

When you format a tape, any information previously recorded on the tape medium is erased and written over with new information. Information is also written over when new data files are appended to the newly recorded volume label.

Note: Do not reuse an old tape volume if permanent read or
                                       write errors have been detected more than two times.
                                       Also do not reuse an old tape volume if temporary read
                                       or write errors for that volume are excessive. To
                                       determine if temporary errors are excessive, see "Ensure
                                       tapes are in good condition" on page 46.

To format a tape cartridge, perform the following steps:

Tape libraries

To format a tape, the cartridge must have a status of **Available** or **Mounted**. Then it is possible to do the following:

1. In iSeries Navigator, expand your server—>**Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Tape Libraries**—>your tape library.

2. Select **Cartridges**.

3. Right-click the cartridge that you want to format and select **Format**. You can select multiple cartridges to format.

Stand-alone tape devices

To format a tape, the stand-alone device must have a status of **Available**. Then it is possible to do the following:

1. In iSeries Navigator, expand your server—>**Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Stand-Alone Devices**.

2. Right-click your tape device and select **Format**.

Commonly used options for formatting a tape cartridge

The most commonly used options for formatting a tape cartridge are:

- New volume label
- Check for active files
- Tape density

The online help in iSeries Navigator has more detailed information about these options.

≫

Use stand-alone devices

There are several types of tape cartridges and stand-alone tape devices that are commonly used on the iSeries$^{(TM)}$ server. See the operator's manual for your tape device for specific operating instructions. This topic provides information that is common for most stand-alone devices.

- "Status lights" on page 32
- "View the capabilities of a stand-alone device" on page 35

Status lights: The quarter-inch and eight-millimeter tape units have three indicator lights: two green and one amber. These status lights are turned on and off in various combinations to indicate the status of the tape unit.

The following topics have detailed information about interpreting the status lights for these tape units:
- "Quarter-inch tape status lights"
- "Eight-millimeter tape status lights" on page 34

Quarter-inch tape status lights: ≫ This topic shows the status lights for the MLR3 and MLR1 tape units.
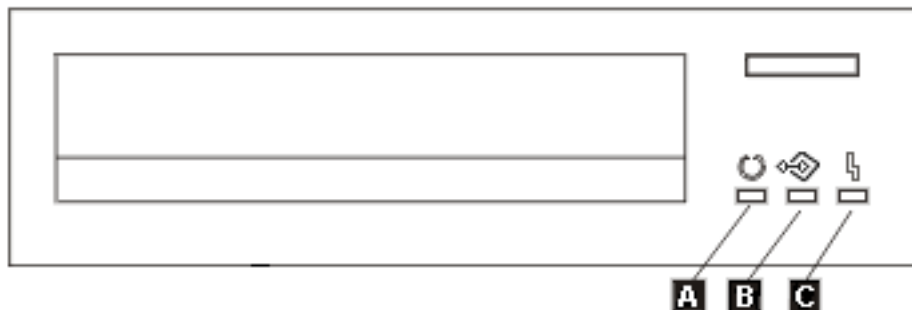
The symbols that are located next to the status lights are the International Organization for Standardization (ISO) symbols that define the general function of the status lights as follows.
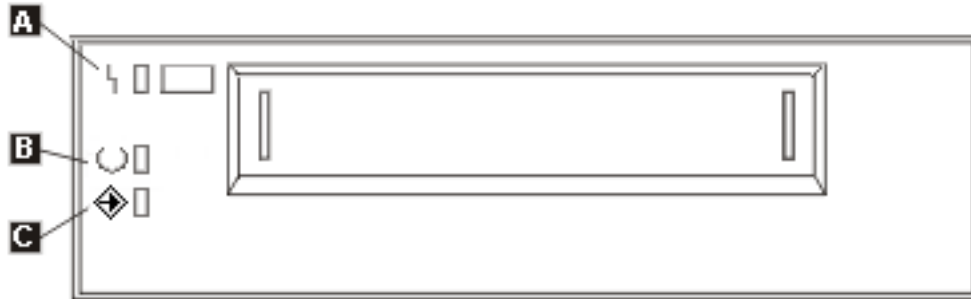
Symbol	Definition
A	Ready. This light indicates the following conditions: • Off - No cartridge installed or no fault condition • Green - Cartridge installed, loading or unloading • Green flashing - Power on self-test in progress
B	Activity. This light indicates the following conditions: • Off - No cartridge installed. No activity or fault condition • Green flashing - Cartridge activity
C	Fault. This light indicates the following conditions: • Off - No fault condition • Amber - Cleaning required or worn tape media • Amber flashing - Fault condition

The various on/off combinations of the status lights are shown in the following figure.

Status Lights	State	Status
	On	
	On	Status light tests. (The status lights are on for 2 seconds when the power is turned on.)
	On	
	Flashing	Power up self-tests. Diagnostic cartridge activity.
	Off	
	Off	
	Off	
	Off	Cartridge not loaded.
	Off	
	Off	
	Off	Cartridge not loaded. Cleaning required.
	On	
	On	
	Off	Cartridge loaded. No activity.
	Off	
	On	Cartridge loaded. Activity.
	Flashing	
	Off	
	On	Cartridge loaded. No activity. Cleaning required.
	Off	
	On	
	On	Cartridge loaded. Activity. Cleaning required.
	Flashing	
	On	
	Off	
	Flashing	Cartridge loading or unloading
	Off	
	Off	Cartridge loading or unloading. Cleaning required.
	Flashing	
	On	
	Off	
	Off	Unrecoverable drive failure or microcode download failure.
	Flashing	

《

Eight-millimeter tape status lights: 》 This topic shows the status lights for the 8mm tape units that support the 5.0 GB, 7.0 GB or 20 GB format.

The symbols located next to the status lights are the International Organization for Standardization (ISO) symbols that define the general function of the status lights as follows:

Symbol	Definition
A	Disturbance. The amber status light flashes whenever the tape unit encounters an unrecoverable fault. It is on solid whenever the tape drive requires cleaning.
B	Ready. The green status light is on solid whenever the tape unit is ready to receive the tape backup commands.
C	Read-Write. The green status light flashes whenever the tape unit is moving the tape.

The various on/off combinations of the status lights are shown in the following figure.

Status Lights	State	Status
	On	The Power-on Self Test (POST) is running or the system has issued a reset to the drive.
	On	**Note:** The POST condition can occur either when the power is first applied or after use of the diagnostic cartridge.
	On	
	Off	One of the following has occurred:
	Off	1. The power is off.
	Off	2. The POST has completed successfully, but no tape cartridge was inserted.
	Off	A tape cartridge has been inserted and the tape drive is performing a tape load/unload operation.
	Off	
	Flashing	
	Off	The tape load operation has completed and the tape drive is ready to receive commands from the system.
	On	
	Off	
	Off	The tape is in motion and the tape drive is busy running a device operation.
	On	
	Flashing	
	Flashing	The flash rate is fast (4 flashes per second) when using the test cartridge. The flash rate is slow (1 flash per second) when the tape drive has detected an internal fault that requires corrective action. Refer to your Service Guide or contact your service representative.
	Off	
	Off	
	On	The tape path requires cleaning.
or	Off or On	
or	Off or Flashing	

View the capabilities of a stand-alone device: You can use iSeries$^{(TM)}$ navigator to view the capabilities for each stand-alone device, such as:

- Assign capability
- Hardware data compression
- Whether the device is self-configured
- The highest instantaneous performance that is reported by the tape device.
- Densities supported by the tape device

- Capabilities associated with each density

To view the capabilities of a stand-alone tape device, do the following steps:

1. In iSeries Navigator expand **My Connections** —> **your iSeries server** —> **Configuration and Service** —> **Hardware** —> **Tape Devices**.
2. Select **Stand-Alone Devices**.
3. Right-click the tape device with the capabilities you want to view, and select **Properties**.
4. Select the **Capabilities** page.

《

Use tape libraries

》You can use tape libraries to manage large amounts of data, either as part of a backup, archival and recovery system, or as part of typical IT operations. Media management software, such as BRMS, automates many tape library functions. However, operating the tape library still requires that you manage both how the tape library resources are utilized and how it uses resources on the system. Moreover, maintaining cartridges is an integral part of tape library automation.

The following topics provide detailed information for using your tape library.
- "Tape library use without a media management application"
- "Reassign cartridges when the system name changes" on page 37
- "Set up a tape library as a stand-alone device" on page 38
- "Set up a tape library as an alternate IPL device" on page 38
- "Control tape library resources using tape library attributes" on page 39
- "Make cartridges available to the tape library inventory" on page 39
- "Eject cartridges from the tape library inventory" on page 40
- "Use the mounted category to load groups of tapes into a tape device" on page 41
- "Share cartridges" on page 41
- "End of volume" on page 42
- "Avoid deadlocked files during save and restore operations with tape libraries" on page 42
- "Optimize tape library performance" on page 42
- "View the capabilities of a tape library" on page 42 《

Tape library use without a media management application: 》

While a media management application greatly simplifies and extends a tape libraries capabilities, you can perform many tape functions in an iSeries[(TM)] environment with commands included in OS/400[(R)]. The following table shows the typical setup and operational tasks and associated CL commands for the tape library.

You need to use these commands if you do not use a media management application such as BRMS.

Task	Command
Creating a tape library device description	Auto-configured or use Create Device Description (Media Library) (CRTDEVMLB)
Displaying RS232/LAN resource/description	Display Hardware Resources (DSPHDWRSC)
Configuring the 3494 communication (RS232/LAN/TCP)	Configure Device Media Library (CFGDEVMLB)
Display LAN information for 3494 Add LAN Host	Display LAN Media Library (DSPLANMLB)
Removing a tape library device description	Delete Device Description (DLTDEVD)
Changing the tape library device description	Change Device Desc (Media Library) (CHGDEVMLB)

Task	Command
Changing the tape library device attributes for a job	Change Job MLB Attributes (CHGJOBMLBA) command or Change Job MLB Attributes (QTACJMA) API
Displaying the tape library device attributes for a job	Display Job (DSPJOB) OPTION(*MLBA) or Work with Job (WRKJOB) OPTION(*MLBA)
Retrieving the tape library device attributes for a job	Retrieve Job MLB Attributes (QTARJMA) API
Display tape library information	Display Tape Status (DSPTAPSTS)
Checking the status of the tape library	Work with Media Library Status (WRKMLBSTS)
Creating user categories.	Create Tape Category (CRTTAPCGY)
Mounting a category	Set Tape Category (SETTAPCGY) OPTION(*MOUNTED)
Demounting a category	Set Tape Category (SETTAPCGY) OPTION(*DEMOUNTED)
Assigning a mounted category to a different job	Set Tape Category (SETTAPCGY) OPTION(*ASSIGN)
Releasing a mounted category from a job	Set Tape Category (SETTAPCGY) OPTION(*RELEASE)
Deleting a user category.	Remove all the cartridges from the category. Use the Delete Tape Category (DLTTAPCGY) command
Listing all user or system categories	Display Tape Category (DSPTAPCGY)
Changing the category for cartridges	Change Tape Cartridge (CHGTAPCTG) or Work with Tape Cartridges (WRKTAPCTG), option 2
Inserting cartridges	Add Tape Cartridge (ADDTAPCTG) or Work with Tape Cartridges (WRKTAPCTG), option 1
Ejecting cartridges	Remove Tape Cartridge (RMVTAPCTG) or Work with Tape Cartridges (WRKTAPCTG), option 4
Mounting cartridges for output or input commands	Specify the tape library device and cartridge identifier with the commands
Demounting a cartridge	Demounting is implicit with ENDOPT(*UNLOAD), a demount of a category, or a new mount request
Working with a list (or subset) of cartridges within a tape library	Work with Tape Cartridges (WRKTAPCTG)
Displaying information about a cartridge	Display Tape Cartridge (DSPTAPCTG) or Work with Tape Cartridges (WRKTAPCTG), option 5
Working with the tape library resource manager queue	Work with MLB Resource Queue (WRKMLBRSCQ)
Retrieving the capabilities for a tape library device or resource	Retrieve Device Capabilities (QTARDCAP) API
Retrieve the status for a tape library device or resource	Retrieve Device Status (QTARDSTS) API
Retrieving the information for a tape library	Retrieve Device Information (QTARDINF) API

Note: An end-of-tape option of *UNLOAD for any of the tape commands causes the cartridge to be returned to a storage cell when the tape operation has completed processing. It might not be returned to its original storage cell. When using *REWIND the cartridge remains in the drive after the tape operation has completed. However, this cartridge is unloaded if another cartridge has been requested. When using *LEAVE the cartridge remains in the drive after the tape operation has completed.

≪

Reassign cartridges when the system name changes: ≫If you change your system name, you must move the cartridges from the categories that were owned by the old system name to categories that are owned by the new system name. If you do not do this, the cartridges will not appear in the inventory for the new system name. For some library types, the cartridges may appear when you use the parameter

CGY(*ALL *ALL) for the Work with Tape Cartridges (WRKTAPCTG) or Display Tape Cartridge (DSPTAPCTG) command, but you will not be able to use the cartridges.

If you have already changed the system name and need to recover the cartridges, perform the following steps:

1. Type DSPTAPCGY (the Display Tape Category command) to display all of the tape categories, record the names of the user-defined categories for use in step 3, then exit.
2. **Note: Do not restart the system after this step.**
   Temporarily change the system name back to the previous name by using the CHGNETA command.
3. If you were using user-defined categories with the old system name, type CRTTAPCGY (the Create Tape Category command) to create the same user-defined categories from step 1 above for the new system name.
4. Type WRKTAPCTG (the Work with Tape Cartridge command) to work with all of the categories that are associated with the old system name.

   ```
   WRKTAPCTG DEV(mlb-name)
    CGY(*ALL old_system_name)
   ```
5. Change the category system name to the new system name by selecting 2 (Change) with the parameter CGY(*SAME new_system_name).
6. Type CHGNETA to return the system name to the new system name. **Do not** restart the system.

≪

Set up a tape library as a stand-alone device: ≫Occasionally, it might be necessary to use the tape resources in a tape library without the benefit of the automation. An example of this is when you perform an alternate IPL. Another example is when the tape library automation is disabled. Using the tape resource in this fashion is referred to as stand-alone mode. In stand-alone mode, the tape resource operates like other tape devices that are not in a tape library. Most tape libraries provide modes or commands to move media to a tape resource. See the operator information for your tape library for the different operating modes available. When automation is not used, the tape library operates as an automatic cartridge loader for the tape device and loads cartridges individually or sequentially in the device.

Tape library devices are configured with tape library device descriptions for the tape library. There are also separate tape device descriptions for the tape resources. These tape device descriptions are the devices that are used for stand-alone operation.

To use the tape resources in stand-alone mode, the resource must be available to the tape device description. Do the following steps:

1. Either deallocate the tape resource from the tape library or vary off the tape library device.
2. Vary on the tape device description, and send commands to this device.
   The tape resource in iSeries(TM) Navigator shows a status of **Unavailable**. No tape library functions operate for this tape resource.
3. Mount the cartridges manually, by a device mode, or by device operator panel commands. ≪

Set up a tape library as an alternate IPL device: ≫You can use the devices in a tape library for alternate initial program load (IPL) when they are attached to an I/O processor (IOP) and I/O adapter (IOA) in a position that supports an alternate IPL and are set to the correct address. For more information about the IOP and IOA positions and device addresses that support an alternate IPL, see Alternate IPL device.

You can use alternate installation for tape libraries that are attached to an IOP and IOA that is not in a position that supports alternate IPL.

For more information about using an alternate installation device, see Backup, Recovery and Media Services and Backup and Recovery .

Control tape library resources using tape library attributes: Depending on your business environment you might want to control the use of tape resources to allow important jobs to finish quickly. OS/400(R) provides several features for this. You can use the Change Job Media Library Attributes (CHGJOBMLBA) command to change the priority of tape resource requests for a particular job, and the Work with MLB Resource Queue (WRKMLBRSCQ) command to work with the tape resource manager queue.

Change tape library job attributes

The CHGJOBMLBA command allows you to change the resource allocation attributes for your own job or another user's job if you have *JOBCTL special authority. You can use the resource allocation priority to change the priority of requests to use a tape resource within a tape library. You can assign a higher priority to certain jobs to allow them to get a tape resource as soon as one becomes available. You can assign a lower priority to jobs that can wait until all other higher priority jobs finish using the tape resources. Typically, very short-running tape operations such as the dynamic retrieval of an object that was saved storage free should be assigned a high resource allocation priority. Long-running jobs that are not required to finish quickly, such as Duplicate Tape (DUPTAP) or Display Tape (DSPTAP), can be assigned a lower resource allocation priority.

You can also add *MLBA to either the Work with Job (WRKJOB) or Display Job (DSPJOB) command in order to view or adjust your tape library attributes.

Change access to a tape resource within a library

The WRKMLBRSCQ command allows you to manipulate the requests to use a tape resource within a tape media library. The WRKMLBRSCQ command shows the resources that are currently processing a request, have a category mounted, or the requests that are waiting to be assigned a tape resource. You can change the resource allocation attributes for requests that are waiting to use a tape resource by using option 2 (Change Request MLB Attributes) on the Work with MLB Resource Queue (WRKMLBRSCQ) display. The attributes for the next request can be changed by using the CHGJOBMLBA command to change the resource allocation attributes for the job that is currently using the tape resource. You can do this by using option 5 (Work with job) on the Work with MLB Resource Queue (WRKMLBRSCQ) display, and then selecting option 21 (Work with media library attributes).

There are times when a request will show a priority of 0. These requests are for when a tape resource is being used by the system for a tape operation. An example is when a tape command using ENDOPT(*UNLOAD) is completed and the system is still unloading the cartridge.

Change tape library attributes with APIs

You can use the Retrieve Job Media Library Attributes (QTARJMA) and Change Job Media Library Attributes (QTACJMA) APIs to control tape library attributes programmatically. For a more detailed description and an example, see Control tape library attributes with APIs.

Make cartridges available to the tape library inventory: Before you can use the tape library, it must have media in it. If a tape library is empty, open the door and insert all available media into the empty slots. This can be done to save time rather than inserting only a small number at a time through the convenience input/output (I/O) station. When the door is closed, the tape library will inventory the contents. Each cartridge ID is noted and recorded in the operating system and Library Manager (if present).

Most tape libraries provide an (I/O) station for adding cartridges without interrupting any automatic operations. An I/O station can have multiple slots or just a single slot. Some tape libraries have no I/O station. For these tape libraries, cartridges are added by stopping the automation and opening the door to access the storage slots.

Tape cartridges that are placed in the 3494 i/o station are moved to a storage slot by the 3494 Library Manager software. For other tape libraries, the tape cartridges remain in the i/o station until you make them available using iSeries(TM) Navigator. When you make a cartridge available you must specify a "Cartridge categories" on page 10 of media. Also, making a cartridge available changes the cartridge "Cartridge status" on page 9.

To make a cartridge available do the following steps:

1. In iSeries Navigator, expand **My Connections**—> **your iSeries server** —> **Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Tape Libraries** —> **your tape library**.
2. Select **Cartridges**.
3. Right-click a cartridge with a status of Inserted that you want to make available and select **Make Available**. You can select multiple cartridges to add to a category.

You can also use the Add Tape Cartridge (ADDTAPCTG) command to make a cartridge available.

≪

Eject cartridges from the tape library inventory: ≫When you eject a cartridge, you remove it from the tape library inventory. All tape library devices use iSeries(TM) Navigator to eject cartridges. You can also use the Remove Tape Cartridge (RMVTAPCTG) to change media to the *EJECT category.

When you eject a cartridge you can eject it to one of three locations:

- Tape library default
- Convenience station
- High capacity output station

See the iSeries Navigator help for more detailed information about these locations.

To eject tapes from a tape library, use one of the following procedures:

Specify tapes to eject by category or cartridge ID

1. In iSeries Navigator, expand **My Connections** —> **your iSeries server** —> **Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Tape Libraries**.
2. Right-click your tape library, and select **Eject Cartridges**.

Select tapes to eject from the Cartridge folder

1. In iSeries Navigator, expand **My Connections** —> **your iSeries server** —> **Configuration and Service** —> **Hardware** —> **Tape Devices** —> **Tape Libraries** —> **your tape library**.
2. Select **Cartridges**.
3. Right-click the cartridge you want to eject and select **Eject Cartridge**. You can select multiple cartridges to eject.

Note: If you are using the character-based interface, cartridges that are in the convenience (*CNV) category are exported when they are unloaded from a tape resource for a tape command that is using ENDOPT(*UNLOAD). If a cartridge in the *CNV category is unloaded from a tape resource by the system to load another cartridge the cartridge that was in the tape resource will not be ejected from the tape library.

≪

Use the mounted category to load groups of tapes into a tape device: ≫ The mounted category allows a group of tapes to automatically be loaded into a tape device. The media are mounted in the order in which they were placed into the category. It is similar in function to an Automatic Cartridge Loader (ACL) on the stand-alone 3490 devices. This function is available with the Set Tape Category (SETTAPCGY) command. The mounted category is provided for all tape library devices.

To load groups of tapes into a tape device for 3494 devices, use the Library Manager software. To load groups of tapes into a tape device for libraries other than the 3494, use OS/400(R) (the SETTAPCGY command). Because of this difference, the 3494 Library Manager software loads the next tape as soon as the previous tape is unloaded. For all other libraries, the tape resource is not loaded until a tape command requiring media is issued to the tape library device.

With a category of mounted, a tape resource is dedicated for category mount operations until a SETTAPCGY (*DEMOUNTED) command is issued. When the SETTAPCGY has been issued, any OS/400 command to the tape library device with VOL(*MOUNTED) will be directed to the tape resource that is set up for the mounted category.

One category of cartridge can be mounted per available tape resource. To mount more than one category for a tape library the MNTID parameter must be used with the SETTAPCGY command to identify the mounted category operations. A job can only have one mounted category session active at a time. The mounted category session can be released from the job that mounted the category of cartridges and can be assigned to another job by using the *RELEASE and *ASSIGN options on the SETTAPCGY command.

Notes:

1. Tape management systems are notified when a category of cartridges is mounted and demounted. When a command comes from a user to VOL(*MOUNTED), the tape management system has the ability to accept or reject the operation.
2. BRMS does not use the category of mounted to perform its processing. Using the mounted category in combination with BRMS functions is not recommended. Mounting a category of cartridges while concurrently using BRMS to perform tape operations can have unpredictable results.

≪

Share cartridges: ≫ You can share the cartridges in a tape library between multiple platforms and iSeries(TM) servers. When an iSeries server is using a cartridge in a 3494 tape library, the cartridge must be in a category accessible to the iSeries server. This can be the *SHARE400 category or a user-defined category.

Volume protection between platforms

When initializing a tape, systems other than the iSeries server are able to write a 1-character security flag to the tape label. This is to restrict users who might read data from tapes initialized this way. Even though writing this security flag is not available in OS/400(R), OS/400 can read tapes written with this security flag in the tape label. When OS/400 detects the security flag, it decides whether that user can read the data, depending on the user's special authorities.

When the tape contains EBCDIC data, all users can read the tape when the security flag contains a space (hexadecimal 40), a zero (hexadecimal F0) or a hexadecimal 00. If it contains any other value, the user needs *ALLOBJ and *SECADM authority to read data from the tape.

If the tape contains ASCII data, all users can read the tape if the security flag contains an ASCII space (hexadecimal 20). If it contains any other value, the user requires *ALLOBJ and *SECADM authority to read data from the tape.

You cannot specify this security flag when a tape is initialized on an iSeries server and is to be read on another platform. «

End of volume: » To be a fully automated solution without a tape management system, each volume that is needed must be specified on the command in the VOL parameter. If the system runs out of tape cartridges specified in the volume list, a CPA6798 inquiry message is issued allowing the user to supply an additional cartridge allowing the tape operation to continue. If the cartridge supplied is not found or not available, a CPA6797 inquiry message is sent allowing the user to supply an alternate cartridge to continue the tape operation. Tape management systems have the ability to provide more volumes through exit points in the OS/400(R) tape functions.

See "Avoid deadlocked files during save and restore operations with tape libraries" for other end-of-volume concerns. «

Avoid deadlocked files during save and restore operations with tape libraries: » Tape automation uses special files located in the QUSRSYS library. If these files do not exist on the system, OS/400(R) supports a limited set of automation functions.

For automation in the early stages of recovery scenarios, you can mount cartridges by specifying the cartridge identifiers in the VOL parameter of the OS/400 commands. However, this subset of automation does not support the use of the cartridge commands, such as Work with Tape Cartridges (WRKTAPCTG) or Display Tape Cartridge (DSPTAPCTG).

During a save of the QUSRSYS library, the files that allow use of the WRKTAPCTG or DSPTAPCTG commands might be put in a restricted state and made unavailable for use. This can result in a deadlock and eventually end the save operation. To avoid this situation, the save of the QUSRSYS library must not cross a volume boundary. It must fit on the mounted volume. Alternatively, you can save the QUSRSYS library by using the save-while-active function. «

Optimize tape library performance: » You can optimize the performance of your tape library by using work management and load balancing techniques. You can also attempt to improve the performance by using different connection configurations.

Note:	If you attach a library containing high speed tape drive resources (such as 3590, 358x) to a 6501 or 6534 I/O processor, you should not attach any other high speed tape drive resources to I/O processors on the same bus, or performance will be impacted.

For more detailed information about performance, see the Resource Library section of the Performance Management 🔹 Web site.

«

View the capabilities of a tape library: » You can use iSeries(TM) navigator to view the capabilities for each tape library such as:
- Assign capability
- Hardware data compression
- Whether the device is self-configured
- The highest instantaneous performance that is reported by the tape device.
- Densities supported by the tape device
- Capabilities associated with each density

To view the capabilities for a tape library do the following steps:

1. In iSeries Navigator, expand **My Connections**.
2. Expand the iSeries server that you want to work with.
3. Expand **Configuration and Service**.
4. Expand **Hardware**.
5. Expand **Tape Devices**.
6. Expand **Tape Libraries**.
7. Expand the tape library for which you want to format a tape.
8. Select **Tape Resources**.
9. Right-click the tape resource with the capabilities you want to view and select **Properties**.
10. Select the **Capabilities** page.

《

Maintain tape resources

》This topic explains how to keep your tape resources in good condition.

"Storage and handling of tape cartridges"
This topic describes how to handle your tape cartridges and describes the best environment in which to store your tape cartridges.

"Protect data on tape cartridges" on page 44
This topic describes how to keep data safe on tape cartridges.

"Ensure tapes are in good condition" on page 46
This topic describes how to ensure that the tape cartridges are in good condition using the Work with Lifetime Statistics display.

"Clean your tape drives" on page 48
This topic has tasks to help keep your tape drives clean.

"Licensed Internal Code updates" on page 50
This topic explains what to do with the Licensed Internal Code updates that IBM^R releases. 《

"Run retension operations for tape cartridges" on page 50
This topic explains the importance of retention times for tape cartridges.

Storage and handling of tape cartridges

》Tape drives require specific maintenance and environmental conditions to operate well over time. To avoid problems with your IBM$^{(R)}$ tape drive you should:

- Use high quality, data grade media
- Handle and store this media properly
- Operate the tape drive in a clean environment
- Keep the tape drive properly cleaned

Media grades

IBM uses two different grades of media. IBM supplies program temporary fixes (PTF) on a tape that is designed to be written to only once and read from a few times. This tape is designed for limited use, not as a backup medium. IBM also sells media that is designed for storage use.

If analysis by IBM service personnel indicates a problem with non-IBM media, it may be necessary for you to replace the media.

The following topics have more information for handling and storing your tape cartridges:
- "Tape environment"
- "Tape handling and storage"

≪

Tape environment: ≫ Tape drives are designed to operate in a clean environment. Problem factors are dirt, dust, fibers, and airborne particles. Airborne particles are the most difficult to address. When you install a tape in the tape drive, the clearance between the heads and the tape is measured in microns. Particles can damage the tape or the head if they come in contact with either. IBM[R] offers a tape drive filter enclosure for some systems to solve this problem. The enclosure draws air in through a filter and supplies the tape drive with clean air. You are responsible to provide a clean operating environment for the tape drive and system.

For specific requirements for environmental conditions such as temperature and humidity, see the operator's manual for your tape cartridge. ≪

Tape handling and storage: ≫ Most tape arrives in a sealed cartridge so that the tape will remain in a clean environment. Opening the cartridge allows dirt and airborne particles to enter and then become a source of contamination. Only the tape drive should open the cartridge; not an operator. Inside the cartridge, the tape is under correct tension. If the cartridge is dropped, this tension will be relaxed. Inserting a dropped cartridge into a tape drive can cause incorrect loading and result in a jam. This will ruin the tape and can cause physical damage if the cartridge is not removed properly.

To store the tapes properly, put them in their protective containers and store them on their ends. The storage area must be clean, dry, at room temperature, and away from any magnetic fields.

≪

Protect data on tape cartridges

≫ This topic has general instructions for protecting data on a tape cartridge. For specific information, see the manual for your specific tape drive.

Tape cartridges have a switch that you can use to write-protect the data on the tape. The switch typically has a label that indicates that it is write-protected such as:
- A padlock icon
- A dot on the switch
- A label such as **SAFE** or **SAVE**.

The following instructions are an example of protecting data from being overwritten on a quarter-inch tape. See the operator's guide for your tape device instructions that are specific to your tape cartridge. Do one of the following
- Set the pointer toward **SAFE** for older style tape cartridges, as shown in the first image.
- Set the pointer toward the locked padlock icon for the newer style tape cartridges, as shown in the second image below.

To not protect the data do one of the following:
- Set the pointer away from **SAFE** for the older style tape cartridges, as shown in the first image below.
- Set the pointer toward the unlocked padlock icon, for the newer style tape cartridges, as shown in the second image below.
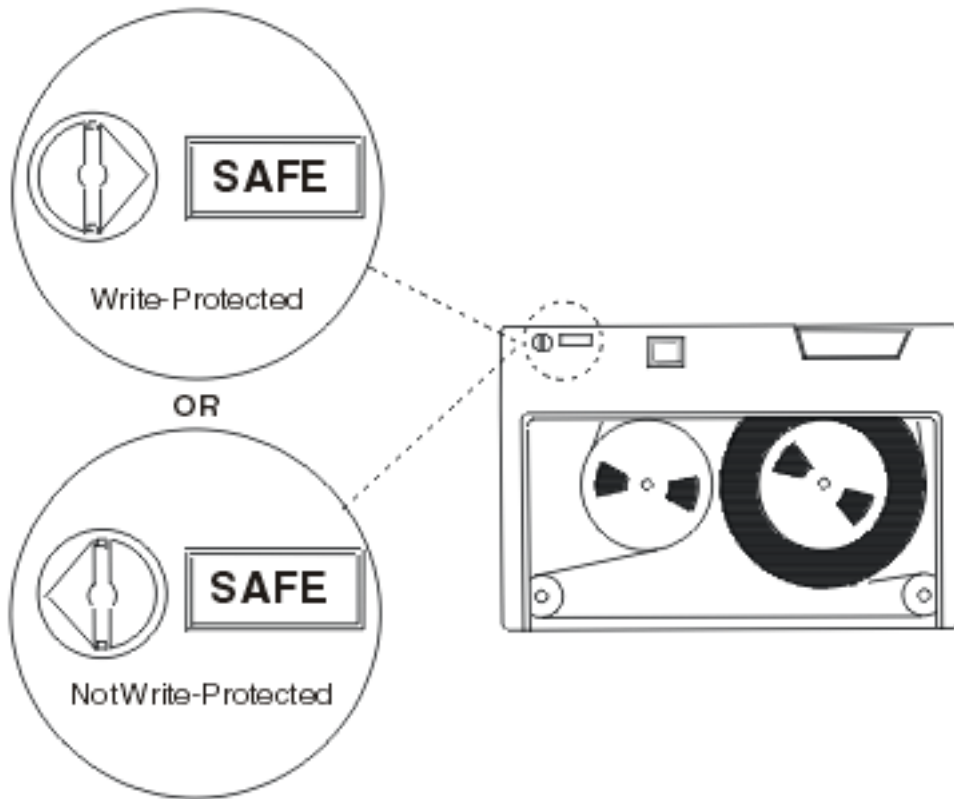
Write-protect positions for an older-style tape cartridge
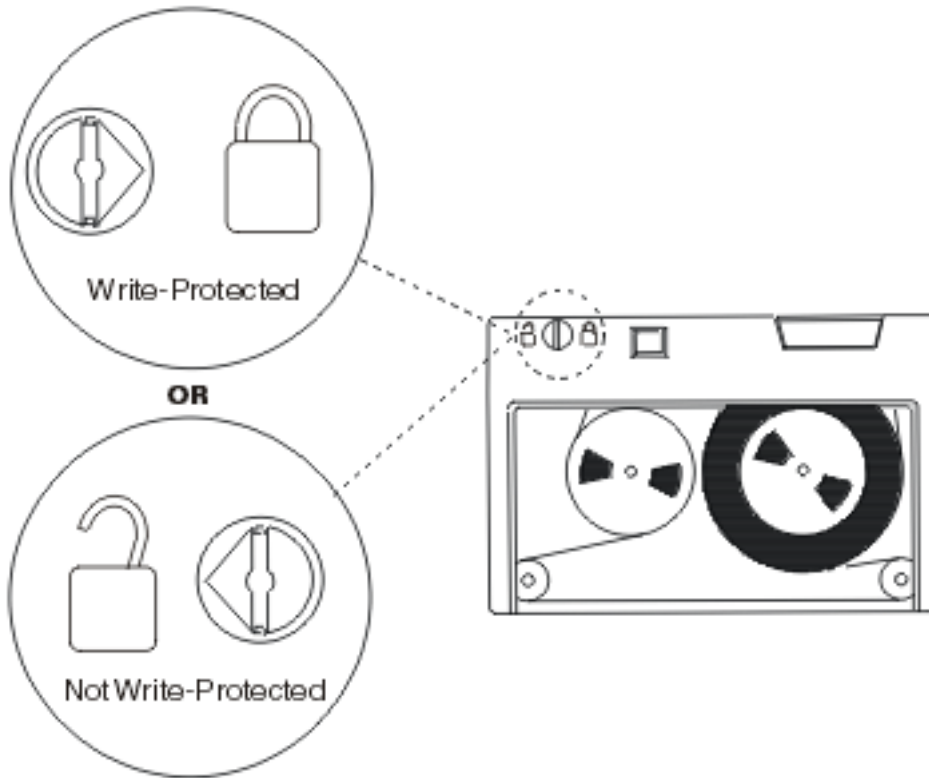
Write-protect positions for a newer-style quarter-inch tape cartridge

For information about your tape device, see Tapes Supported on iSeries^(TM) . If your tape device is an

LTO tape device, see IBM^(R) LTO Ultrium Tape Libraries Guide (SG24-5946) .

Ensure tapes are in good condition

To ensure that your tapes are in good condition, keep track of the tape volume statistics on your
iSeries^(TM) server.

1. Type STRSST (the Start System Service Tools command).
2. Select option 1 (Start a service tool) on the *System Service Tools* menu.
3. Select option 1 (Product Activity Log) on the *Start a Service Tool* menu.
4. Select option 4 (Work with removable media lifetime statistics) on the *Product Activity Log* menu.
5. Select the type of removable media for which you want data on the *Select Media Option* display.
6. If you see the >> or > symbols preceding the volume ID on the Work with Lifetime Statistics display,
   take the appropriate action as is described in the table following the image of the Work with Lifetime
   Statistics display.

```
 _____ [_][□][X]
 File   Edit   View   Communication   Actions   Window   Help
 [□] [▣▣] [▣▣]  [▣▣] [▣▣]  [▣▣] [▣]  [▣]  [▣▣] [▣▣]  [▣▣] [▣▣]  [▣]  [▣▣] [▣]

                     Work with Lifetime Statistics

 Removable media . . . . . . . :   1/4 inch cartridge tape

 Type options, press Enter.
 4=Delete entry   6=Print entry

             Volume     --Temporary Errors---   --------K Bytes-------
 Option   ID              Read      Write           Read      Written

       >> PHB021       23452450      23450       23457123    97689690
          THB021              2          0          14307           0
          AIPLT               0          3         214494      137546
          AD0000              0          0              3           0
          AIPL                0          0              2       27620
          VIHE                0          0              1           0
          MM                  0          0            361           0
          PHB031              0          0              2           0
          PTFFIX              0          0              3         432

 F3=Exit           F5=Refresh          F10=Delete all
 F11=Print all     F12=Cancel

 (C)  COPYRIGHT IBM CORP.                        .
 _____
 [ ] [_____]                    [_____]  //
```

Symbols in the Work with Lifetime Statistics display

Symbol	Explanation	Action to take
>>	Media replacement recommended	Copy the contents of the media to a new tape and discard the old tape.

>	Media approaching replacement criteria	• Replace the tape if the tape format is:
		  – QIC-120
		  – 7208 2.3 GB
		  – 6250 bpi density
		• If the tape format does not fulfill the previous conditions, continue to keep track of this tape to ensure that media replacement is not necessary.

Note: To ensure accurate statistics, each tape cartridge or reel must have a unique volume ID.

Remove a media lifetime statistics entry after a volume is replaced

After media has been replaced, remove the lifetime statistics entry by using option 4(delete entry). Also, you can use the Print Error Log (PRTERRLOG) command to print and delete the entry by typing the following:

```
PRTERRLOG TYPE(*VOLSTAT) VOLTYPE(xxxx) VOL(xxxxxx) VOLSTAT(*DLT)
```

≪

Clean your tape drives

≫ Dirt can build up on the heads of any tape drive, no matter how clean the environment. Every time tape motion occurs, some of the media surface comes off on the heads. Over time, this builds up and causes errors in reading and writing. Cleaning the read/write head prevents a build up of debris that can cause irrecoverable errors when writing or reading data.

You can use cleaning cartridges a limited number of times. When a cleaning cartridge has been used to its maximum number of times, the usefulness of the cartridge expires. When cartridges expire, replace them. Never reuse an expired cleaning cartridge. An expired cleaning cartridge introduces previously removed dirt to the tape drive. When you have cleaned the tape drive, mark the usage on the cartridge in order to best determine when your IBM(R) cleaning cartridge has expired.

When you use cleaning cartridges you should not use a grease pencil on the label of the cleaning cartridge. Also, the cleaning cartridge should be undamaged and clean when it is inserted into a tape unit.

The following topics provide information for cleaning your tape drives:
- "Clean quarter-inch tape drives"
- "Clean eight-millimeter tape drives" on page 49
- "Clean half-inch tape drives" on page 49
- "Clean LTO Ultrium tape drives" on page 50

≪

Clean quarter-inch tape drives: ≫ For quarter-inch tape drives, you should clean the head after every 8 hours of tape movement when using IBM(R) tape cartridges. Other tape media might require cleaning more frequently. When you use a new tape cartridge, it is advisable to clean the head after two hours of tape movement, or before loading each new tape cartridge.

System messages are posted when the tape unit determines that cleaning is required. The MLR1, MLR1-S, and MLR3 tape units also have a cleaning status light that indicates that cleaning is required. It is important to respond to these cleaning indicators and clean the head using a recommended cleaning method.

Recommended IBM cleaning cartridges

Tape unit identification		Cleaning cartridge part number	
Front bezel label	Feature code numbers	35L0844	16G8572
SLR100	4487 4587 4687	Best	Do not use
MLR3	4486 4586 6386 6486	Best	Do not use
SLR60	4584 4684 6384 6484	Best	Do not use

Tape unit identification		Cleaning cartridge part number	
MLR1-S QIC-5010-DC	4483 4583 6383 6483	Best	Do not use
QIC-4GB-DC	4482 4582 6382 6482 7201-122	Best	Acceptable
QIC-2GB (DC)	6381 6481	Best	Acceptable
QIC-2GB	6380 6480	Best	Acceptable

《

Clean eight-millimeter tape drives: 》 The eight-millimeter tape drives count the number of hours of tape motion and indicate when it is time to clean the tape drive by displaying a message to clean soon and turning on the Fault status light.

Tape unit	Cleaning cartridge part number
4585 4685 7206-VX2	19P4880
7208-002	16G8467
6390 7208-012	16G8467
7208-222	16G8467
7208-232	16G8467
7208-234	16G8467
7208-342	35L1409
7208-345	35L1409
9427-210 9427-211	16G8467

《

Clean half-inch tape drives: 》On the average, clean the tape path on each drive every seven days. If you use an unusually large amount of tape, clean the tape path more often. If the tape unit displays a *CLEAN message, clean the tape drive path as soon as possible. You should also clean the tape path after each initial program load (IPL), after a drive is reset, or whenever the power on the tape unit has been interrupted.

To clean the tape path, insert the special cleaning cartridge as you would a typical tape cartridge. Keep track of the number of uses on the label provided with each cleaning cartridge and then throw the cartridge away after 500 uses.

If your tape drive has the automatic cartridge loader feature, put the cartridge into the feed position and press the start push button. The cleaning cartridge can also be put into the input stack, and the cleaning procedure takes place whenever the cleaning cartridge is loaded into the drive. If you start cleaning during a job, an inquiry message is displayed. After responding to the message, the drive threads the

cleaning tape, cleans the read/write head, and then rewinds and unloads the cleaning cartridge. When the cartridge has been unloaded, remove it and mark the usage label.

Cleaning the 3490 F*xx*, 3494, and 35*xx* tape drives

These tape drives provide random access to the tape cartridges. When the device detects that cleaning is needed, the tape drive will perform the cleaning operation, if the cleaning cartridge is in the internal cell known only to the Random Access Cartridge Loader. The tape drive keeps track of the number of cleaning operations performed by the cleaning cartridge and ejects the cleaning cartridge through the priority cell when the cleaning cycles allowed for the cleaning cartridge have been used up.

The cleaning cartridges for half-inch tape drives are specified in the following table:

Tape drive	Cleaning cartridge part number
3490	4780527
3570	05H2463
3590	05H4435
3592	05H3929

《

Clean LTO Ultrium tape drives: 》 All IBM$^{(R)}$ Ultrium tape drives have an integrated cleaning device which brushes the head when loading and unloading a cartridge. Along with this, each drive has a cleaning procedure using a special cleaning cartridge.

The only time you must clean your Ultrium tape drive is when the tape drive alerts you to clean it. For

more details about cleaning your tape drive, see The IBM LTO Ultrium Tape Libraries Guide 🔴 .

The following table shows cleaning cartridges for Ultrium tape devices.

Type	Cleaning cartridge part number
Ultrium 1	08L9124
Ultrium 2	35L2086

《

Licensed Internal Code updates

》 IBM$^{(R)}$ constantly works to provide the best possible tape drive products. To make certain that the drives work their best, IBM occasionally releases changed Licensed Internal Code for the tape drives. When a Licensed Internal Code change is developed, IBM makes it available to you through the service organization or by electronic delivery.

Licensed Internal Code changes are also available by downloading and installing fixes using electronic customer support, or by ordering and installing cumulative fix packages from IBM Global Services. 《

Run retension operations for tape cartridges

》 For older tape cartridge types, the quarter-inch tape units run a retension operation whenever a tape cartridge is loaded. *Retension* means that the tape unit moves the tape to the end-of-tape position and rewinds it to the beginning-of-tape position. The retension operation is part of the load sequence. The tape unit also runs a retension operation if a tape cartridge is in the tape unit when the door is closed.

When using MLR3-25GB, DC5010, MLR1-16GB, SLR100, and SLR60 tape cartridges, the tape units run the retension operation only when necessary (as determined by the tape unit) to maintain correct tape tension. The approximate retension times are as follows:

Retension times for quarter-inch tape cartridges

Tape cartridge	Approximate retension time
DC5010	Fewer than 6 minutes
DC6150	Fewer than 3 minutes
DC6320	Fewer than 3 minutes
DC6525	Fewer than 4 minutes
DC9120	Fewer than 4 minutes
DC9250	Fewer than 4 minutes
MLR1-16GB	Fewer than 8 minutes
MLR3-25GB	Fewer than 8 minutes
SLR5-4GB	Fewer than 8 minutes
SLR60	Fewer than 8 minutes
SLR100	Fewer than 8 minutes

≪

Example: Manage tape resources

≫Each system in the following example reports two tape subsystems, or resources. These tape resources are connected to the tape library resource. In this example, the tape library resource is the 3494 Data Server. The 3494 Data Server then generates an automatic configuration of a device description for a media library (MLB) . In this situation, any request to the tape library device (the 3494 Data Server) results in the tape library resource manager allocating which tape resource to use. This simplifies tape management tasks for most users because the system is responsible for the majority of those tasks.

Note: Users with multiple systems and limited attachment capabilities might still need to force the use of specific resources.

The Work with Media Library Status (WRKMLBSTS) command allows you to view the tape libraries and associated tape resources from a configuration standpoint. Using this command on each of the three systems in the example results in the following displays:

View of tape library TAPMLB01 from System A
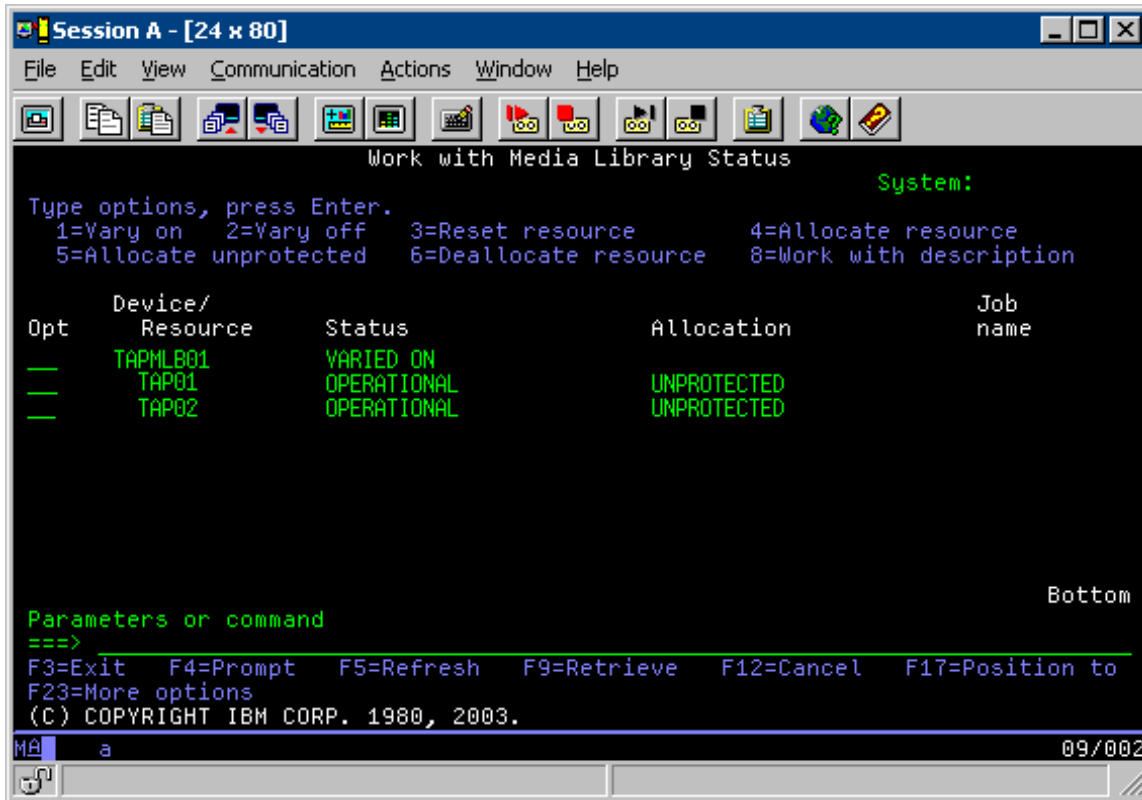
View of tape library TAPMLB01 from System B

View of tape library TAPMLB01 from System C

```
Session A - [24 x 80]                                          _ □ ✗

File  Edit  View  Communication  Actions  Window  Help

□  ⬚⬚ ⬚⬚  ⬚⬚ ⬚⬚  ⬚⬚ ⬚⬚  ⬚⬚  ⬚⬚ ⬚⬚  ⬚⬚ ⬚⬚  ⬚⬚  ⬚⬚ ⬚⬚

                    Work with Media Library Status
                                              System:
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
 __   TAPMLB01       VARIED ON
 __     TAP02        OPERATIONAL         UNPROTECTED




                                                      Bottom
Parameters or command
===>
F3=Exit    F4=Prompt    F5=Refresh    F9=Retrieve    F12=Cancel    F17=Position to
F23=More options
(C) COPYRIGHT IBM CORP. 1980, 2003.
MA     a                                                    09/002
```

There are three possible values for the allocation of each resource. Each value assumes that the tape library is varied on. The values are:

ALLOCATED
An allocated resource is assigned to a particular system and no other system can access it. The allocated state is analogous to a stand-alone device that is varied on with the value ASSIGN(*YES).)

UNPROTECTED
An unprotected tape resource is not assigned to a particular system and is available to respond to requests to its tape library device. This unprotected state is analogous to a stand-alone device that is varied on with the value ASSIGN(*NO). If a request is made to the tape library device and the tape resource is selected by the tape library device resource manager, the tape resource is assigned while it is being used.

DEALLOCATED
A deallocated tape resource is not assigned to a particular system and is unavailable to respond to requests to its tape library device. If the tape library is varied off, all of its tape resources are deallocated. The deallocated state allows the use of a tape resource in stand-alone mode. It also allows temporary use of a tape resource if a malfunction occurs with the robotic components of the tape library.

When a tape resource that is shared between systems is not in use, it should remain in an unprotected state with the tape library device varied on. If the tape resource is left in an allocated or deallocated state, a command request to use the resource might result in an error stating that no resources are available.

If you are using BRMS, you should not use SHARED *YES for media libraries. Use UNPROTECTED to share your resources. You can also use a combination of UNPROTECTED and ALLOCATED on the network to ensure that each system has the correct device that is required for backup operations. Leave the tape libraries varied on at all times, and use the allocation status to control use.

Force use of specific resources

One problem to consider in the example is the problem of cable limitations. One system can potentially prevent another from accessing tape resources even when one is available. The difference is in how a user can force a system to use a specific resource. The ways to force a system to use a specific resource are:

- Schedule jobs based on time (page 54)
- Use the resource selection sequence (page 54)
- Use multiple tape library device descriptions (page 55)

Schedule jobs based on time

One method of resolving this problem is to manipulate the start times of save operations on each system. In the example, system A and system B are contending for tape resource TAP01. Starting the save operation on system B first ensures that system B has access to a tape resource.

The following table shows how the strategy chart appears if this method is used in the example.

Table 1. Schedule to meet system and device constraints using time management

Start time	Approximate complete time	Backup group	System	Device	Tape resource forced
10:05 p.m.	1:00 a.m.	2	A	TAPMLB01	TAP01 (TAP02 is busy on system C)
10:00 p.m.	11:00 p.m.	5	C	TAPMLB01	TAP02
11:00 p.m.	1:00 a.m.	6	C	TAPMLB01	TAP02
1:05 a.m.	6:00 a.m.	1	A	TAPMLB01	TAP02 (TAP01 is busy on system B)
1:00 a.m.	4:00 a.m.	3	B	TAPMLB01	TAP01
4:00 a.m.	6:00 a.m.	4	B	TAPMLB01	TAP01

Use the resource selection sequence

Because ALLOCATED resources are selected for use before UNPROTECTED resources, you can use this aspect to your advantage. A user exit (the *EXIT special value) is a user-defined CL command that permits automatic processing of predefined user routines. On system A in the example, you can use the *EXIT special value in the BRMS control group to change TAP02 from UNPROTECTED to ALLOCATED. The next save request then attempts to access TAP02 first. When the save operation is completed, you put use the *EXIT special value at the end of the control group to change the resource back from ALLOCATED to UNPROTECTED. For more information about the *EXIT special value, see Backup

Recovery and Media Services for iSeries(TM)

In order to accomplish this in the example, keep all the resources in UNPROTECTED status and change two backup groups. In this situation, you only are only concerned about systems that are attached to more than one resource. Only systems that are attached to more than one resource can produce a resource access conflict. In this example, the system that is attached to more than one resource is System A, in Table 1. System A belongs to backup group 1 and backup group 2.

1. Change Save backup group 2
   a. Change TAP01 from *UNPROTECTED to *ALLOCATED by specify the following command for the *EXIT special value:

      `VRYCFG CFGOBJ(TAPMLB01) CFGTYPE(*MLBRSC) STATUS(*ALLOCATE) RSRCNAME(TAP01)`
   b. Perform the save operation
   c. Change TAP01 from *ALLOCATED to *UNPROTECTED by specifying the following command for the *EXIT special value:

```
                VRYCFG CFGOBJ(TAPMLB01) CFGTYPE(*MLBRSC) STATUS(*UNPROTECTED) RSRCNAME(TAP01)
```
2. Change Save backup group 1

   a. Change TAP02 from *UNPROTECTED to *ALLOCATED by specifying the following command for
      the *EXIT special value:
```
       VRYCFG CFGOBJ(TAPMLB01) CFGTYPE(*MLBRSC) STATUS(*ALLOCATE) RSRCNAME(TAP02)
```
   b. Perform the save operation

   c. Change TAP02 from *ALLOCATED to *UNPROTECTED by specifying the following command for
      the *EXIT special value:
```
      VRYCFG CFGOBJ(TAPMLB01) CFGTYPE(*MLBRSC) STATUS(*UNPROTECTED) RSRCNAME(TAP02)
```

The following table shows how the strategy table appears if this method is used in the example.

Table 2. Schedule to meet system and device constraints using ALLOCATE before UNPROTECT

Start time	Approximate complete time	Backup group	System	Device	Tape resource forced
10:00 p.m.	1:00 a.m.	2	A	TAPMLB01	TAP01
10:00 p.m.	11:00 p.m.	5	C	TAPMLB01	TAP02
11:00 p.m.	1:00 a.m.	6	C	TAPMLB01	TAP02
1:00 a.m.	6:00 a.m.	1	A	TAPMLB01	TAP02 (TAP01 is busy on system B)
1:00 a.m.	4:00 a.m.	3	B	TAPMLB01	TAP01
4:00 a.m.	6:00 a.m.	4	B	TAPMLB01	TAP01

Use multiple tape library device descriptions

You can also use the multiple tape library device descriptions that are created when a tape library is
configured. As each tape resource in a tape library reports in to the iSeries server, a separate tape library
description might be created. Typically, you should use one TAPMLB*xx* and assign all the tape resources
to it. However, system A in the example differs from this. The following display shows the configuration
that is generated on system A.

```
Session A - [24 x 80]
File  Edit  View  Communication  Actions  Window  Help

                  Work with Media Library Status
                                          System:
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
___    TAPMLB01    VARIED OFF
___    TAPMLB02    VARIED OFF




                                                          Bottom
Parameters or command
===>
F3=Exit    F4=Prompt    F5=Refresh    F9=Retrieve    F12=Cancel    F17=Position to
F23=More options
(C) COPYRIGHT IBM CORP. 1980, 2003.
MA    a                                                        09/002
```

After the command CFGDEVMLB(TAPMLB01) completes, you can see both resources under TAPMLB01, even though TAP02 actually generated TAPMLB02. Both resources are set to UNPROTECTED.


```
Session A - [24 x 80]
File  Edit  View  Communication  Actions  Window  Help

                  Work with Media Library Status
                                          System:
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
___    TAPMLB01    VARIED ON
___     TAP01      OPERATIONAL         UNPROTECTED
___     TAP02      OPERATIONAL         UNPROTECTED
___    TAPMLB02    VARIED OFF




                                                          Bottom
Parameters or command
===>
F3=Exit    F4=Prompt    F5=Refresh    F9=Retrieve    F12=Cancel    F17=Position to
F23=More options
(C) COPYRIGHT IBM CORP. 1980, 2003.
MA    a                                                        09/002
```

If you varied on TAPMLB02, it also recognizes TAP01 and TAP02. However, because only one tape library can use a resource, TAP01 and TAP02 must to be set to DEALLOCATED in TAPMLB02, as is shown on the following display.

```
Session A - [24 x 80]                                            _ □ ✕
 File   Edit   View   Communication   Actions   Window   Help
 □  □□  □□  □□  □□  □  □□  □□  □  □  □
                    Work with Media Library Status
                                                 System:
 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
 __     TAPMLB01      VARIED ON
 __      TAP01        OPERATIONAL          UNPROTECTED
 __      TAP02        OPERATIONAL          UNPROTECTED
 __     TAPMLB02      VARIED ON
 __      TAP01        OPERATIONAL          DEALLOCATED
 __      TAP02        OPERATIONAL          DEALLOCATED



                                                              Bottom
 Parameters or command
 ===>
 F3=Exit    F4=Prompt    F5=Refresh    F9=Retrieve    F12=Cancel    F17=Position to
 F23=More options
 (C) COPYRIGHT IBM CORP. 1980, 2003.
 MA      a                                                      09/002
```

In order to use the TAPMLB02 device description, you set TAP01 to UNPROTECTED in TAPMLB01 and you set TAP02 to UNPROTECTED in TAPMLB02, as is shown in the following display.

```
Session A - [24 x 80]                                          _ □ ×

File  Edit  View  Communication  Actions  Window  Help

  [toolbar icons]
                    Work with Media Library Status
                                                  System:
  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
   __    TAPMLB01      VARIED ON
   __      TAP01       OPERATIONAL          UNPROTECTED
   __      TAP02       OPERATIONAL          DEALLOCATED
   __    TAPMLB02      VARIED ON
   __      TAP01       OPERATIONAL          DEALLOCATED
   __      TAP02       OPERATIONAL          UNPROTECTED



                                                            Bottom
  Parameters or command
  ===>
  F3=Exit    F4=Prompt    F5=Refresh    F9=Retrieve    F12=Cancel    F17=Position to
  F23=More options
  (C) COPYRIGHT IBM CORP. 1980, 2003.
  MA   a                                                        09/002
```

The following table shows how the strategy chart appears if you use this method in the example.

Table 3. Schedule to meet system and device constraints using multiple tape library descriptions

Start time	Approximate complete time	Backup group	System	Device	Tape resource forced
10:00 p.m.	1:00 a.m.	2	A	TAPMLB01	TAP01
10:00 p.m.	11:00 p.m.	5	C	TAPMLB02	TAP02
11:00 p.m.	1:00 a.m.	6	C	TAPMLB02	TAP02
1:00 a.m.	6:00 a.m.	1	A	TAPMLB02	TAP02
1:00 a.m.	4:00 a.m.	3	B	TAPMLB01	TAP01
4:00 a.m.	6:00 a.m.	4	B	TAPMLB01	TAP01

≪

Troubleshoot tape resources

≫ The following topics provide information for troubleshooting your tape resources:

"Verify that your tape unit works correctly" on page 59
This topic provides steps to verify that the tape unit is working correctly.

"Collect library information for problem analysis" on page 59
This topic provides information to collect the library data that a service technician needs to repair your tape library.

"Problem handling for tape libraries" on page 59
This topic provides information for handling problems for certain tape libraries.

Verify that your tape unit works correctly

To verify that your tape unit is working correctly, do the following:

1. Remove the cartridge from the tape unit.

2. Type WRKCFGSTS *DEV *TAP on a command line and make the tape unit unavailable to the iSeries(TM) server (vary off).

3. Clean the tape unit. See the cleaning instructions for the tape unit you are using.

4. Type the Verify Tape (VFYTAP) command on a command line and press Enter.

Collect library information for problem analysis

When problem analysis or problem isolation is required, collect and send the following information to the appropriate service support personnel:

- The tape flight recorder (page 59) information.
- If you are using BRMS, collect the BRMS flight recorder (page 59) information.
- If you are using a 3494 tape library, collect the library manager transaction logs (page 59).

Tape flight recorder

Use the following command to collect the tape flight recorder information for your tape library:

```
CALL QTADMPDV TAPMLBxx
```

Substitute the name of your tape library for TAPMLB*xx*

BRMS flight recorder

Use the Dump BRMS (DMPBRM) command to collect the BRMS flight recorder information.

Library manager transaction logs

Copy the transaction logs, the time and date of the failure, and information about the volumes in question:

- Insert a blank diskette in drive A of the personal computer.
- Select `Service.`
- Select `Copy files.`
- Select the transaction logs to be copied.
- Select `OK.`
- Select drive A. Type the file name and description of the problem.
- Select `Copy files.`

Problem handling for tape libraries

The following are instructions for problem handling for the IBM(R) TotalStorage(R) Enterprise Tape Library 3494.

Under typical operational conditions, the operator does not use the library manager often. The software manages the 3494 from requests sent from an iSeries(TM) server. For most purposes, the best function to have active on the display of the library manager is the System Summary window. The system summary gives you indications of the 3494 status, including whether operator intervention is required in case of

errors. If the Intervention Required LED on the front operator panel is flashing, check the System Summary window. If intervention is required, the **Intervention** field on the lower right side of the display shows `Required` instead of `None`.

To check and respond to errors do the following:

1. To check for errors and problems, click **Commands** and select the Operator Intervention command.

   Problems are likely when a condition occurs from which the 3494 cannot recover on its own. Depending on the type of error or exception condition experienced, some or all of the 3494 operations are suspended until the problem is corrected.

2. To respond to an error, select the condition from the list on the **Operator Intervention** window and select the items.

3. Select **OK** after the problem has been resolved (often by manual intervention that may require you to open the front door of the 3494).

4. Repeat these steps until all error conditions are resolved.

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Optical storage

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Optical storage refers to any storage method that uses a laser to store and retrieve data from media. Examples of this media are compact disk read-only memory (CD-ROM), digital video disk read-only memory (DVD-ROM), digital video disk random access memory (DVD-RAM), write-once read-many (WORM) optical cartridges, and erasable optical cartridges.

Optical media is a newer technology than tape, and one that is growing in popularity in the iSeries^(TM) community. Following are some of its advantages:

- **Durability.** With proper care, optical media can last a long time, depending on what kind of optical media you choose.
- **Great for archiving.** Several forms of optical media are write-once read-many, which means that when data is written to them, they cannot be reused. This is excellent for archiving because data is preserved permanently with no possibility of being overwritten.
- **Transportability.** Optical media are widely used on other platforms, including the PC. For example, data written on a DVD-RAM can be read on a PC or any other system with an optical device and the same file system.
- **Random access.** Optical media provide the capability to pinpoint a particular piece of data stored on it, independent of the other data on the volume or the order in which that data was stored on the volume.

While optical has many advantages, there are also some *disadvantages* to consider, as follows:

- **Reusable**. The write-once read-many (WORM) characteristic of some optical media makes it excellent for archiving, but it also prevents you from being able to use that media again.
- **Writing time**. The server uses software compression to write compressed data to your optical media. This process takes considerable processing unit resources and may increase the time needed to write and restore that data.

Another option that you can use for optical storage is virtual optical storage. When you use virtual optical storage, you create and use optical images that are stored on your disk units.

For more information for optical storage and virtual optical storage see the following topics:
- "Optical devices" on page 61
- "Virtual optical storage" on page 63

To compare tape and optical media in order to decide which is best for you, go to "Comparison of offline storage" on page 12.

For information about optical media and your iSeries server, see Optical Support ![icon]. For broad information about the optical technologies, see Tape and Optical Storage ![icon] . «
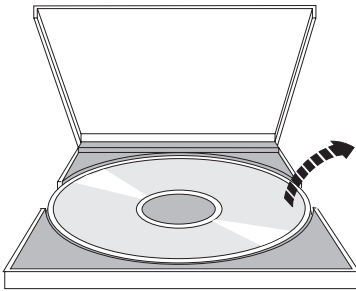
Optical devices

»

Your server comes with a rack-mounted CD-ROM or DVD-ROM drive. As an option, you can order a DVD-RAM drive as a feature to replace your internal drive or to have it in addition to your internal drive. All optical drives are multi-user devices that multiple users can access concurrently.

Note: Optical drives on the iSeries(TM) server are not enabled for the digital audio disk.

Load and unload an optical disk

1. Look at the following figure and remove the disk from the protective case.

2. Slide the disk into the tray with the label side showing. If your optical device is vertically positioned, make sure that the disk is secured by the two tabs at the bottom of the tray as shown on the left in the following figure.
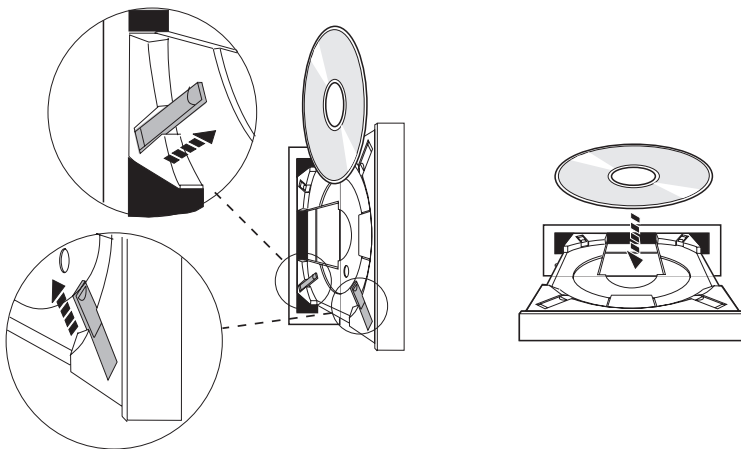
3. When you have properly positioned the disk in the tray, press the Eject button or push the tray into the drive as is in the following figure.
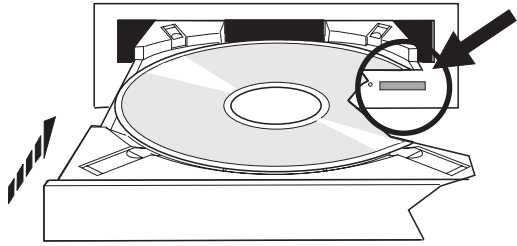
4. To remove the disk from the drive, look at the following figure and press the Eject button.

Cleaning

No preventive maintenance is necessary for the optical drive. Always handle optical disks by the edges to avoid finger prints. Optical disks can be wiped with a soft lint-free cloth or lens tissue. Always wipe in a straight line from the inner hub to the outer rim.
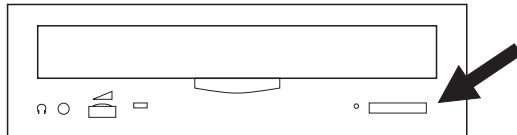
Verify an optical device

The Verify Optical (VFYOPT) command can be used to detect hardware errors, or verify whether a problem has been resolved. This function can be used to verify a CD-ROM drive or a directly attached optical media library device.

To use this function, do the following:

1. Type `VFYOPT DEV(xxxxx)` where *xxxxx* is the device name.

   A display is shown with instructions on how to perform verification test.

2. Follow the instructions, and press the Enter key. The verification test is run.

   If the test completes successfully , you will receive a message about the successful completion. If hardware errors occur during the test, you will receive an error message.

Optical media libraries

The iSeries server supports both directly-attached (SCSI) and LAN-attached optical media library devices. These devices are an excellent alternative to storing data traditionally kept on paper, diskette, microfilm, microfiche, and tape. Optical libraries are high capacity, random access devices that provide fast access to a large amount of data. In addition, optical storage provides permanent, long term archive characteristics unmatched by other storage mediums.

The iSeries server supports attachment of the IBM[(R)] 3995 Optical Library Dataserver as well as non-IBM optical library devices. You can find more information about optical drives from the following:

- Optical Drives
- Tape and Optical Publications
- Optical Device Support on AS/400[(R)] and iSeries
- Optical Support

Virtual optical storage

When you use virtual optical storage, you create virtual images, CD or DVD images, that exist on your server disk units. You can use virtual images to perform a variety of tasks:

- Install software such as Licensed Internal Code, program temporary fixes (PTFs), OS/400(R), and licensed programs
- Distribute software
- Perform backups
- Create distribution media for Central Site
- Create Save Licensed Programs media

The following topics provide information about virtual optical storage and how you can use it.

> **"Concepts for virtual optical storage"**
> Read general information about virtual optical storage, including what it is and how to use it.
>
> **"Prepare for virtual optical storage" on page 68**
> Meet the requirements for virtual optical storage and prepare to use it.
>
> **"Set up virtual optical storage" on page 69**
> Read a high-level overview of the steps used to set up virtual optical storage. This topic also provides links to information that provide specific instructions for setting up virtual optical storage based on what task you want to accomplish.
>
> **"Change write protection for image catalog entries" on page 71**
> Use this information to change the access-mode for virtual optical media.
>
> **"Create actual media from a virtual image" on page 71**
> Use these instructions to copy a virtual image to an optical disk.
>
> **"Transport virtual images to another server" on page 73**
> Use these instructions to move virtual images among different servers.
>
> **"Troubleshoot virtual optical storage" on page 73**
> Troubleshoot common virtual optical problems.

Concepts for virtual optical storage

Virtual optical storage consists of objects that, when used together, imitate CD or DVD media on your disk units. The imitated CDs or DVDs appear to the server to be actual media. The objects that virtual optical storage uses are as follows:

Virtual image

A **virtual image** is an object that contains the data that is typically on an actual CD or DVD. The virtual image is a stream file that resides in the integrated file system. You must initialize a virtual image before you can write to it. In a backup and recovery scenario, you can also span virtual images.

Virtual optical device

A **virtual optical device** is a device description that supports virtual optical storage, like an actual optical device description supports actual optical storage. One to 35 virtual optical device descriptions can be active at a time on the server.

You create a virtual optical device, by selecting the RSRCNAME(*VRT) or TYPE(632B) parameters in the Create Device Description (Optical) (CRTDEVOPT) command.

Image catalog

An **image catalog** is an object that can contain up to 256 image catalog entries. Each catalog is associated with one user-specified integrated file system directory. The system recognized identifier for the object type is *IMGCLG. Image catalogs can have the following statuses:

Ready
All of the loaded and mounted image catalog entries are available for use by the active virtual optical device. The image catalog can be made ready by using the LODIMGCLG (Load Image Catalog) command with the parameter OPTION(*LOAD).

Not ready
None of the image catalog entries in the image catalog are available for use by the virtual optical device.

You can view or change image catalogs by using the Work with Image Catalogs (WRKIMGCLG) command.

Image catalog entry

An **image catalog entry** is a position within an image catalog that contains information about a virtual image that is located in the image catalog directory. Examples of image catalog entry information include a file name of the virtual image, a volume identifier, the index position in the catalog, access information, write protection information, and a text description of the image.

The following are the possible statuses of an image catalog entry. If the image catalog is in a ready state, these statuses represent the current status of the image catalog entry. If the image catalog is in a not ready state, these statuses represent what the status of the image catalog entry will be when the image catalog is put in a ready state.

Mounted
The virtual image associated with the selected image catalog entry is active or loaded in the active virtual optical device. The mounted virtual image is the currently available virtual image that can be seen by using the Work with Optical Volumes (WRKOPTVOL) command. One virtual image can be in mounted status at a time.

Loaded
The virtual image associated with the selected image catalog entry is active or loaded in the selected virtual optical device.

Unloaded
The virtual image associated with the selected image catalog entry is not active or not loaded in the active virtual optical device. Only image catalog entries with a status of mounted or loaded can be accessed through the virtual optical device.

Access

Access refers to whether an image catalog entry is read-only or if it is also writable. With respect to access, an image catalog entry can have the following statuses:

*READONLY
The virtual image associated with the image catalog entry is read-only.

*READWRITE
You can both read and write to the virtual image associated with the image catalog entry.

Write protection

Write protection refers to whether you have enabled the write protection switch for an image catalog entry. The status for write protection are as follows:

Y
Write protection is set for the image catalog entry. You cannot write to the virtual image associated with the image catalog entry.

N
Write protection is not set for the image catalog entry. You can write to the virtual image associated with the image catalog entry.

If the access for an image catalog entry is *READWRITE, you set the write protection switch to **Y** or **N**. If the access for the image catalog entry is *READONLY, the write protection switch is always set to Y.

You can view or change image catalog entries by using the Work with Image Catalog Entries (WRKIMGCLGE) command. You can use the WRKIMGCLGE command to change image catalog entries whether the image catalog is in a ready state or a not ready state. The WRKIMGCLGE command also indicates if the image catalog is in a ready state or a not ready state.

You can change image catalog entries by using the Load/Unload/Mount IMGCLG Entry (LODIMGCLGE) command or by typing GO IMGCLG at a command line.

The following topics provide more concepts for virtual optical storage:
*   "Benefits of virtual optical storage"
*   "Format of virtual images" on page 66
*   "Volume spanning" on page 66
*   "Limitations of virtual optical storage" on page 67

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Benefits of virtual optical storage: ≫

Virtual optical storage can help eliminate media errors and user intervention. It can also increase system availability. Also, virtual optical storage provides the following advantages:

Electronic distribution

You can use virtual optical storage to simplify software and data distribution by creating CD or DVD images on your server. You can distribute these images electronically using file transfer protocol (FTP) or other electronic methods. On the server that receives the images, you can mount the images in a virtual device for easy access. You can also receive or distribute programming temporary fixes (PTFs) electronically.

Object signing

You can secure a virtual image by giving it a digital signature. OS/400$^{(R)}$ provides support for using digital certificates to digitally sign objects. A digital signature on an object is created by using a form of cryptography and is like a personal signature on a written document. To read how to create a digital signature, see Object signing and signature verification.

CD and DVD creation

You can use virtual optical storage to create actual media.

Backup and recovery

Because a virtual image can span more than one volume, you can use it for backup and recovery. If you have enough disk space, you can back up your system to virtual images. You can then use those virtual images to create a multivolume set of CDs or DVDs.

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Format of virtual images: ≫

Virtual images are in one of two file formats:
- International Standards Organization (ISO) 9660
- Universal disk format (UDF)

ISO 9660

If a virtual image is in ISO 9660 format, it is read-only. Also, you cannot span virtual images that are in ISO 9660 format.

UDF

The virtual image is in UDF if you do one of the following:
- Create a virtual image by specifying FROMFILE(*NEW) on the Add Image Catalog Entry (ADDIMGCLGE) command.
- Create a virtual image from a DVD.
- Create a virtual image from CD-RW media which is in UDF.

Typically, you specify FROMFILE(*NEW) when you plan to save to a virtual image or plan to use a virtual image to distribute software. You can also span virtual images that are in UDF.

If you want to create actual media from a virtual image in UDF, you can send the virtual image to a PC or you can use the Duplicate Optical (DUPOPT) command to copy the virtual image directly to a DVD-RAM drive on your server.

Volume spanning: ≫

When a save operation **spans** a volume, it pauses the save process when the current piece of media you are using runs out of space and it continues the save operation on the next piece of media. In the context of backup and recovery, a volume is the media that you are using to save your data. Spanning occurs when the volumes have files that continue from one volume to the next.

When you perform a save operation and span virtual images, the multivolume set of virtual images behaves just like a multivolume set of any form of actual media.

One advantage of using virtual optical storage for a backup operation is that if you have enough disk space, you can perform unattended backups without the use of a media autoloader or a media library.

Similar to actual devices, when you span volumes of virtual images, you can specify a volume list or specify *MOUNTED for the VOL parameter on all of the save commands. If you specify a volume list, the server mounts the volumes of virtual images when they are needed. If you specify *MOUNTED, you must have the virtual images mounted when you start the command. In either case, you must provide enough volumes to complete the save operation.

Whether you specify *MOUNTED or a volume list, if you do not provide enough volumes to complete save operation, the server sends you inquiry message OPT149F - Load next volume on optical device &1. Inquiry message OPT149F provides you with three options:
* Cancel the operation
* Allow the server to create a new volume for you
* Pause the operation and create a new volume manually

If you allow the server to create a new volume for you, the server does the following:
* Adds a *NEW volume and insert it at position 256 in the image catalog
* Mounts the volume in the virtual device
* Initializes the new volume
* Continues the save

When the server creates a new volume, the server gives the new virtual image a name. The server uses a time stamp for the volume ID. The image name is a combination of volume ID and the volume sequence number. The server inserts the new virtual image in position 256 of the image catalog. The size of the new virtual image is the same as the previous virtual image.

The following table shows an example of what happens when the server adds two new volumes during save to an image catalog where Volume 2 existed before starting the save.

Index	Volume ID	Virtual image name	Volume sequence number	Size	Description
1	Volume1	File1	1	1300 MB	My Save 1
2	Volume2	File2	2	650 MB	My Save 1
253	030311124115	0303111241150003	3	650 MB	SET ID VOLUME1 SEQ 0003
254	030311124330	0303111255320004	4	650 MB	SET ID VOLUME1 SEQ 0004
255	030311124545	0303111256450005	5	650 MB	SET ID VOLUME1 SEQ 0005
256	030311124801	0303111248010006	6	650 MB	SET ID VOLUME1 SEQ 0006

Consideration for full backups

If you are doing a full backup, with the Save System (SAVSYS) command for example, the first volume must be least 1489 MB. The first volume must be at least 1489 MB because the first volume must be large enough to save the Licensed Internal Code. The remaining volumes can be smaller than 1489 MB.

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Limitations of virtual optical storage: ≫

You can use virtual optical storage for all operations that can write to actual media with the following exceptions:

Main storage dump in SST and DST
System service tools (SST) and dedicated services tools (DST) provide the capability to perform a main storage dump to media. You cannot use virtual optical storage for a main storage dump to media.

Save Licensed Internal Code
The Save Licensed Internal Code function is only available at the Initial Program Load (IPL) display or at the Install the Operating System display. Because the integrated file system is not available when these functions are used, the virtual optical device will not have any loaded media.

PTFs
If you build a custom fix package and save it to a virtual image, you cannot span volumes. Your custom fix package must fit on one volume.

IBM(R) Integrated xSeries(R) Server for iSeries(TM)
Integrated xSeries Server hardware does not support write operations to virtual images.

Backup and recovery
You only perform a restore operation from virtual images if the server is already up and running. Installations done by using an image catalog require a command line to start an installation.

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Prepare for virtual optical storage
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To prepare to use virtual optical storage, you need to consider these items:
- Whether you have the authority to create virtual images
- How much disk space you have
- The number of volumes of virtual images you need

Authority needed to create virtual images

You must have security administrator (*SECADM) and all object (*ALLOBJ) special authorities to use the commands required to create virtual images.

How much disk space you have

Because virtual images are stored on your disk units, they can quickly use disk space. It is essential that you determine whether you have enough disk space. The smallest allowable size for a optical image file volume is 48 MB. The largest allow able size is 16 GB.

To determine how much disk space you have, do the following:
1. In iSeries(TM) Navigator, expand **My Connections** —> **your iSeries server** —> **Configuration and Service** —> **Hardware** —> **Disk Units** —> **Disk Pools**.
2. Right-click the disk pool you want to view, and select **Properties**.
3. Select the **Capacity** page.

   The **Capacity** page displays the used space, free space, total capacity, threshold, and percentage of disk space used for the disk pool.

   You can also use the Work with Disk Status (WRKDSKSTS) command to determine your free space.

If you need to clean up disk space, see Clean up disk storage space.

The number of volumes of virtual images you need

To determine how many volumes you need, do the following:
1. Determine the how much data you are going to store.
2. Determine the size of each virtual image. You can determine the size based on what you want to do with the optical image file. For example, if are going to copy the optical image files to a CD, the largest you can make the volumes is 650 MB.
3. Divide the amount of data you are going to store by the size of your volumes. For example, if you plan to save 1 GB of data, and you want to copy your volumes to a CD, you need to create two volumes.

Consideration for full backups

If you are doing a full backup, for example, using the Save System (SAVSYS) command, the first volume must be at least 1489 MB. This is because the first volume must be large enough to store the Licensed Internal Code. The remaining volumes can be smaller than 1489 MB.

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Set up virtual optical storage
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The following provide a high-level overview of how to set up virtual optical storage for the most common tasks. The exact steps you use to set up virtual optical storage depend on what task you want to accomplish, such as performing a save operation or distributing software.

The specific tasks provide links to instructions for the different tasks that you can perform with virtual optical storage.

Note: Your user profile must have *ALLOBJ and *SECADM authority to use the image catalog commands.

The tasks are as follows:
- Install from an image catalog (page 69)
- Create writeable virtual images in an image catalog (page 70)
- Use virtual images in an image catalog (page 70)
- Specific tasks (page 70)

Install from an image catalog
1. Create the image catalog:
   ```
   CRTIMGCLG IMGCLG(MYCATALOG) DIR('/MYCATALOGDIRECTORY') CRTDIR(*YES)
   ```
2. Add the image from physical media or from image files received from another system:
   - To add images from physical media:
     ```
     ADDIMGCLGE IMGCLG(MYCATALOG) FROMDEV(OPTXX) TOFILE(*fromfile)
     ```
     Repeat this step for each optical disk.
   - To add the image from an image file:
     ```
     ADDIMGCLGE IMGCLG(MYCATALOG) FROMFILE(SLIC_N) TOFILE(*fromfile)
     ```
     Repeat this step for each file in your catalog directory. This step assumes your image is already in the image catalog directory.
3. Create and vary on the virtual device:

```
CRTDEVOPT DEVD(OPTVRT01) RSRCNAME(*VRT)
VRYCFG CFGOBJ(OPTVRT01) CFGTYPE(*DEV) STATUS(*ON)
```

4. Load the image catalog in the virtual device:
```
LODIMGCLG IMGCLG(MYCATALOG) DEV(OPTVRT01)
```

5. Verify the catalog for upgrade. For the:
```
VFYIMGCLG IMGCLG(MYCATALOG) TYPE(*UPGRADE) SORT(*YES)
```
The following are required for the verify operation:
   a. Licensed Internal Code for OS/400[(R)]
   b. Operating System/400[(R)]
   c. OS/400 - Library QGPL
   d. OS/400 - Library QUSRSYS

6. Start the install:
```
PWRDWNSYS OPTION(*IMMED) RESTART(*YES) IPLSRC(*IMGCLG) IMGCLG(AL)
```

Create writeable virtual images in an image catalog

1. Create the image catalog:
```
CRTIMGCLG IMGCLG(MYCATALOG) DIR('/MYCATALOGDIRECTORY') CRTDIR(*YES)
```

2. Add the image from physical media or from image files received from another system.

   If you are adding a new blank image, type the following command:
```
ADDIMGCLGE IMGCLG(MYCATALOG) FROMFILE(*NEW) TOFILE(NEWIMAGEFILE) IMGSIZ(16000)
```
   Repeat this step for each optical disk needed.

3. If you do not already have a virtual optical device type 632B, create one and vary it on:
```
CRTDEVOPT DEVD(OPTVRT01) RSRCNAME(*VRT)
VRYCFG CFGOBJ(OPTVRT01) CFGTYPE(*DEV) STATUS(*ON)
```

4. Load the image catalog in the virtual device:
```
LODIMGCLG IMGCLG(MYCATALOG) DEV(OPTVRT01)
```

5. Initialize the virtual image:
```
INZOPT NEWVOL(MYVOLUMEID) DEV(OPTVRT01) CHECK(*NO) TEXT(MYTEXTDESCRIPTION)
```

Use virtual images in an image catalog

1. Create the image catalog:
```
CRTIMGCLG IMGCLG(MYCATALOG) DIR('/MYCATALOGDIRECTORY') CRTDIR(*YES)
```

2. Add the image from physical media or from image files received from another system.
   - To add images from physical media:
```
ADDIMGCLGE IMGCLG(MYCATALOG) FROMDEV(OPTXX) TOFILE(*fromfile)
```
     Repeat for each optical disk.
   - To add images from an image file:
```
ADDIMGCLGE IMGCLG(MYCATALOG) FROMFILE(SLIC_N) TOFILE(*fromfile)
```
     Repeat this step for each file in your catalog directory. This step assumes your image is already in the image catalog directory.

3. Create and vary on the virtual device:
```
CRTDEVOPT DEVD(OPTVRT01) RSRCNAME(*VRT)
VRYCFG CFGOBJ(OPTVRT01) CFGTYPE(*DEV) STATUS(*ON)
```

4. Load the image catalog in the virtual device
```
LODIMGCLG IMGCLG(MYCATALOG) DEV(OPTVRT01)
```

Specific tasks

The following links provide instructions for the specific tasks that you can perform with virtual optical storage.

Install or replace software
To install or replace software using virtual optical storage see Preparing to upgrade or replace software using an image catalog.

Software distribution
To set up virtual optical storage for software distribution see Prepare the central system for virtual images in the Distribute software topic.

Install fixes
To install fixes with virtual optical storage, see Install fixes from an image catalog.

Perform a save operation
To save to virtual optical storage, see Consider using virtual optical storage in the Backup up your server topic.

Perform a restore operation

To restore from virtual images, see Backup and Recovery .

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Change write protection for image catalog entries
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All image catalog entries include a write-protect switch, which functions identically to the write-protect switch on actual media. The initial position of this switch is on for read-only media and off for writable media. Virtual images in International Standards Organization (ISO) 9660 format is read-only while media in universal disk format (UDF) can be writable or read-only.

When you add a new image catalog entry to an image catalog, the image catalog entry is not write-protected by default. After you add an image catalog entry to an image catalog, you can change whether it is write-protected with the Change Image Catalog Entry (CHGIMGCLGE) command.

To change an image catalog entry to be write-protected, type the following command, where the image catalog name is MYCAT and the image catalog index is 3:

```
CHGIMGCLGE IMGCLG(MYCAT) IMGCLGIDX(3) WRTPTC(*YES)
```

To change an image catalog entry to be not write-protected, type the following command where the image catalog name is MYCAT and the image catalog index is 3:

```
CHGIMGCLGE IMGCLG(MYCAT) IMGCLGIDX(3) WRTPTC(*NO)
```

≪

Create actual media from a virtual image
≫

One of the advantages to using virtual optical storage is that you can copy virtual images to actual media. If you plan to copy your virtual images to actual media, you must ensure that they are the correct format and the correct size.

The Image Size (IMGSIZ) parameter of the Add Image Catalog Entry (ADDIMGCLGE) command has these values that you can use to specify the correct size for your virtual images:

*CD650

The size of the virtual image is 650 MB. Images created with this size can be written to any standard 650 MB media or larger.

*DVD2600

The size of the virtual image is 2.6 GB. Images created with this size can be written to any 2.6 GB media.

*DVD4700

The size of the virtual image is 4.7 gigabytes. Images created with this size can be written to any 4.7 GB media.

When you create a virtual image, the image is a pure byte image. The server creates no headers in the image and uses no compression.

Format of the virtual image

A virtual image can be in one of two formats, ISO 9660 and universal disk format (UDF). You can only use a virtual image in UDF to create actual media. For more information about file format, see "Format of virtual images" on page 66.

Create actual media using a PC

To create an actual media using a PC, you must use a method such as FTP or iSeries^(TM) Navigator to move the file to a PC that has software with image burning capability.

To create actual media, do the following:

1. Use a transport method such as FTP or iSeries Navigator to move the image file to your PC. To use FTP to move the image file to your PC, see Transfer files with FTP.

    To use iSeries Navigator do the following:

    a. In iSeries Navigator expand **My Connections** —> **your iSeries server** —> **File systems** —> **Integrated File System**.
    b. Navigate to the directory with your virtual image.
    c. Select the image and drag it to the desktop of your PC.
2. Use image burning software on your PC to burn the image to a CD or DVD. It is recommended that you use disk-at-once mode rather than track-at-once mode or session-at-once mode.

Create actual media using a DVD-RAM drive

If you have a DVD-RAM drive on your server, you can use the DUPOPT command to create actual media from a virtual image.

The size of your virtual image must be the same size or smaller as the media in your DVD-RAM.

To create actual media, do the following steps:

1. Vary on your virtual optical device by typing the following command:

    `VRYCFG CFGOBJ(`*virtual-device-name*`) CFGTYPE(*DEV) STATUS(*ON)`
2. Load your image catalog by typing the following command:

    `LODIMGCLG IMGCLG(`*catalog- name*`) DEV(`*virtual-device-name*`) OPTION(* LOAD)`
3. Type WRKIMGCLGE (the Work with Image Catalog command) to ensure that your image catalog entry is loaded and mounted. If it is not, do the following:

    a. If the image catalog entry is not loaded, type 8(LOAD) and press Enter.
    b. If the image catalog entry is not mounted, type 6(MOUNT) and press Enter.

c. Vary on your DVD-RAM drive by typing the following command:

```
VRYCFG CFGOBJ(DVD-device-name) CFGTYPE(*DEV) STATUS(*ON)
```

4. Verify that your media is loaded in your DVD device.

5. Duplicate the virtual image to the DVD by typing the following command:

```
DUPOPT   FROMVOL(*MOUNTED)  TOVOL(*MOUNTED)  NEWVOL(*FROMVOL)
         CLEAR(*YES)  FROMDEV(virtual-device-name)  TODEV(DVD-device-name)
```

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Transport virtual images to another server

One benefit of using virtual optical storage is that you can use copies of a virtual image on more than one server. To transport a virtual image to another server, use one of the following methods.

FTP

You can transfer a virtual image from one server to another by using File Transfer Protocol (FTP). To use FTP you must have TCP/IP set up and running on your server. See FTP for more information. For instructions on moving a file with FTP see Transfer files with FTP.

iSeries(TM) Navigator

There are two ways that you can use iSeries Navigator to transfer files between systems. The easiest way to use iSeries Navigator is to drag the file from one server to another.

You can also use Management Central in iSeries Navigator to move files. Management Central is a powerful suite of systems management functions that make managing multiple systems as easy as managing a single system. For more information, see the Management Central topic. For instructions on moving a file with Management Central, see Packaging and sending objects with Management Central

QFilesvr.400

The OS/400(R) File Server file system (QFileSvr.400(R)) is an integrated file system that provides transparent access to other file systems that reside on remote servers. For more information about QFileSvr.400 see OS/400 File Server file system (QFileSvr.400).

Note: You largest file size that you can transfer using QFileSvr.400 is 4 GB.

Troubleshoot virtual optical storage

Typically, when an error occurs with virtual optical storage, the operation stops and you receive an inquiry or escape message. The message indicates that there is something wrong with the volume being processed and provides recovery instructions. Follow the instructions to recover from the inquiry or escape message.

The following is a list of the most common inquiry and escape messages that occur with virtual optical storage:

Inquiry messages

OPT1260 - Active file found on volume &1.
OPT1314 - Volume is write-protected or read-only.
OPT1321 - Error occurred processing volume &2.
OPT1486 - Load next volume on optical device &1.
OPT1487 - Load volume &2 on optical device &1.
OPT1488 - Volume &2 on optical device &1 is not initialized.
OPT1495 - Volume name list exhausted on device &1.
OPT1496 - Load volume with sequence number &5 on device &1.
OPT149B - Load volume with correct starting volume on device &1.

OPT149C - Load volume with correct continued file on device &1.
OPT149D - Optical volume is part of a existing volume set.
OPT149E - Found unexpected volume on device &1.
OPT149F - Load next volume on optical device &1.
OPT1503 - Optical volume contains active files.
OPT1504 - Optical device &1 is empty.

Escape messages

OPT1390 - Error with virtual volume image.
OPT1605 - Media or device error occurred.

To see any of these messages, type: DSPMSGD OPT*xxxx* at a command line and press Enter.

Storage area networks

Storage area networks (SANs) are a newer development in the disk and tape attachment business. They consolidate the storage of multiple, heterogeneous platforms into a single set of centrally managed resources. To do so, they employ a combination of technologies, including hardware, software, and networking components. They support direct, high-speed data transfers between servers and storage devices in the following ways:

- **Server to storage.** This is the traditional model of interaction with storage devices. The advantage of a SAN in this context is that the same storage device may be accessed serially or concurrently by multiple servers.
- **Server to server.** A SAN may be used for high-speed, high-volume communications between servers.
- **Storage to storage.** This outboard data movement capability enables data to be moved without server intervention, thereby freeing up server processor cycles for other activities like application processing. Examples include a disk device backing up its data to a tape device without server intervention, or remote device mirroring across the SAN. This type of data transfer is not currently available on the iSeries(TM) server.

For more information about storage area networks in general and how they work, see Introduction to

Storage Area Networks .

SANs provide many benefits in your iSeries network, including the following:

- **Scalability.** Storage is independent of the server itself, so you are not limited by the number of disks you can attach directly to the server.
- **Improved availability of applications.** Storage is independent of applications and is accessible through alternative data paths.
- **Better application performance.** Storage processing is moved from the servers onto a separate network.
- **Centralized and consolidated storage.** Storage capacity can be connected to servers at a greater distance, and storage resources can be disconnected from individual hosts. The results can be lower overall costs through better use of the storage, lower management costs, increased flexibility, and increased control.
- **Data transfer for storage at remote sites.** You can keep a remote copy of data for disaster protection.
- **Simplified centralized management.** A single image of storage media simplifies management.

For more information about how you can use storage area networks with your iSeries server, see IBM(R) e(logo)server iSeries in Storage Area Networks: Implementing Fibre Channel Disk and Tape with iSeries

 .

Related information for storage solutions

Following are the iSeries^(TM) manuals (PDFs) and IBM^(R) Redbooks^(TM) (PDFs), and Web sites that relate to the Storage Solutions topic. You can view or print any of the PDFs.

Manuals

- Backup, Recovery and Media Services for iSeries (about 2.5 MB)

- Hierarchical Storage Management (about 943 KB)

- Optical Support (about 1.3 MB)

Redbooks

- Introduction to Storage Area Network, SAN (about 4.1 MB)

- iSeries in Storage Area Networks (about 6.8 MB)

Web sites
- Backup, Recovery and Media Services
- Hierarchical Storage Management
- iSeries Storage Solutions
- IBM TotalStorage^(R)

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