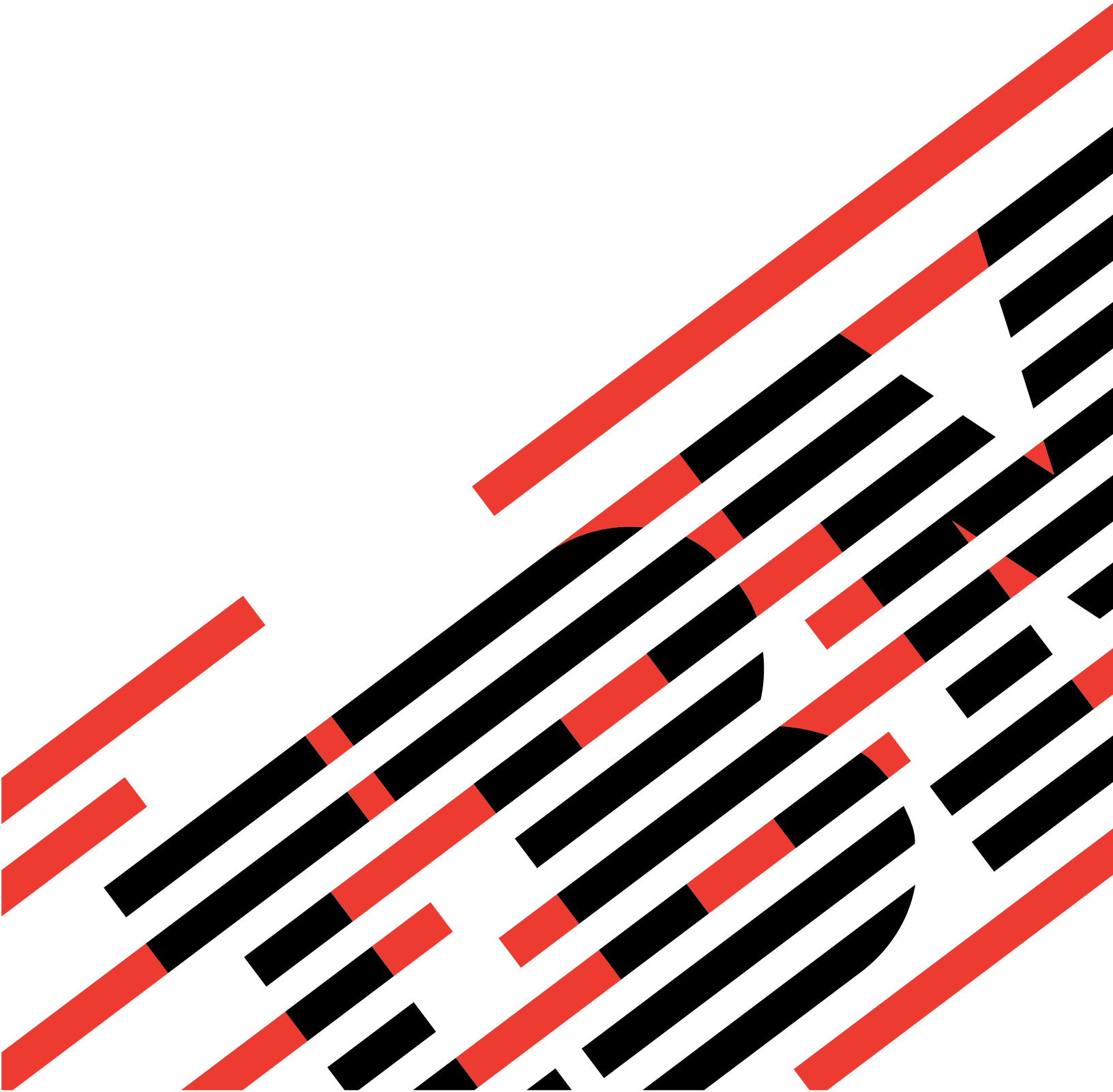
IBM Systems - iSeries

Storage solutions

Version 5 Release 4



IBM Systems - iSeries

Storage solutions

Version 5 Release 4

Note

Before using this information and the product it supports, read the information in "Notices," on page 171.

Fourth Edition (February 2006)

This edition applies to version 5, release 4, modification 0 of IBM i5/OS (product number 5722-SSI) and to all subsequent releases and modifications until otherwise indicated in new editions. This version does not run on all reduced instruction set computer (RISC) models nor does it run on CISC models.

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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™ storage and help you make choices about which storage technologies are right for your company now, and which may be useful in the future.

Notes:

- 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® Total Storage.
- This information includes programming examples. Read the Code license and disclaimer information for important legal information.

Related tasks

Getting your media ready to save your server

Related information

IBM Total Storage

What's new for V5R4

For V5R4, the Tape and Optical storage topics have been expanded to include:

Addition of virtual tape

The Tape topic has been expanded to include virtual tape functions that allow you to create virtual tape images that exist on your server disk units.

- Virtual Tape

Enhanced optical support information

The Optical storage topic now includes the information previously found in the *Optical Support* book. All of the information formerly in the *Optical Support* book is now available in the iSeries Information Center.

- Optical Storage

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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.

Printable PDF

Use this to view and print a PDF of this information.

To view or download the PDF version of this document, select Storage solutions.

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1. Right-click the PDF in your browser (right-click the web page address above).
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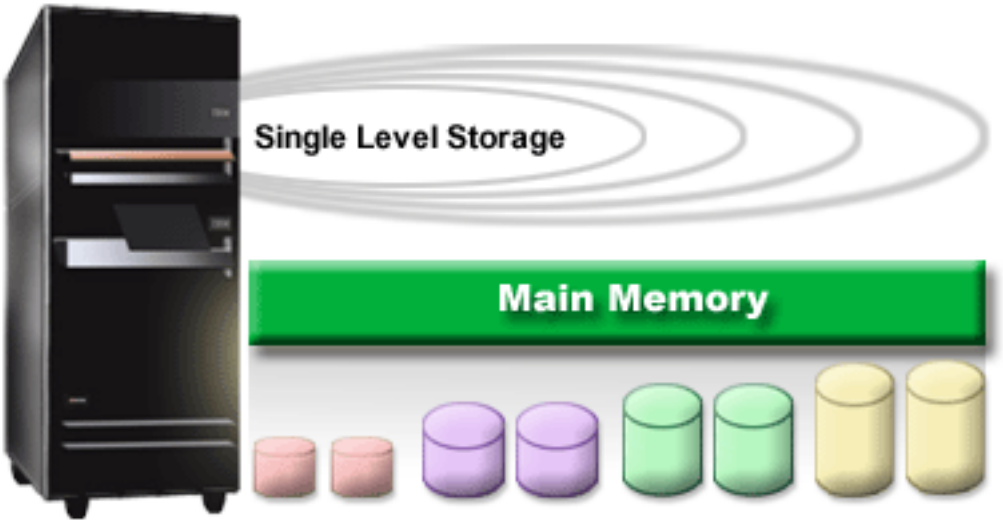
How the iSeries views storage

This topic describes how objects are stored on your iSeries server and lays the groundwork for the other topics in this section.

The iSeries 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:



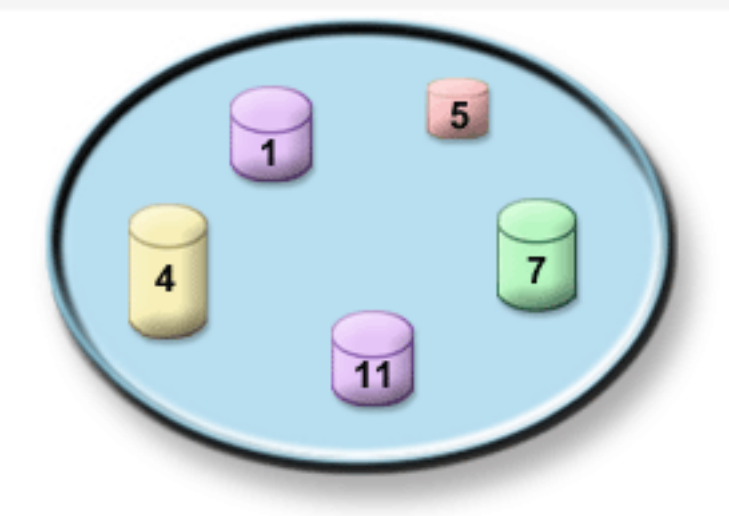
When you save a file, you do not assign it to a storage location; instead, the server places the file in the location that ensures the best performance. It may spread the data in the file across multiple disk units, if that is the best option. When you add more records to the file, the system assigns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

Disk

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

Disk storage is the storage that is usually internal to your iSeries 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.

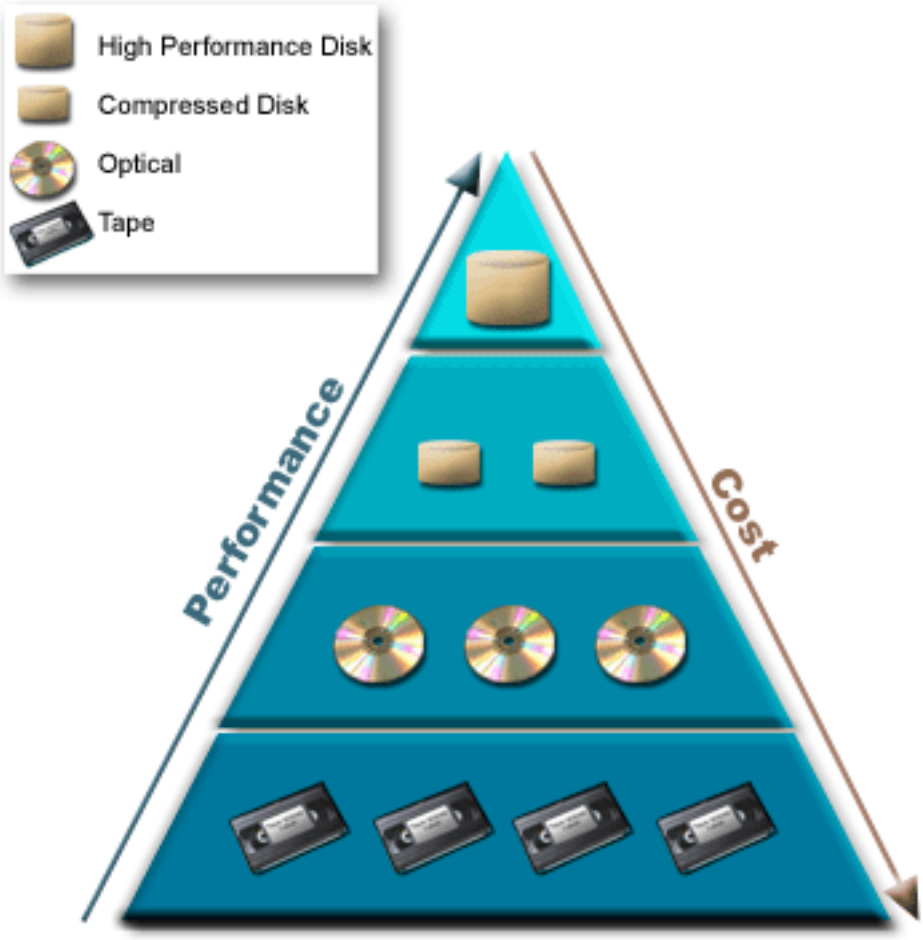


For detailed information about disk pools, disk pool types, and examples of how to use disk pools for different purposes, see Disk pools. For information about how to configure disk units and disk pools, see Manage disk pools.

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:



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.

Related concepts

Disk pools

Using independent disk pools

Plan for disk protection

Related tasks

Manage disk pools

Related information

Hierarchical storage management

Tape

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.

Tape is probably the most common form of removable storage media for the iSeries. 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 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
- Plan for a tape solution

Installing and configuring

- Install stand-alone tape devices
- Install tape libraries
- Configure tape libraries

Use and maintenance

- Use tape devices
- Maintain tape resources
- Example: Manage tape resources in a tape library

Troubleshooting

- Verify that your tape unit works correctly
- Collect library information for problem analysis
- Problem handling for tape libraries

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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 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:

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

Related information

Tape Offerings

Automatic cartridge loaders

Automatic cartridge loaders provide automation solutions for small- to medium-sized 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.

Related information

Tapes Supported on iSeries

Tape libraries

Tape libraries can help you perform unattended save and restore operations, archival and retrieval operations, spool archiving, and other tape related tasks.

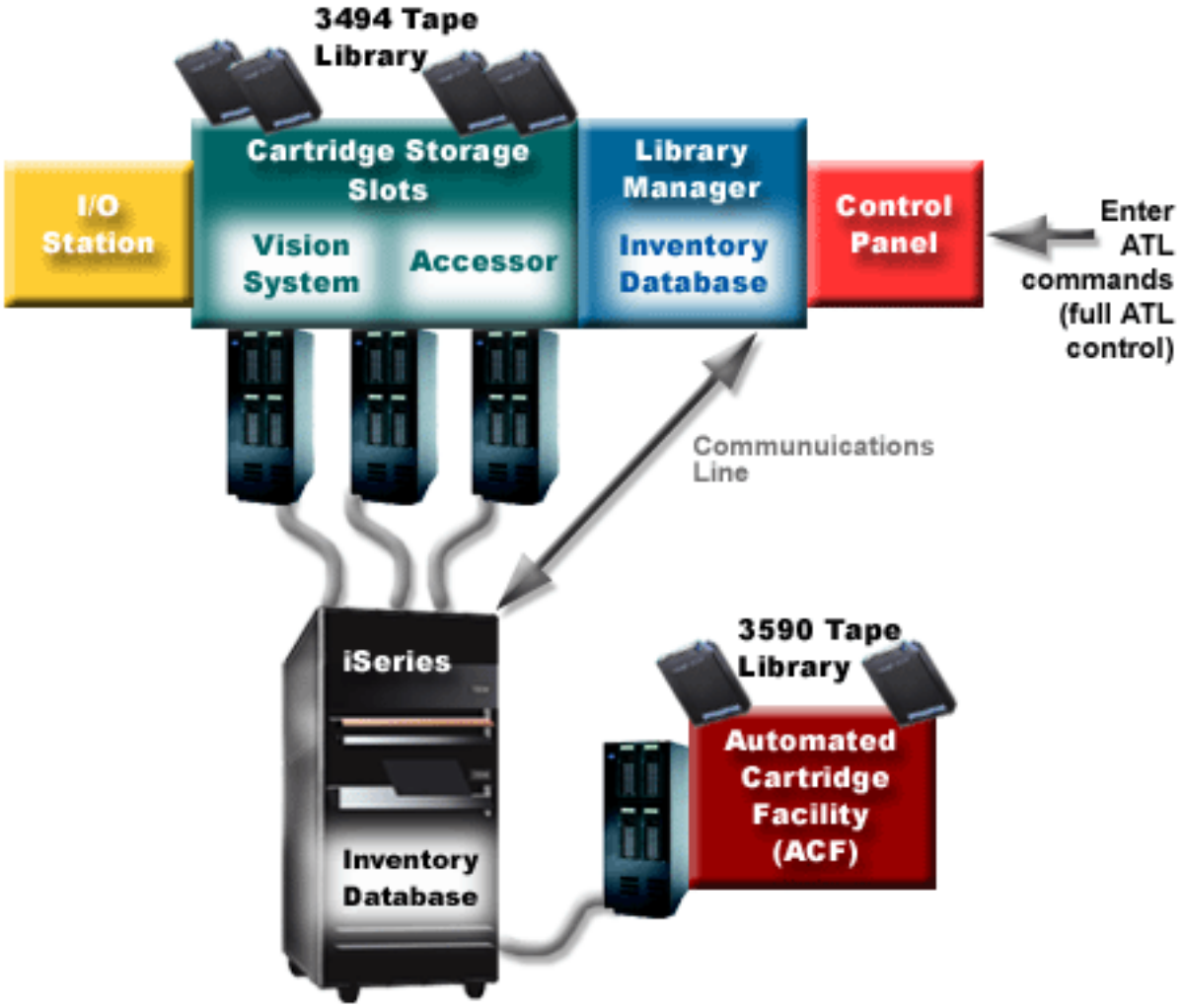
Tape libraries are often used with some form of automation software, and are capable of supporting multiple systems across different platforms and large quantities of cartridges. In these environments, a media management application often maintains the cartridge inventory and handles most of the tape 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 i5/OS™.

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:

This topic provides a description of the 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 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.

Related tasks

"Set up a tape library as a stand-alone device" on page 41
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.

Common configuration types for tape libraries:

This topic provides a description of several common configurations for tape libraries.

The iSeries 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 with the same capability is within a tape library that is connected to the same i5/OS partition, the drives are pooled together to form a single logical library. Drives with different capabilities within the same tape library must either be connected to separate IOAs or the tape library must be partitioned so that each kinds of drive is in a separate logical partition.

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® 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.

Related concepts

Backup, Recovery and Media Services

Related information

Backup, Recovery and Media Services

Cartridge concepts for tape libraries:

This topic explains how cartridges work with 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:

There are several 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.

Related concepts

"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.

Related tasks

"Make cartridges available to the tape library inventory" on page 44
Before you can use the tape library, it must have media loaded and made available.

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 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 i5/OS unloads the tape resource for another request.

Alternate restart
The cartridge has been assigned to the alternate restart category. This category is provided by i5/OS 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. i5/OS 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 Cartridge assignment when the iSeries system name changes 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.

Related concepts

"Cartridge status" on page 10
There are several possible types of status for a cartridge in relation to a tape library.

Related tasks

"Reassign cartridges when the system name changes" on page 40
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.

"Make cartridges available to the tape library inventory" on page 44
Before you can use the tape library, it must have media loaded and made available.

Related reference

Create Tape Category (CRTTAPCGY)

Delete Tape Category (DLTTAPCGY)

Display Tape Category (DSPTAPCGY

Cartridge identifiers and volume identifiers:

Cartridge and volume identifiers are used to label each cartridge so they can be tracked and located in the tape library.

Every cartridge and volume ID can contain the characters A through Z, 0 through 9, $, @, #. Only the first 6 characters are recognized by i5/OS; 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.
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.

Related concepts

"Optical storage" on page 66
This topic provides an overview and reference guide for IBM optical support on the iSeries server with the i5/OS operating system.

Plan for a tape solution

Several things need to be considered when planning for a tape solution.

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

Tape management software

- Tape resource management with Backup Recovery and Media Services

Capabilities of the tape solution

- Comparison of tape solutions
- Eight-millimeter cartridge and tape unit compatibility
- Quarter-inch cartridge and tape unit compatibility
- Half-inch and Magstar® MP cartridges and tape unit compatibility
- LTO Ultrium cartridges and tape unit compatibility

Connection configurations with your iSeries server

- Multiple iSeries servers sharing a tape library
- Multiple tape libraries on an iSeries server
- Multiple tape drives in a tape library
- Configurations of different platforms with a tape library

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

Related information

Tapes Supported on iSeries

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.

Related concepts

Backup, Recovery and Media Services

Related information

Backup, Recovery and Media Services

Comparison of tape solutions

The iSeries server supports several different single tape devices, autoloaders, and tape libraries.

Product name	Description	Media	Storage	Data transfer	Drives
Single tape devices					
IBM Magstar 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 (mbps) (15 mbps 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 3: up to 400 GB (800 GB compressed)	Ultrium 1: Up to 15 mbps (30 mbps compressed) Ultrium 2: Up to 35 mbps (70 mbps compressed) Ultrium 2: Up to 80 mbps (160 mbps compressed)	1
IBM TotalStorage® Enterprise Tape Drive 3592	The 3592 is a tape device that provides both fast access to storage and high-capacity storage.	4 cartridges	j1a: 300 GB (900 GB compressed) per cartridge e05: 500 GB (1500 GB compressed) per cartridge	j1a: 40 mbps (1000 mbps compressed) per cartridge e05: 100 mbps (250 mpbs compressed)	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 to 80 GB (160 GB compressed) per cartridge	6 mbps (12 mbps 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 to 380 KB per second (kbps) (760 kbps compressed)	1

Product name	Description	Media	Storage	Data transfer	Drives
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 mbps (6 mbps compressed)	1
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 mbps (20 mbps 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 mbps with a maximum SCSI burst rate of 20 mbps.	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 to 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 mbps (15 mbps 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 mbps (30 mbps compressed)	1

Product name	Description	Media	Storage	Data transfer	Drives
IBM TotalStorage LTO Ultrium Tape Autoloader 35812U	The 35812U is an automation solution that complies with LTO specifications.	1 to 8 cartridges	Varies according to drives	Varies according to drives	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 to 34 cartridges	Varies according to drives	Varies according to drives	1 to 2
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	Varies according to drives	Varies according to drives	1 to 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 to 6881 cartridges (depending on model)	Varies according to drives	Varies according to drives	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 to 10 cartridges	Up to 60 GB (180 GB compressed) per cartridge	Up to 14 mbps	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 mbps (10 mbps)	1

Related information

Tapes Supported on iSeries

Tape Offerings

Eight-millimeter cartridge and tape unit compatibility

The iSeries supports several tape unit types.

- 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.

Related concepts

“Clean eight-millimeter tape drives” on page 53
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.

Quarter-inch cartridge and tape unit compatibility

For full read-and-write capability, there are guidelines for determining which tape cartridges to use for each tape unit.

Capacity-and-date rate by media type and format			
Media type (IBM P/N)	**iSeries format (density)**	**Data compac- tion[3]**	**Capacity and data rate[4]**
SLR100 50GB (35L0968)	SLR100	Yes	50 GB 5.0 MB per second (mbps)
SLR100 5GB (35L0661)	SLR100	Yes	5 GB 5.0 mbps
SLR60 30GB (19P4209)	SLR60	Yes	30 GB 4.0 mbps

Capacity-and-date rate by media type and format			
Media type (IBM P/N)	**iSeries format (density)**	**Data compac- tion[3]**	**Capacity and data rate[4]**
MLR3-25 GB (59H4128)	MLR3	Yes	25 GB 2.0 mbps
MLR1-16 GB (59H4175)	QIC5010	Yes	16 GB 1.5 mbps
DC5010 (16G8574)	QIC5020	Yes	13 GB 1.5 mbps
SLR5-4 GB (59H3660)	QIC4DC	Yes	8 GB 760 KB per second (kbps)
SLR5-4 GB (59H3660)	QIC4GB	No	4 GB 380 kbps
DC9250 (16 GB8436)	QIC2DC	Yes*	5 GB 600 kbps
DC9200 (16G88541)	QIC2DC	Yes*	4 GB 600 kbps
DC9250 (16G8436)	QIC2GB	No	2.5 GB 300 kbps
DC9200 (16G8541)	QIC2GB	No	2 GB 300 kbps
DC9120 (21F8730)	QIC1000	No	1.2 GB 300 kbps
DC9100 (16G8539)	QIC1000	No	1 GB 300 kbps
DC6525 (21F8597)	QIC525	No	525 MB 200 kbps
DC6320 (21F8583)	QIC525	No	320 MB 200 kbps
DC6150 (21F8578)	QIC120	No	120 MB 120 kbps
DC6150 (21F8578)	QIC24	No	60 MB 92 kbps

1. 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 i5/OS 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.
2. 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 on page 20.

Read-and-write support by tape unit feature code number[1,2]							
Media type (IBM P/N)	**6380 6480**	**6381 6481**	**4482 4582 6382 6482 7207-122**	**4483 4583 6383 6483**	**4584 4684 6384 6484 5753 7207-330 7212w/FC1107**	**4486 4586 6386 6486**	**4487 4587 4687 5754 7329-308 7212w/FC1108**
SLR100 50GB (35L0968)	No	No	No	No	No	No	R/W
SLR100 5GB (35L0661)	No	No	No	No	R/W	No	R/W
SLR60 30GB (19P4209)	No	No	No	No	R/W	No	R/W
MLR3-25 GB (59H4128)	No	No	No	No	R/W	R/W	R/W
MLR1-16 GB (59H4175)	No	No	No	R/W	R/W	R/W	R

Read-and-write support by tape unit feature code number[1,2]							
Media type (IBM P/N)	**6380 6480**	**6381 6481**	**4482 4582 6382 6482 7207-122**	**4483 4583 6383 6483**	**4584 4684 6384 6484 5753 7207-330 7212w/FC1107**	**4486 4586 6386 6486**	**4487 4587 4687 5754 7329-308 7212w/FC1108**
DC5010 (16G8574)	No	No	No	R/W	R/W	R/W	R
SLR5-4 GB (59H3660)	No	No	R/W	R	R	R	R
SLR5-4 GB (59H3660)	No	No	R/W	R	R	R	R
DC9250 (16 GB8436)	No	No	R/W	R	R	R	No
DC9200 (16G88541)	No	R/W	R/W	R	R	R	No
DC9250 (16G8436)	R/W	R/W	R/W	R	R	R	No
DC9200 (16G8541)	R/W	R/W	R/W	R	No	R	No
DC9120 (21F8730)	R/W	R/W	R/W	No	No	No	No
DC9100 (16G8539)	R/W	R/W	R/W	No	No	No	No
DC6525 (21F8597)	R/W	R/W	R/W	No	No	No	No
DC6320 (21F8583)	R/W	R/W	R/W	No	No	No	No
DC6150 (21F8578)	R/W	R/W	R/W	No	No	No	No
DC6150 (21F8578)	R	R	No	No	No	No	No

1. See Clean quarter-inch tape drives 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.

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.

Related concepts

"Clean quarter-inch tape drives" on page 52
For quarter-inch tape drives, you should clean the head after every 8 hours of tape movement when using IBM tape cartridges. Other tape media might require cleaning more frequently.

Half-inch and Magstar MP cartridges and tape unit compatibility

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

Tape unit	Cartridge part number	Capacity	Compression	Length
3592	Data 18P7534	300 GB	900 GB	610 m (2001 ft.)
	Economy Data 24R0316	60 GB	180 GB	122 m (396.5 ft.)
	WORM 18P7538	300 GB	900 GB	610 m (2001 ft.)
	Economy WORM 24R0317	60 GB	180 GB	122 m (396.5 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		175 m (575 ft.)
3570	05H2462	5 GB	15 GB	547 ft. (167 m)
	08L6187			
	08L6663	7 GB	21 GB	227 m (745 ft.)

Related concepts

"Clean half-inch tape drives" on page 53
This topic provides information specific to cleaning half-inch tape drives.

LTO cartridges and tape unit compatibility

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

Cartridge type	Part number	Part number	Part number
LTO Ultrium Tape Drive	Ultrium 3 400 GB	Ultrium 2 200 GB	Ultrium 1 100 GB
Ultrium 3	Read and Write	Read and Write	Read only
Ultrium 2		Read and Write	Read and Write
Ulturium 1			Read and Write
The Part number for Ultrium Universal cleaning cartidge is 35L2087.			

Related concepts

"Clean LTO Ultrium tape drives" on page 54
All IBM 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.

Related information

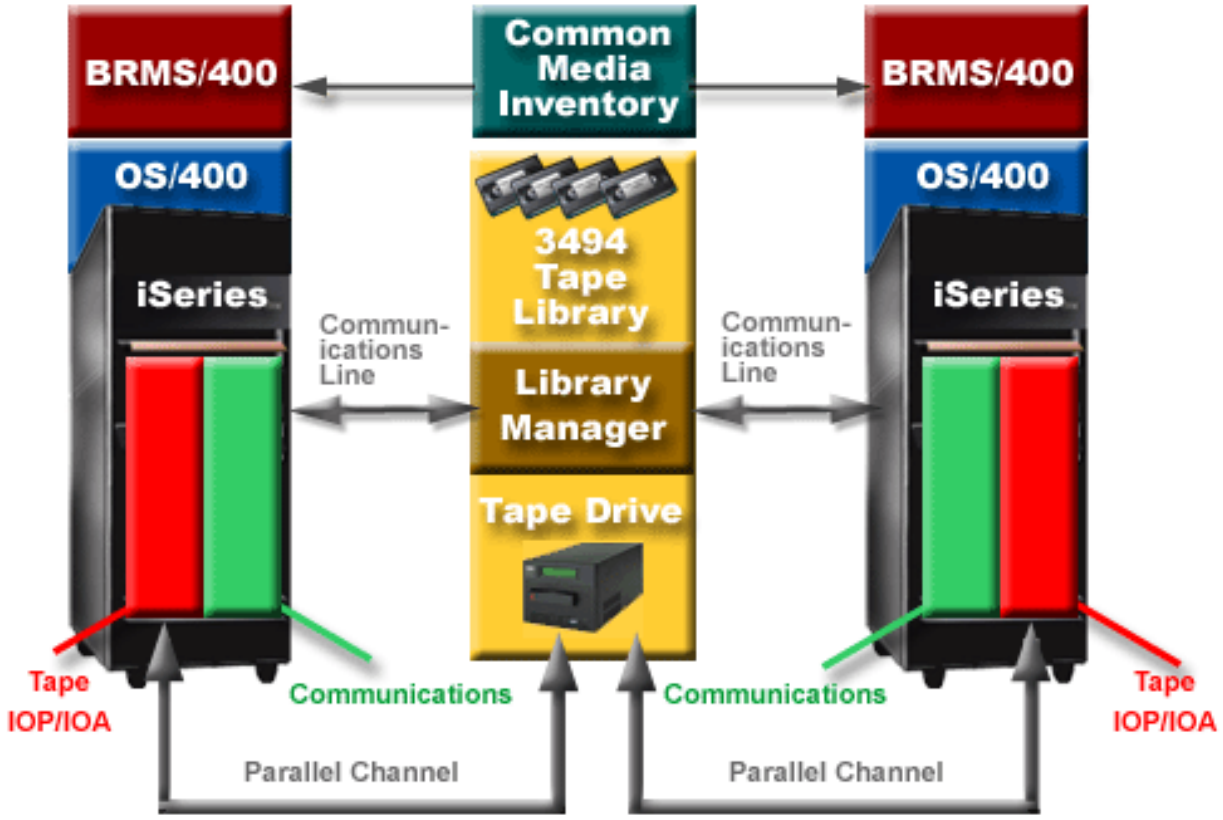
IBM TotalStorage Tape Libraries Guide for Open Systems

Multiple iSeries servers sharing a tape library

The IBM TotalStorage 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 server supports attachment to multiple 3494 IBM TotalStorage Enterprise Tape Libraries.

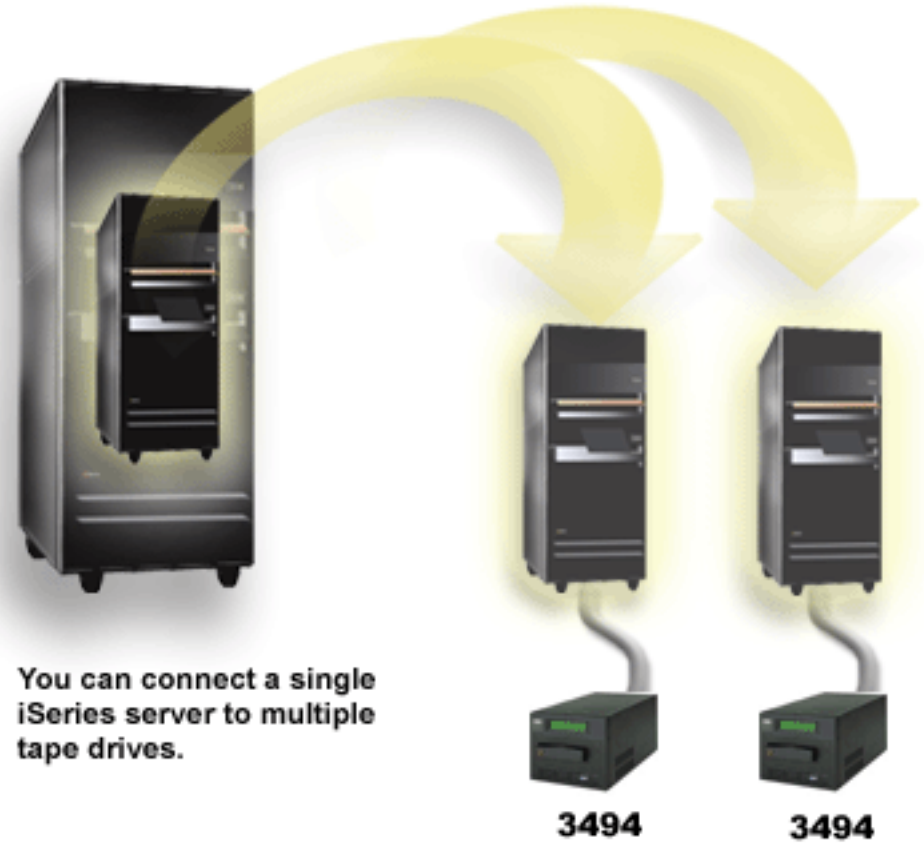
Each 3494 must have at least one communications line and at least one tape drive connection to the iSeries server. The number of 3494s that can be attached to an iSeries server depends on the number of tape IOP features that can be installed and supported on a given iSeries server. BRMS provides support for multiple 3494s attached to a single iSeries server.

Multiple tape drives in a 3494 Tape Library Dataserver

Larger iSeries 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.



The following figure shows an unsupported configuration. The cable attaches the iSeries server to the tape drives.
Figure 1. Supported configuration

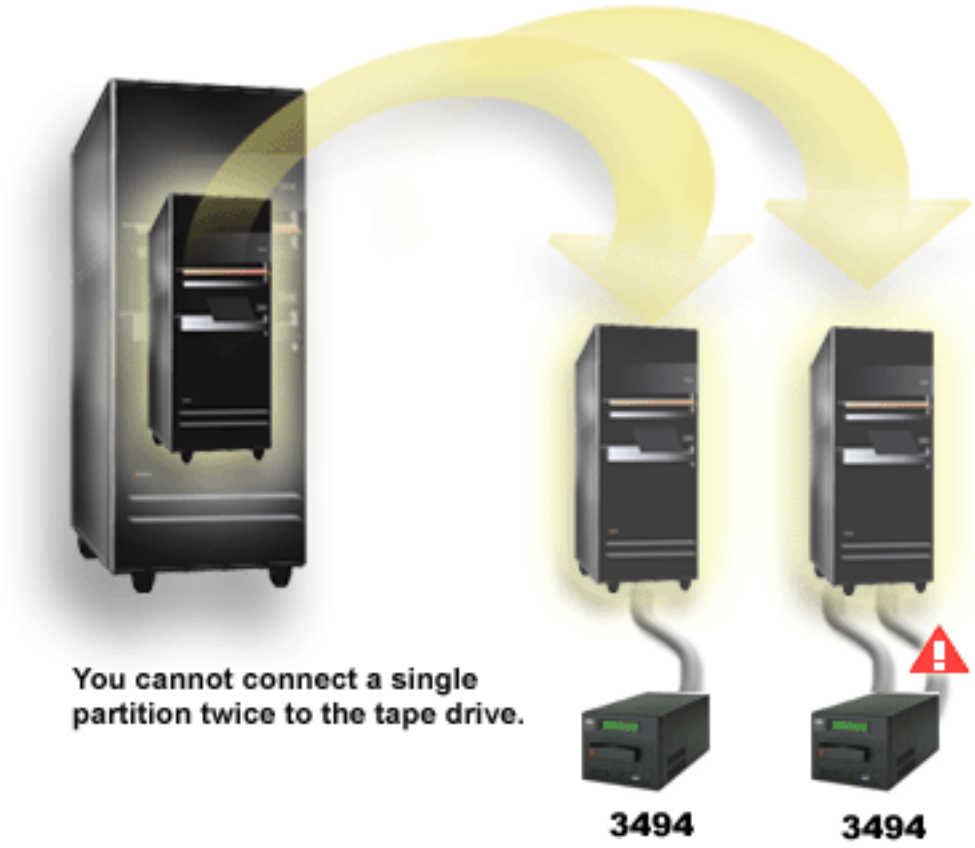


Figure 2. Unsupported configuration

Configurations of different platforms with the 3494 Enterprise Tape Library

The IBM TotalStorage Enterprise Tape Library 3494 can be shared by iSeries servers, pSeries servers and ES/9000® 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 server you have and which type of tape device you are installing.

Related tasks

Install iSeries features

Related information

Tape Storage Publications

Share servers with external drives

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.

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 server
- Two iSeries servers
- An iSeries server and a different server

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(TAPCTL`*xx*`) CFGTYPE(*CTL) STATUS(*ON) RANGE(*OBJ)`

Note: By using the code examples, you agree to the terms of the "Code license and disclaimer information" on page 170.

Configure the SCSI address for half-inch and Magstar MP tape units

For a 34*xx* or 35*xx* 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 34*xx* 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 server automatically configures and varies on an attached tape library.

Related concepts

"Set up a tape library as an alternate IPL device" on page 41
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. To be used for alternate IPL, the devices must be set to the correct address.

Related information

3490E Model F Tape Subsystem

3494 Tape Library

Magstar 3570 Tape Subsystem

Magstar 3575 Tape Library Dataserver

IBM 3581 Ultrium Tape Autoloader

IBM 3583 Ultrium Scalable Tape Library

IBM 3584 UltraScalable Tape Library

3590 Enterprise Tape System

Configure tape libraries

After you have set up the tape library and connected it to your system, the iSeries server automatically configures it.

The system creates a device description named TAPMLB *xx*, where *xx* is the next available device description number, and configures any associated tape resources (MLBRSC) and tape device descriptions (TAP *xx*). The system creates tape device descriptions for each tape resource. These tape device descriptions are used for stand-alone operations when the tape library is in stand-alone, auto, or manual mode, and for service.

Note: A tape device description is required for each device resource for the tape library device to operate properly.

Note: Drives with different capabilities within the same tape library must either be connected to separate IOAs, or the tape library must be partitioned so that each kind of drive is in a separate logical partition. There will be a separate tape library device description created for each kind of tape device within the tape library.

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 for more information.

Configure a 3494 tape library

The 3494 tape library supports connections to multiple 3490, 3590, and 3592 tape devices within the same physical unit. When the iSeries server configures these devices, it creates a unique device description for each kind of tape device in the physical 3494 tape library. When any 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 for a 3494 tape library 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 Add cartridges to the tape library inventory 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
- Cartridge assignment when the server name changes

Related concepts

"Create a data link" on page 28
A communication line must be created between the tape library and the library manager.

Related tasks

"Make cartridges available to the tape library inventory" on page 44
Before you can use the tape library, it must have media loaded and made available.

"Reassign cartridges when the system name changes" on page 40
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.

Add a tape library to a LAN

Several steps must be taken to add a LAN to your library.

To add the LAN host to the 3494 library, you will need the LAN connection information from the iSeries 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.

Related concepts

"Create a data link"
A communication line must be created between the tape library and the library manager.

Create a data link

A communication line must be created between the tape library and the library manager.

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 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.

Create a TCP/IP connection

To configure a LAN connection using TCP/IP to communicate to the 3494 Library Manager, use the following command:

To display the required LAN information about the iSeries, 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.

Note: By using the code examples, you agree to the terms of the "Code license and disclaimer information" on page 170.

Related concepts

"Add a tape library to a LAN" on page 27
Several steps must be taken to add a LAN to your library.

Related tasks

"Configure tape libraries" on page 26
After you have set up the tape library and connected it to your system, the iSeries server automatically configures it.

Related reference

Configure Device MLB (CFGDEVMLB)

Share tape library resources

Because library devices can be shared among multiple systems and users, it is possible to 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 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** → **Tape Devices** → **Hardware** → **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.

Related information

Tape and Optical Storage Publications

Use tape cartridges

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

You can use iSeries 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

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.

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.

Related tasks

"Format tape cartridges" on page 33
Use iSeries 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.

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 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 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 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.

To format a tape cartridge, perform the following steps:

Related tasks

"Duplicate tape cartridges" on page 32
You can duplicate tapes by using a tape library or a stand-alone device.

"Ensure tapes are in good condition" on page 50
This topic describes how to ensure that the tape cartridges are in good condition using the Work with Lifetime Statistics display.

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

This topic provides usage and management information for stand-alone tape devices.

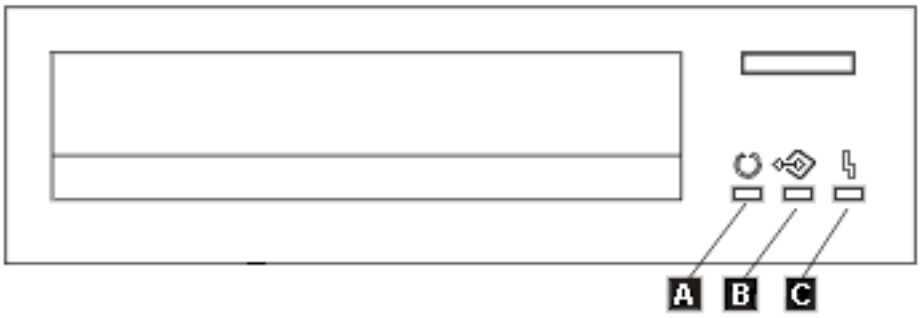
There are several types of tape cartridges and stand-alone tape devices that are commonly used on the iSeries server. See the operator's manual for your tape device for specific operating instructions. This topic provides information that is common for most stand-alone devices.

Status lights:

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.

Quarter-inch tape status lights:

This topic shows the status lights for the MLR3 and MLR1 tape units and provides information for interpreting the display.



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.

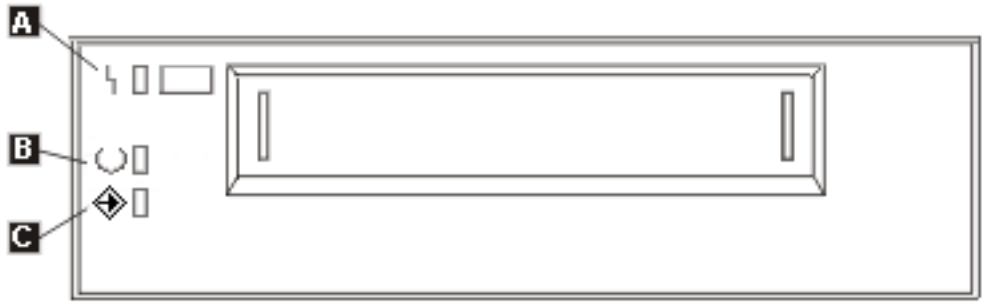
Symbol	Definition
A	Ready. This light indicates the following conditions: • Off - No cartridge installed or no fault condition • Green - Cartridge installed, loading or unloading • Green flashing - Power on self-test in progress
B	Activity. This light indicates the following conditions: • Off - No cartridge 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	Status light tests. (The status lights are on for 2 seconds when the power is turned on.)
	On	
	On	
	Flashing	Power up self-tests. Diagnostic cartridge activity.
	Off	
	Off	
	Off	Cartridge not loaded.
	Off	
	Off	
	Off	Cartridge not loaded. Cleaning required.
	Off	
	On	
	On	Cartridge loaded. No activity.
	Off	
	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	Cartridge loading or unloading
	Flashing	
	Off	
	Off	Cartridge loading or unloading. Cleaning required.
	Flashing	
	On	
	Off	Unrecoverable drive failure or microcode download failure.
	Off	
	Flashing	

Eight-millimeter tape status lights:

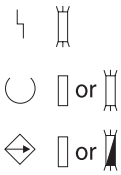
This topic shows the status lights for the MLR3 and MLR1 tape units and provides information for interpreting the display.



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 On On	The Power-on Self Test (POST) is running or the system has issued a reset to the drive. **Note:** The POST condition can occur either when the power is first applied or after use of the diagnostic cartridge.
	Off Off Off	One of the following has occurred: 1. The power is off. 2. The POST has completed successfully, but no tape cartridge was inserted.
	Off Off Flashing	A tape cartridge has been inserted and the tape drive is performing a tape load/unload operation.
	Off On Off	The tape load operation has completed and the tape drive is ready to receive commands from the system.
	Off On Flashing	The tape is in motion and the tape drive is busy running a device operation.
	Flashing Off Off	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.
	On Off or On Off or Flashing	The tape path requires cleaning.

View the capabilities of a stand-alone device:

Use iSeries navigator to view some of the capabilities for each stand-alone device.

- 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

This topic provides usage and management information for 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.

Tape library use without a media management application:

While a media management application greatly simplifies and extends a tape library's capabilities, you can perform many tape functions in an iSeries environment with commands included in i5/OS.

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)
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)

Task	Command
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.

Related information

Control language (CL)

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 on page 41, then exit.
2. **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 on page 40 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.

Related concepts

"Cartridge categories" on page 10
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.

Related tasks

"Configure tape libraries" on page 26
After you have set up the tape library and connected it to your system, the iSeries server automatically configures it.

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 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.

Related concepts

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

Set up a tape library as an alternate IPL device:

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. To be used for alternate IPL, the devices must be 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.

Related concepts

"Install tape libraries" on page 26
The iSeries server automatically configures and varies on an attached tape library.

Alternate IPL device

Backup, Recovery and Media Services

Related information

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. i5/OS 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.

Related information

Control language (CL)

Control tape library resources with APIs:

Use the QTARJMA and QTACJMA APIs to retrieve and to change the tape library attributes for a specific job.

For more information about the fields for the APIs, see:

- Retrieve Job Media Library Attributes (QTARJMA) API
- Change Job Media Library Attributes (QTACJMA) API

Special attention to authority requirements is required when retrieving and changing the resource allocation attributes. The following provides examples of using both APIs.

1. An application using the QTARJMA API retrieves information about the tape library attributes for the current job where the user running the job does not have *JOBCTL special authority.

   Current library attributes

MLB name	RSCALCPTY	INLMNTWAIT	EOVMNTWAIT
*DEFAULT	*DEV	*DEV	*DEV

2. The application then uses the QTACJMA API to change the initial mount wait time (INLMNTWAIT) and the end of volume mount wait time (EOVMNTWAIT).

   The application changes the library attributes

MLB name	RSCALCPTY	INLMNTWAIT	EOVMNTWAIT
*DEFAULT	*DEV	*IMMED	*NOMAX

3. A system administrator with *JOBCTL special authority uses the CHGJOBMLBA command to change the resource allocation priority (RSCALCPTY), initial mount wait time, and the end of volume mount wait time.

   System administrator changes attributes

MLB name	RSCALCPTY	INLMNTWAIT	EOVMNTWAIT
*DEFAULT	50	*IMMED	500

4. The application tries to use the QTACJMA API to restore the tape library attributes it retrieved earlier by using the QTACJMA API *REPLACE option. However, this function fails with an error message of CPF67B4 because the user does not have *JOBCTL special authority. None of the attributes are changed.

   Original application fails to restore attributes

MLB name	RSCALCPTY	INLMNTWAIT	EOVMNTWAIT
*DEFAULT	50	*IMMED	500

Related reference

Retrieve Job Media Library Attributes (QTARJMA)

Change Job Media Library Attributes (QTACJMA)

Make cartridges available to the tape library inventory:

Before you can use the tape library, it must have media loaded and made available.

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 convent 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 Navigator. When you make a cartridge available you must specify a category of media. Also, making a cartridge available changes the cartridge status.

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.

Related concepts

"Cartridge categories" on page 10
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.

"Cartridge status" on page 10
There are several possible types of status for a cartridge in relation to a tape library.

Related tasks

"Configure tape libraries" on page 26
After you have set up the tape library and connected it to your system, the iSeries server automatically configures it.

Related reference

Add Tape Cartridge (ADDTAPCTG)

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 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**.

Related reference

Remove Tape Cartridge (RMVTAPCTG)

Select tapes to eject:

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 i5/OS (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 i5/OS 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.

Related reference

Set Tape Category (SETTAPCGY)

Share cartridges:

You can share the cartridges in a tape library between multiple platforms and iSeries 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 i5/OS, i5/OS can read tapes written with this security flag in the tape label. When i5/OS 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 i5/OS tape functions.

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

Related concepts

"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, i5/OS supports a limited set of automation functions.

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, i5/OS 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 i5/OS 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.

Related concepts

"End of volume" on page 46
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.

Optimize tape library performance:

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.

Related information

Performance Management

View the capabilities of a tape library:

You can use iSeries navigator to view the capabilities for each tape library.

- 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 section contains topics that provide information about 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.

Tape drives require specific maintenance and environmental conditions to operate well over time. To avoid problems with your IBM 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.

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 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 tapes arrive in sealed cartridges 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 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.

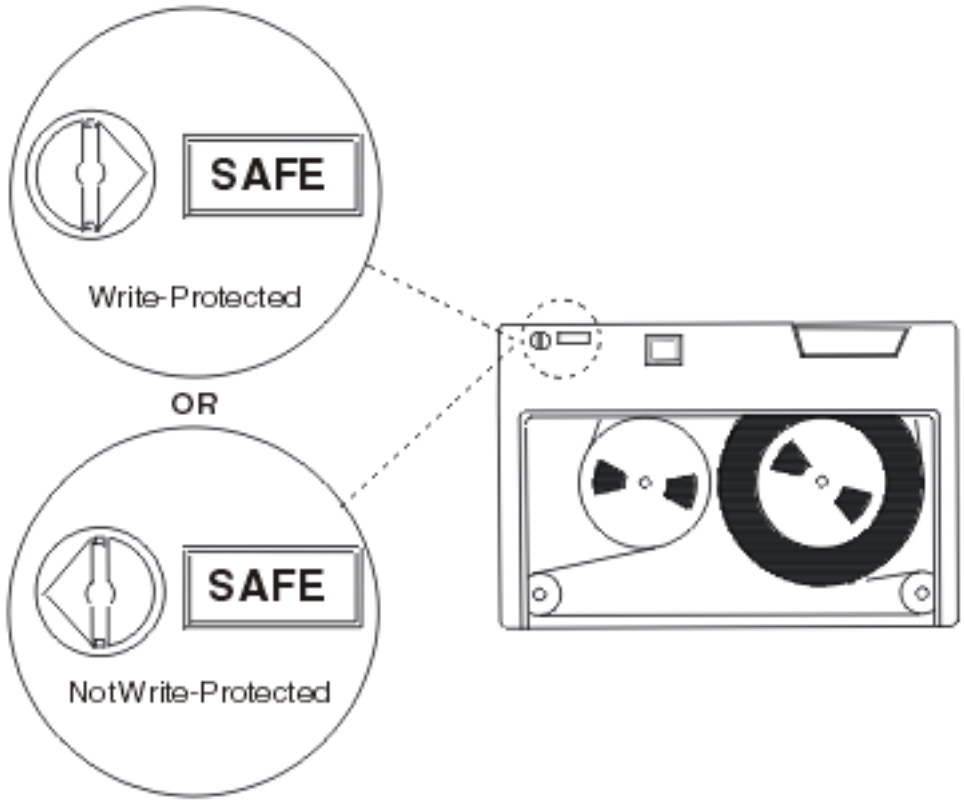


Figure 3. Write-protect positions for an older-style tape cartridge

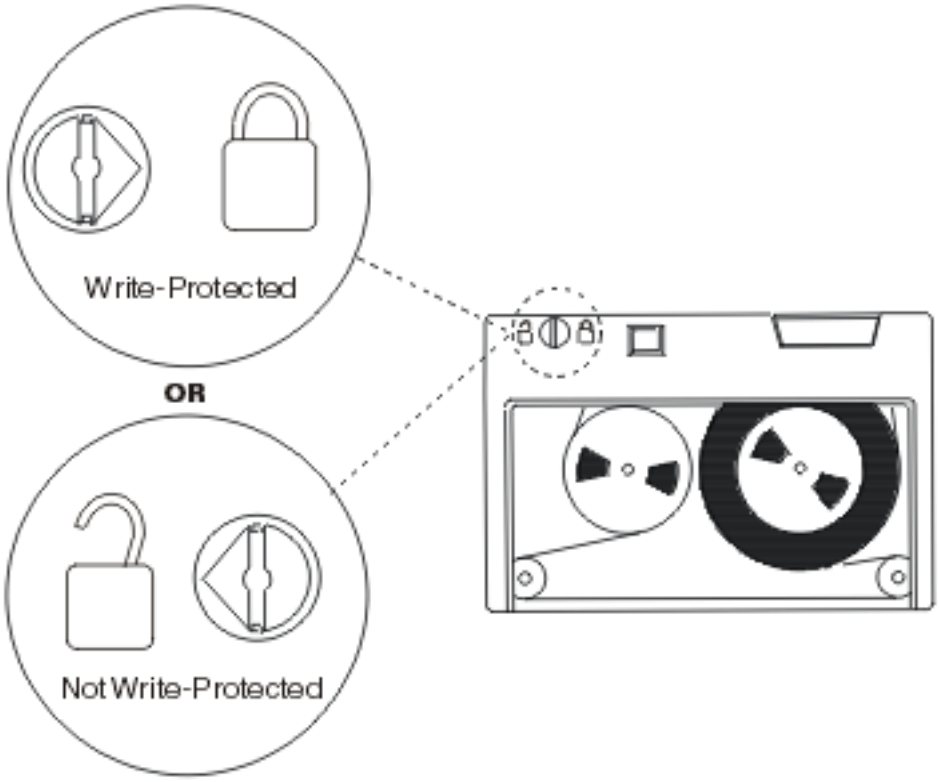


Figure 4. Write-protect positions for a newer-style quarter-inch tape cartridge

For information about your tape device, see Tapes Supported on iSeries. If your tape device is an LTO tape device, see IBM LTO Ultrium Tape Libraries Guide (SG24-5946).

Related information

Tapes Supported on iSeries

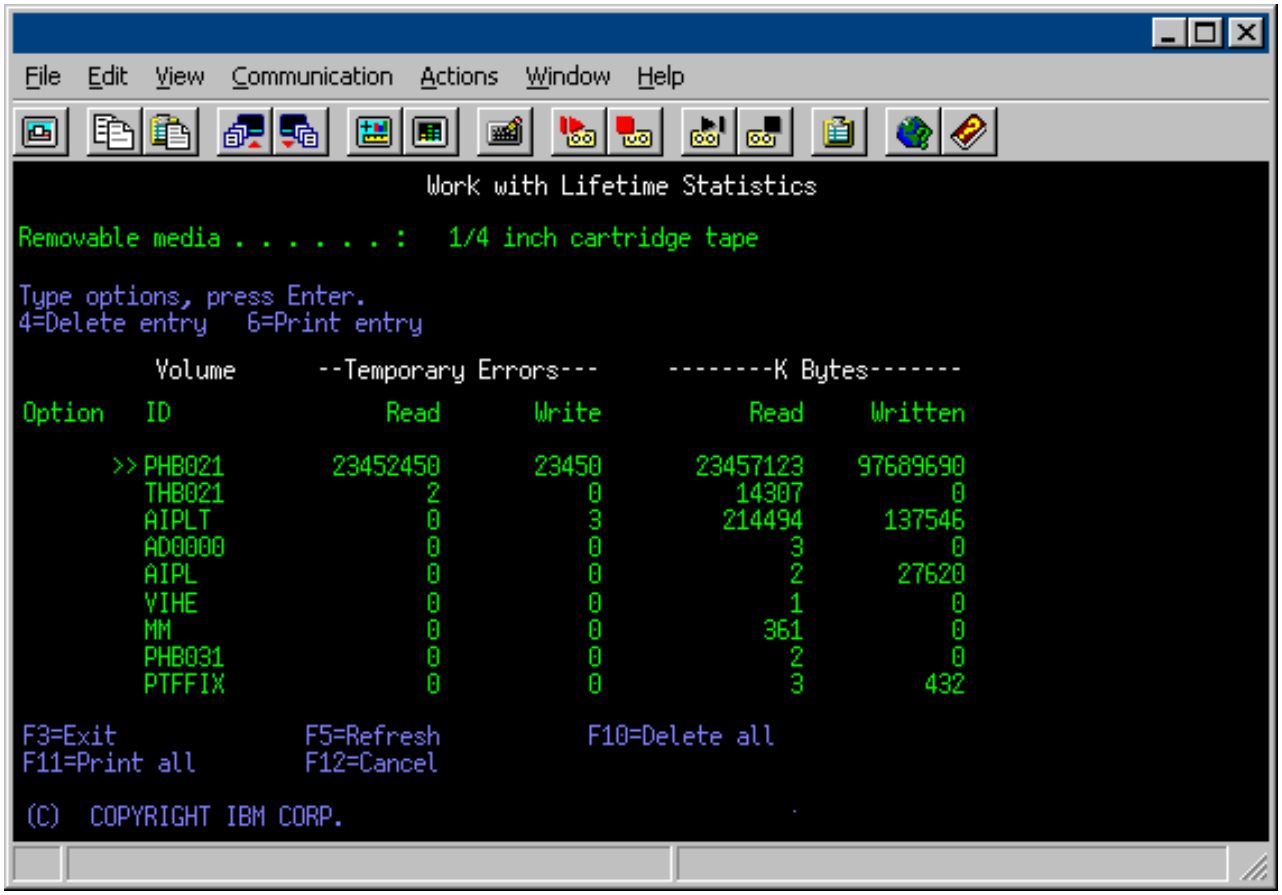
IBM TotalStorage Tape Libraries Guide for Open Systems

Ensure tapes are in good condition

This topic describes how to ensure that the tape cartridges are in good condition using the Work with Lifetime Statistics display.

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



Related tasks

"Format tape cartridges" on page 33
Use iSeries 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.

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

This topic provides information about keeping your tape drives clean.

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 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.

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 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 2 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
MLR1-S QIC-5010-DC	4483 4583 6383 6483	Best	Do not use

Tape unit identification		Cleaning cartridge part number	
Front bezel label	**Feature code numbers**	**35L0844**	**16G8572**
QIC-4GB-DC	4482 4582 6382 6482 7201-122	Best	Acceptable
QIC-2GB (DC)	6381 6481	Best	Acceptable
QIC-2GB	6380 6480	Best	Acceptable

Related concepts

"Quarter-inch cartridge and tape unit compatibility" on page 18
For full read-and-write capability, there are guidelines for determining which tape cartridges to use for each tape unit.

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

Related concepts

"Eight-millimeter cartridge and tape unit compatibility" on page 18
The iSeries supports several tape unit types.

Clean half-inch tape drives:

This topic provides information specific to cleaning 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 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 that are 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

Related concepts

"Half-inch and Magstar MP cartridges and tape unit compatibility" on page 20
This table shows which tape units and half-inch and Magstar MP cartridges are compatible.

Clean LTO Ultrium tape drives:

All IBM 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.

The following table shows cleaning cartridges for Ultrium tape devices.

Type	Cleaning cartridge part number
Ultrium 1	08L9124
Ultrium 2	35L2086
Ultrium 3	35L2086

Related concepts

"LTO cartridges and tape unit compatibility" on page 21
This table shows which Linear Tape Open (LTO) Ultrium tape units and cartridges are compatible.

Related information

IBM TotalStorage Tape Libraries Guide for Open Systems

Licensed Internal Code updates

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

This topic explains the importance of retention times 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

This topic provides an example of how to 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 device (MLD) . 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 (WRKMBLSTS) 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:

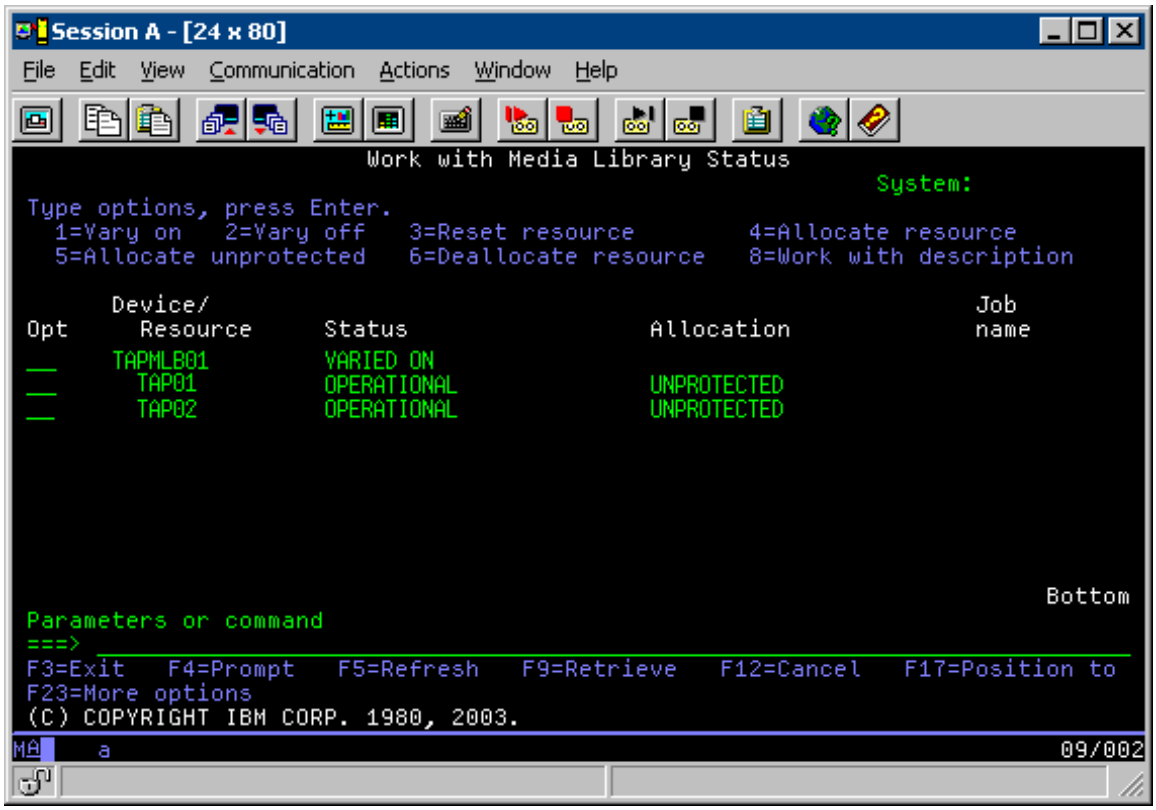


Figure 5. View of tape library TAPMLB01 from System A

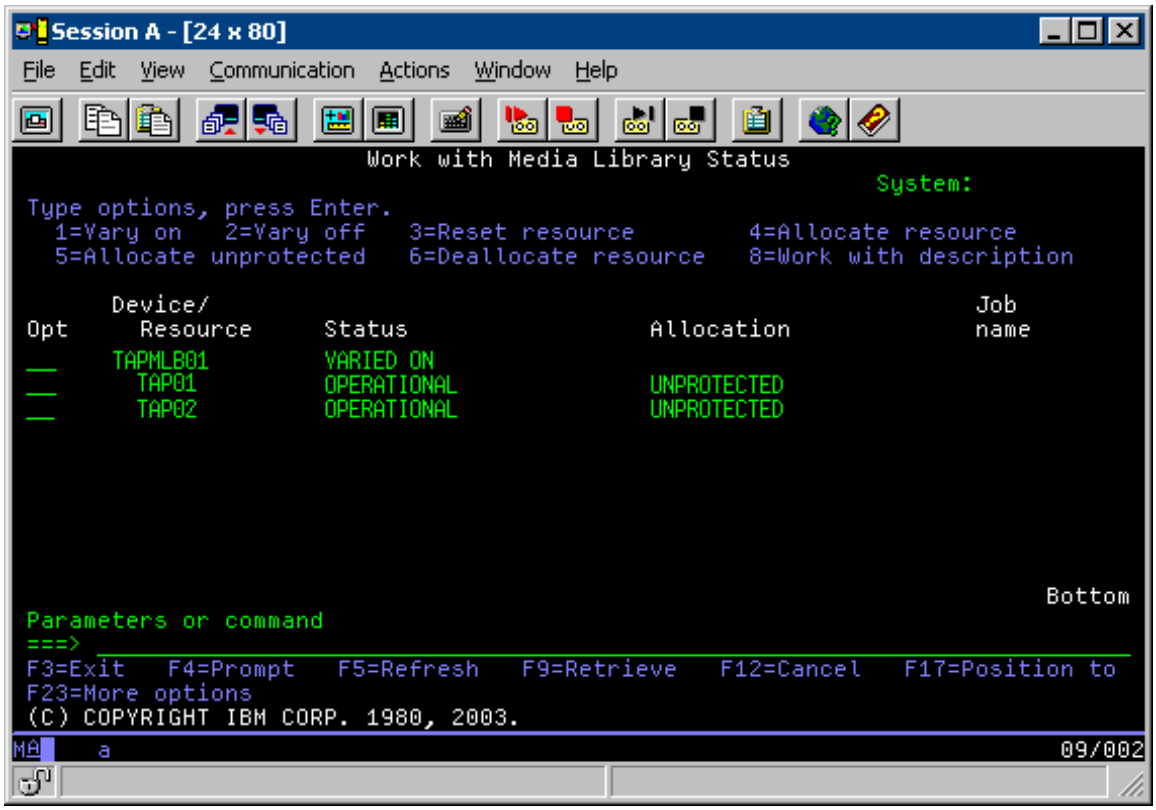


Figure 6. View of tape library TAPMLB01 from System A

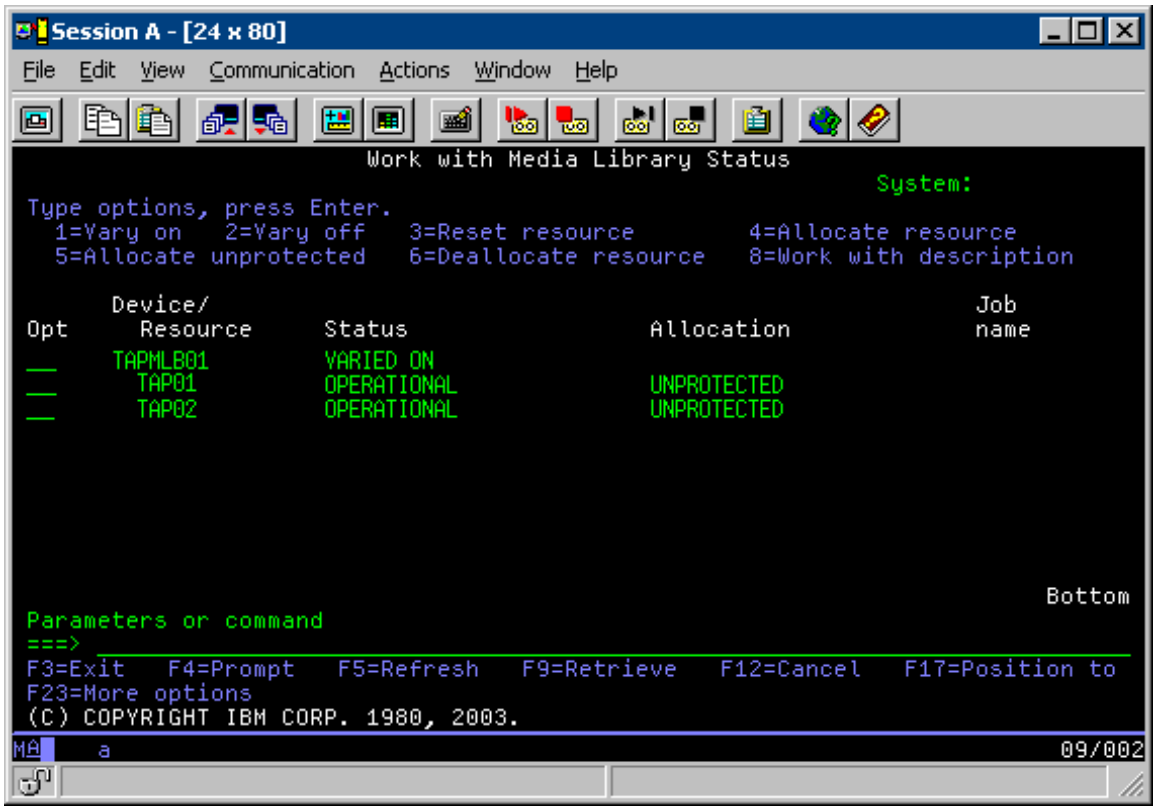


Figure 7. View of tape library TAPMLB01 from System A

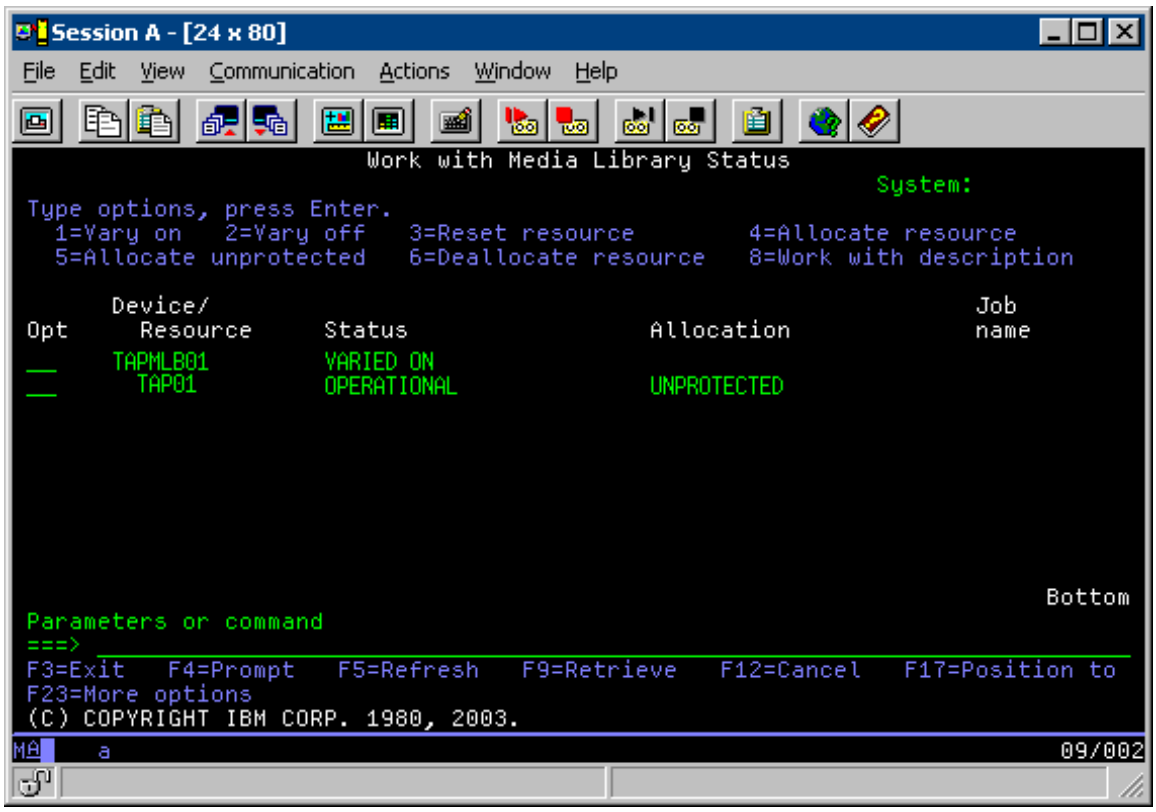
Related reference

Work with Media Library Status (WRKMBLSTS)

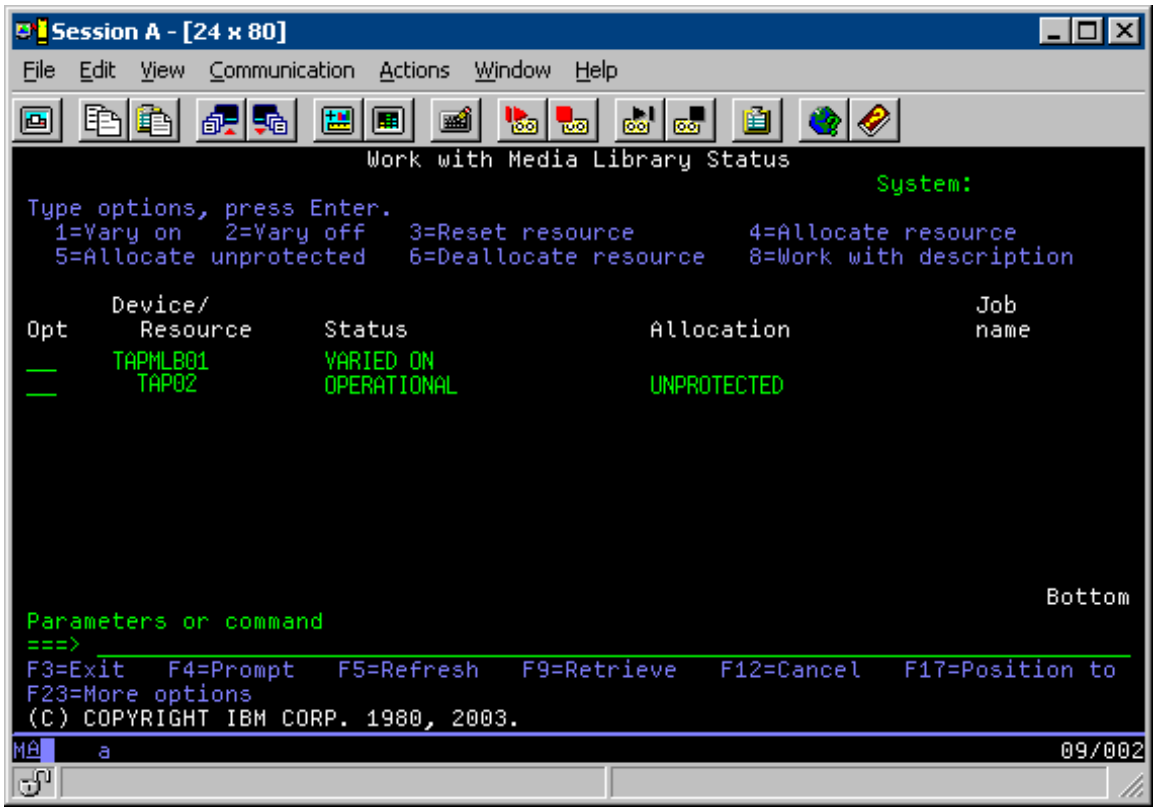
Related information

Backup Recovery and Media Services for iSeries

View of tape library TAPMLB01 from System B



View of tape library TAPMLB01 from System C



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 backup and recovery media services (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"
- "Use the resource selection sequence" on page 61
- "Use multiple tape library device descriptions" on page 62

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. Start the save operation on system B to ensure 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

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

Start time	Approximate complete time	Backup group	System	Device	Tape resource forced
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.	: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 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.

In order to accomplish this in the example, keep all the resources in UNPROTECTED status and change two backup groups. In this situation, you 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 on page 60. 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

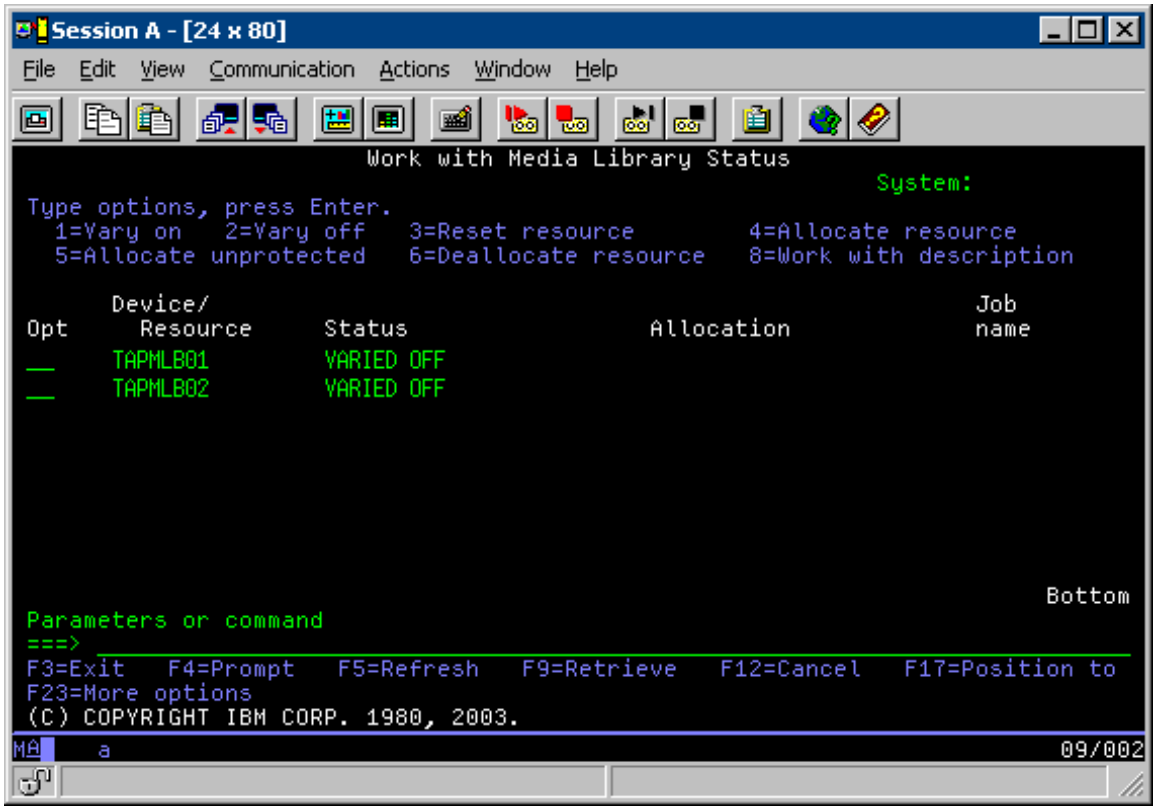
Start time	Approximate complete time	Backup group	System	Device	Tape resource forced
10:00 p.m.	1:00 a.m.	2	A	TAPMLB01	TAP01
10:00 p.m.	11:00 p.m.	5	C	TAPMLB01	TAP02

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

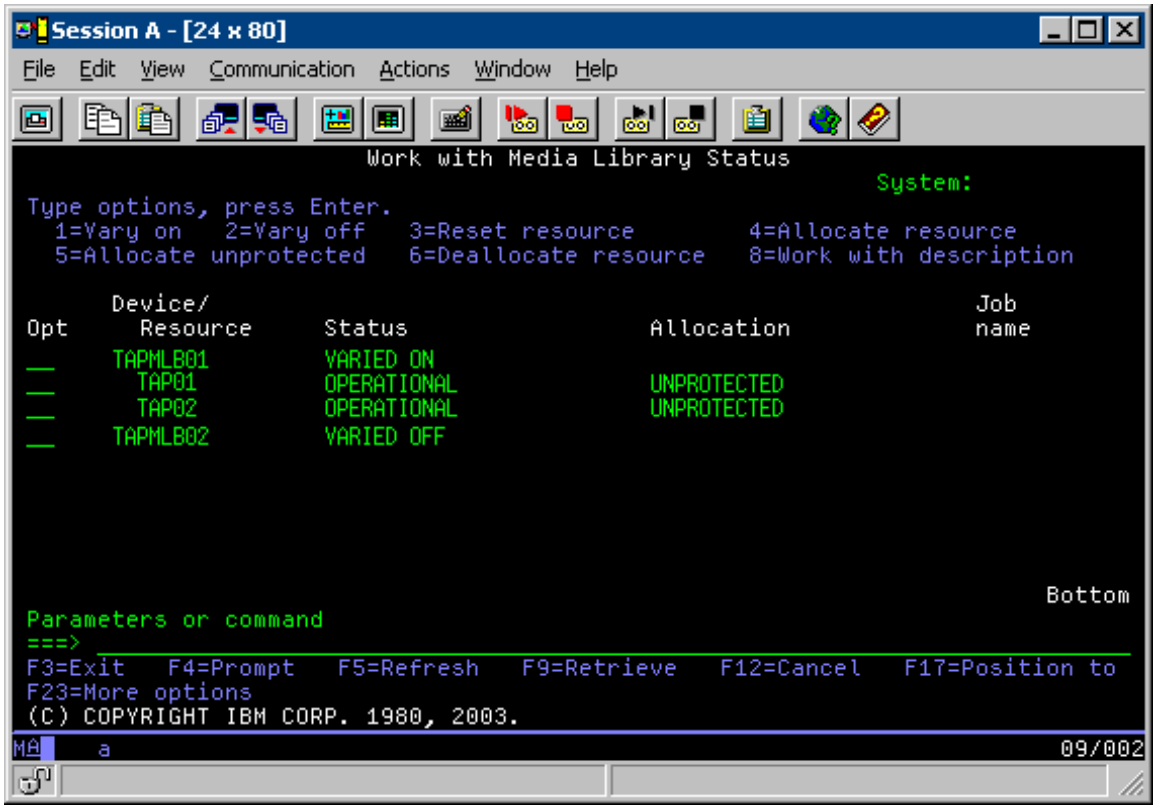
Start time	Approximate complete time	Backup group	System	Device	Tape resource forced
11:00 p.m.	1:00 a.m.	6	C	TAPMLB01	TAP02
1:00 a.m.	6:00 a.m.	1	A	TAPMLB01	TAP02 (TAP01 is busy on system B)
1:00 a.m.	4:00 a.m.	3	B	TAPMLB01	TAP01
4:00 a.m.	6:00 a.m.	4	B	TAPMLB01	TAP01

Use multiple tape library device descriptions

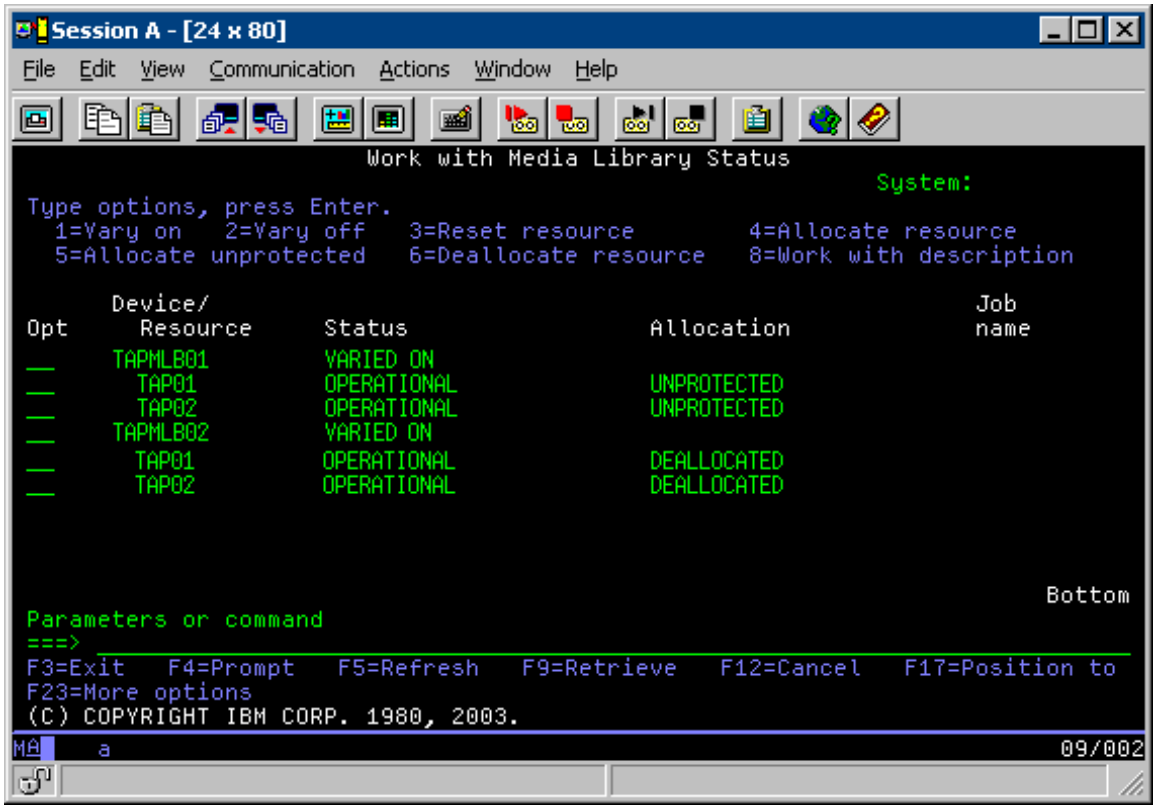
You can also use the multiple tape library device descriptions that are created when a tape library is configured. As each tape resource in a tape library reports to the iSeries server, a separate tape library description might be created. Typically, you should use one TAPMLB *xx* and assign all the 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.



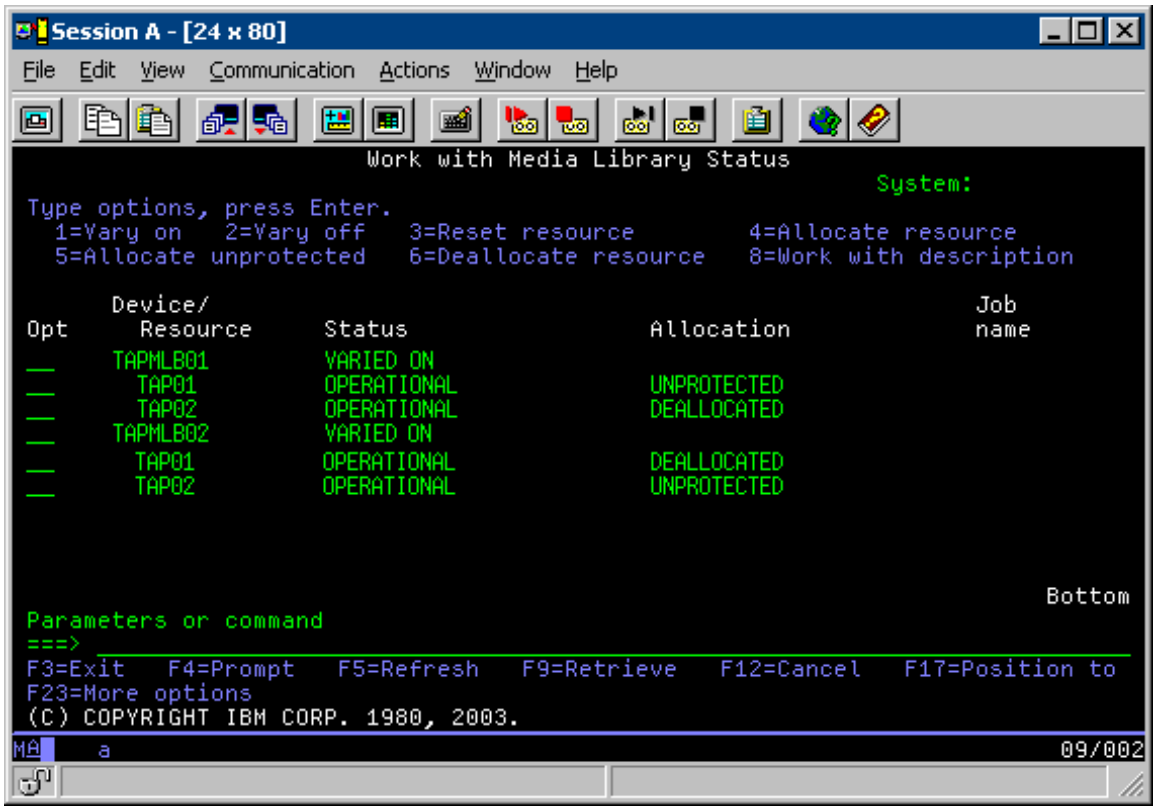
After the command CFGDEVMLB(TAPMLB01) is completed, you can see both resources under TAPMLB01, even though TAP02 actually generated TAPMLB02. Both resources are set to UNPROTECTED.



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.



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.



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

Note: By using the code examples, you agree to the terms of the "Code license and disclaimer information" on page 170.

Troubleshoot tape resources

These topics provide information for troubleshooting your tape resources.

Verify that your tape unit works correctly

This topic provides initial troubleshooting steps and explains how to verify that the tape unit is working correctly.

To clean the tape cartridge and 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 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

This topic provides information to collect the library data that a service technician needs to repair your tape library.

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

- The "Tape flight recorder" information.
- If you are using BRMS, collect the "BRMS flight recorder" information.
- If you are using a 3494 tape library, collect the "Library manager transaction logs" on page 66.

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

This topic provides information for handling problems for certain tape libraries.

The following are instructions for problem handling for the IBM TotalStorage 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 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.

Optical storage

This topic provides an overview and reference guide for IBM optical support on the iSeries server with the i5/OS operating system.

These functions that are unique to optical support:

- CD-ROM devices
- DVD devices Directly attached optical media library devices
- LAN-attached optical media library devices
- Virtual Optical devices

The information contained in this topic is intended for the following audiences:

- System operators and end users iSeries server operators and end users can use this information as their primary reference for CD-ROM, DVD, optical media libraries, and virtual optical support.

- Service representatives can use this information to perform activities as directed by the appropriate optical device service guides.

Optical storage on the iSeries server provides an economical and efficient way to store and retrieve large amounts of information at a high performance level. Optical storage devices offer significant advantages over other high-capacity storages devices, such as tape and microfilm, with faster access times and a hierarchical-type file organization. i5/OS optical storage uses files that are stored in directories and files that are stored in subdirectories similar to UNIX® or PC-based file systems.

The capacity, price, and performance of optical storage continually improve, and IBM remains committed to providing its customers with these improvements over time. Even as new devices are introduced, the basic methods of accessing optical information remain consistent, as these new storage devices are being added under the current file system interfaces that optical storage programs have used for years.

Optical Storage is 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 versatile disk read-only memory (DVD-ROM), digital versatile disk random access memory (DVD-RAM), write-once read-many (WORM) cartridges, and erasable optical cartridges. These are some considerations in the usage of optical storage media:

Table 4. Optical media considerations

Consideration	**Reason for use**
Durability	Optical media can have a shelf life in excess of 50 years
Archive Storage	Write-once read-many (WORM) optical media can be used to archive large amounts of data. Each sector on the media is only written once when creating and updating files and directories. When a file is changed or deleted, a new version of the file gets written, but the old version still exists on the media. All previous versions of the file remain recorded on the media. This capability also exists on erasable media, but the entire disk may be erased and reused.
Transportability	Optical media written with the Universal Disk Format (UDF) media format can be read with any other industry operating system platform that supports UDF, which is an industry standard file system. Optical Media written with High Performance Optical File System (HPOFS) format can be interchanged with other optical media libraries attached to iSeries.
Random access	Optical devices are random access devices. This facilitates the retrieval of relevant data on demand. File access is independent of the order in which the data was stored. Also, multiple users can access the same volume at the same time.

When you use virtual optical storage, you create and use optical images that are stored on your disk units. These optical images are treated as if they were real optical disk media by the internal file system functions. The term virtual applies to the emulation of the optical media sectors when used by read and write functions. Virtual optical media appear as *DVDRAM media in the volume information attributes.

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Related concepts

"Comparison of offline storage" on page 13
Offline storage is data that you save on media that is separate from the server.

Related information

Tape and Optical Storage

Supported Hardware for Optical Storage

A variety of hardware configurations for CD-ROM, DVD-ROM, and DVD-RAM are supported on server. The table below lists the stand-alone optical devices available as well as the media supported in each.

Table 5. Supported stand-alone optical devices

Device Type	Hardware Resource Type and Model	Device	Media Supported
6320/6321	6320-002/6321-002	CD-ROM	CD-ROM CD-R
7210-020	6321-002	CD-ROM Bridgebox External device	CD-ROM CD-R
6330 HH DVD-RAM	6330-002	DVD-RAM	CD-ROM CD-R[1] CD-RW[1,2] DVD-ROM DVD-RAM[4]
7210-025	6330-002	DVD-RAM Bridgebox External device	CD-ROM CD-R[1] CD-RW[1,2] DVD-ROM DVD-RAM
6336	6336-002	DVD-ROM	CD-ROM CD-R CD-RW[2] DVD-ROM DVD-R DVD-RAM[3]

Table 5. Supported stand-alone optical devices (continued)

Device Type	Hardware Resource Type and Model	Device	Media Supported
6331 Slim Rambo	6331-002	Slim Multi-Recorder	CD-ROM CD-R CD-RW[2] DVD-ROM DVD-R DVD-RAM[3]
6333 HH Rambo		IHH Multi-Recorder	CD-ROM CD-R CD-RW[2] DVD-ROM DVD-R DVD-RAM[5]
7210-030	6333-002	External device	CD-ROM CD-R CD-RW[2] DVD-ROM DVD-R DVD-RAM[3]
7212-102 Sam Bass	6330 6333 6336		CD-ROM CD-R CD-RW[2] DVD-ROM DVD-R DVD-RAM[3]
6337 Slim Line DVD-ROM		DVD-ROM	CD-ROM CD-R CD-RW[2] DVD-ROM DVD-R DVD-RAM[3]

1. Read support in DVD-RAM drive only.

2. Read support available at Version 5 Release 2 and later.

3. Read support for Type II DVD-RAM 4.7GB media with the media removed only.

4. Prior to V5R3, writes media in cartridge only. V5R3 on, writes media in or removed from cartridge.

5. Write support for Type II DVD-RAM 4.7GB media with the media removed only.

Optical media libraries come in a variety of configurations that are designed around the different forms of media and different connection options. Optical media libraries range from the single cartridge stand-alone model through models capable of holding 638 optical cartridges and twelve disk drives. Optical media libraries may be directly connected to the server for best functionality and performance, or may be connected through a LAN to allow independent access by PCs or other servers. Verify which adapter is appropriate for your model server and device interface.

Table 6. Currently Supported Optical Storage Devices

Model	Drive Type	Connection	Cartridge Capacity	Number of Drives
3431-705	Multi-Function	LAN	1	1
3995-A23	Multi-Function	LAN	16	1
3995-022	WORM	LAN	32	2

Table 6. Currently Supported Optical Storage Devices (continued)

Model	Drive Type	Connection	Cartridge Capacity	Number of Drives
3995-023	Multi-Function	LAN	32	2
3995-122	WORM	LAN	144	4
3995-123	Multi-Function	LAN	144	4
3995-C20	Multi-Function	LAN	20	1 or 2
3995-C22	Multi-Function	LAN	52	2
3995-C24	Multi-Function	LAN	104	2 or 4
3995-C26	Multi-Function	LAN	156	4 or 6
3995-C28	Multi-Function	LAN	258	4 or 6
3995-C40	Multi-Function	Direct	20	1 or 2
3995-C42	Multi-Function	Direct	52	2
3995-C44	Multi-Function	Direct	104	2 or 4
3995-C46	Multi-Function	Direct	156	4 or 6
3995-C48	Multi-Function	Direct	258	4 or 6
3996-032	Multi-Function	Direct	32	2
3996-080	Multi-Function	Direct	72 or 80	2 or 4
3996-174	Multi-Function	Direct	166 or 174	2 or 4
399F-100	Multi-Function	Direct	24-80	1-4
399F-200	Multi-Function	Direct	104-638	2-12

The following table lists all the Input/Output attachment adapters that you can use to attach Direct and LAN optical libraries to your server. You will need to verify which adapter is appropriate for your model server.

Table 7.

Library Connection Type	iSeries Feature Code	Description/Comments
Token Ring	2724	4/16Mbps
Ethernet	2723/4723	10Mbps
Ethernet	2838/4838	100/10Mbps
Direct	2621	No longer supported
Direct	2729	Supported
Direct	2749	Supported
Direct	5702, 5712	Supported
Direct	6534	Supported
Direct	5736	Supported

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 devices that multiple users can access concurrently.

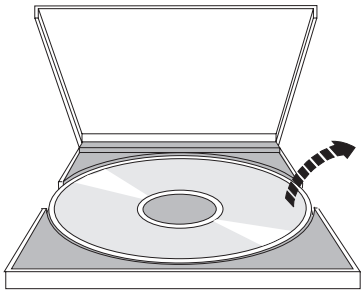
Note: Optical drives on the iSeries server are not enabled for the digital audio disk.

Related information

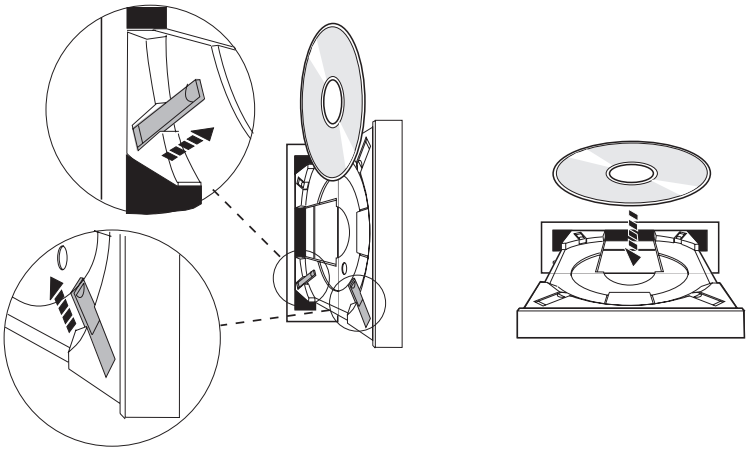
Optical Drives

Load and unload an optical disk

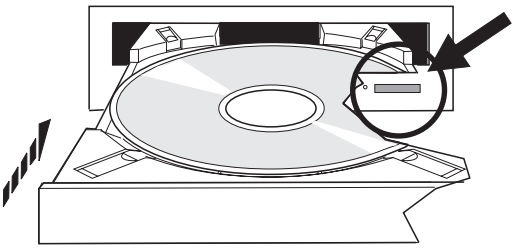
1. Look at the following figure and remove the disk from the protective case.



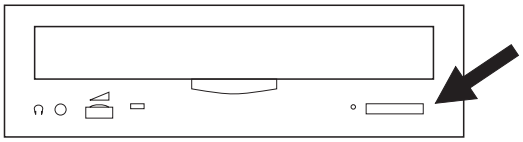
2. Slide the disk into the tray with the label side showing. If your optical device is vertically positioned, make sure that the disk is secured by the two tabs at the bottom of the tray as shown on the left in the following figure.



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.

Optical media libraries

The iSeries server supports both directly attached small computer system interface (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 3995 and 3996 Optical libraries as well as non-IBM optical library devices.

- Optical drives
- Tape and optical publications
- Optical support

Optical media types

Five categories of optical media are available to meet most storage requirements: CD-ROM, DVD-ROM, DVD-RAM, write-once read-many (WORM) optical cartridges, and erasable optical cartridges.

- CD-ROM is a read-only format that is optimized for read performance. CD-ROMs are ideal for wide-scale distribution of programs and data. The CD-ROM data format is identical to the one that is used with personal computers. This makes it possible to develop CD-ROMs for use in both personal computers and the iSeries server. You can read CD-ROMs in either a CD-ROM or DVD drive.
- DVD-ROM is a read-only format that provides a higher capacity than CD-ROM. Like CD-ROM, DVD-ROMs are excellent for wide-scale distribution of programs and data. You can only read DVD-ROMs in a DVD drive.
- DVD-RAM is writable optical media that is available in both double-sided (Type I) and single-sided (Type II) formats, ranging from 2.6 GB per cartridge to 9.4 GB per cartridge. Both types can be accessed in a DVD-RAM drive, and Type II media can be read in a DVD-ROM drive when the media is removed from the cartridge.
- WORM storage is an economical way to archive data, yet still have it quickly and easily accessible. WORM media is available in 1x (650 MB), 2x (1.3 GB), 4x (2.6 GB), 8x (5.2 GB), and 14x (9.1 GB or 8.6 GB) capacities. It is also available in 30 GB Ultra Density Optical (UDO).
- An erasable cartridge offers the most flexibility with similar capabilities as magnetic storage. Erasable media is available in 1x (650 MB), 2x (1.3 GB), 4x (2.6 GB), 8x (5.2 GB), and 14x (9.1 GB or 8.6 GB) capacities. It is also available in 30 GB Ultra Density Optical (UDO).

Both WORM and erasable cartridges must have a sector size of 1024 bytes per sector for 1x, 2x, and 4x media. For 8x media, permanent WORM must have a sector size of 2048. Continuous composite write-once (CCW), WORM, and erasable media can either be 1024 or 2048 bytes per sector. 14x media is available in CCW and erasable in 2048 or 4096 bytes per sector. UDO media is available in 8192 bytes per sector.

Directly attached optical media libraries

One method of connecting optical media libraries is to directly connect the optical media library to your iSeries server. A multi-wire cable connects the library to an I/O processor or I/O adaptor card.

Directly attached optical media libraries support the following functions:

- Hierarchical File System (HFS) application programming interfaces (APIs).

- Most integrated file system commands.
- Many i5/OS save and restore commands.
- Accessable by other LAN-connected iSeries servers by using the integrated file system.

Optical system configurations

All iSeries servers include a rack-mounted CD-ROM or DVD-ROM drive that is ideal for program and data distribution.

The CD-ROM or DVD-ROM drive is primarily intended as a program and data delivery device and, even though many users can potentially access it simultaneously, it can access only one media at a time.

A DVD-RAM drive is available to replace the existing read-only drive or to be added as another internal drive. This drive can read CD-ROM or DVD-ROM media, and can read or write DVD-RAM media. The CD and DVD drives supported on iSeries cannot be used to write to CD-R, CD-RW, DVD-R, DVD-RW, or DVD+RW media.

An optical media library is a device that contains at least one optical disk drive and may contain many optical cartridges. Optical media libraries can manage large numbers of optical cartridges and users.

Optical media libraries connect directly to your iSeries server. A multi-wire cable connects the library to an I/O processor or I/O adaptor card. Optical media libraries support all of the following functions:

- Hierarchical File System (HFS) application programming interfaces (APIs).
- Most integrated file system commands.
- Many i5/OS save and restore commands.
- Accessible by other LAN-connected iSeries servers by using the integrated file system.

Concepts for optical storage

This topic lists the commands available to system administrators and programmers through the primary menu.

You can display the primary menu for optical support by entering GO OPTICAL on the i5/OS command line. System administrators and programmers can access most optical commands through this menu. It is also convenient to enter many of the optical commands directly on the command line. These commands offer the following functions:

- Display optical volumes in an optical media libraby device (MLD), CD device, or DVD device.
- Display files and directories that are contained in any directory in any optical volume.
- Display the file attributes of any optical file.
- Import or export media in a directly attached optical media library, CD-ROM device, or DVD device.
- Make backup copies of a volume, directories, or files that are contained in a directly attached optical devices.
- Initialize a volume that is contained in a DVD-RAM drive or in a directly attached optical media library.
- Work with devices that represent optical media libraries, optical servers, CD drives, and DVD drives.
- Add, remove, or check the status of any LAN-attached optical server.
- Display active LAN-attached server conversations.
- Duplicate one optical volume to another.
- Copy files and directories from one optical volume to another.
- Check a volume for damaged directories and files.

When you enter GO CMDOPT on the command line, a complete list of optical commands appears. Many of these commands are accessible through the previous GO OPTICAL menu.

Optical volumes

All optical data is stored on a unit that is called a volume. This is true regardless of the type of media, the type of optical media library that is used, and the way the storage device connects to your system.

A single CD-ROM or DVD-ROM disk contains one volume. WORM and erasable optical cartridges are two sided and contain two volumes per cartridge (one per side). DVD-RAM can be either one sided or two sided.

Each volume has its own name that is chosen by the person who initializes the volume. The name chosen must be unique from the names of all other volumes on the system. Two volumes with the same name cannot be active at the same time. The volume name usually never changes after the volume is generated, although volume renaming is supported. The creator of the CD-ROMs and DVD-ROMs chooses the names, and the names cannot be changed.

HFS, the integrated file system, and the save and restore functions all use volume names to access or create data on the volume.

You can display and manage the optical volumes on an i5/OS by using the Work with Optical Volumes (WRKOPTVOL) command. The hierarchical file system and integrated file system include the volume name in their path name to select which volume to use. A typical optical path looks like this:

```
/QOPT/VOLUMENAME/MYDIR/MYFILE.EXT
```

Where:

- `/QOPT` is the name of the optical file system.
- `/VOLUMENAME` is the volume name that is chosen for the volume.
- `/MYDIR` is the name of a directory on the volume.
- `/MYFILE.EXT` is the name of a file in the directory.

Optical directories and files

Information on an optical volume is organized into units called directories and the basic element of optical storage is the optical file.

A directory is a logical partition that can contain files and other directories called subdirectories. Every volume contains at least one directory called the root directory. You are not required to have other directories below the root directory. Directories are a convenient way to keep files organized.

Any data that is available to application programs can be stored in or retrieved from optical files in the form of a data stream. Optical files have the following characteristics:

- Data is stored in a stream-file format.
- Data is independent of format and record structures.
- Data is accessed through byte offsets and lengths.
- Data is recognized and managed by the application that creates the file.

Volume identifiers

Loading a CD-ROM or DVD media into a drive causes automatic reading of the information from the media. Part of this information is the volume identifier.

The volume identifier is a name that was given to the CD-ROM or DVD-ROM when it was mastered. The identifier is also the name that is given to the DVD-RAM media when it was initialized. Depending on the media format, the volume identifier can be up to 32 characters in length. On the iSeries server,

applications accessing data from the CD-ROM or DVD often refer to it by its volume identifier. For example, a CD-ROM volume identifier might be VOLID01.

Applications that need to access file data from any optical media need to refer to the volume identifier. For example, you could write a C program to use the integrated file system APIs to read file /DIR1/FILE on the optical volume VOLID01. In this case, the application would specify path /QOPT/VOLID01/DIR1/FILE on the open request.

Optical media formats

i5/OS provides support for several optical media types and media formats.

The media format is the file system architecture that exists on the media to manage file, directory, and volume information.

Writable optical media (such as WORM, erasable, DVD-RAM) is initialized on i5/OS using the Initialize Optical (INZOPT) CL command. WORM media must use media format HPOFS. DVD-RAM media must use media format UDF. Erasable media may use either high performance optical filing system (HPOFS) or universal disk format (UDF) depending on the requirements of the user. You can specify the format by using the MEDFMT keyword on the INZOPT command. The following topic provide information about the different media formats and a comparison so users of erasable media can select the media format that best meets their requirements.

Related concepts

"Initialize optical volumes" on page 95
You must initialize the writable optical media before the system can create directories and files.

"Manage direcotry- and file-level security" on page 129
Directory and file-level security is available for volumes formatted in universal disk format (UDF).

"Optical save and restore" on page 137
The i5/OS Save and Restore CL commands support directly-attached optical media library devices, CD-ROM, DVD-ROM, and DVD-RAM stand-alone devices.

ISO 9660

This industry standard media format was originally designed to specify the volume and file structures of compact-disk read-only memory (CD-ROM) optical disks, and is a read-only media format.

The ISO 9660 format is used currently on CD and DVD read only media. i5/OS supports ISO 9660 media that is created using the primary volume descriptor (PVD). i5/OS does not support ISO 9660 extensions that use the supplementary volume descriptor (SVD).

In addition, there is some support for ISO 9660 extensions defined as the IEEE P1281 (System Use Sharing Protocol) and P1282 (Rock Ridge Interchange Protocol) specifications. These extensions are also known as Rock Ridge. i5/OS supports the Rock Ridge alternate name structures through the PVD. This support provides recognition and handling of mixed case and long file names, similar to a UNIX system. Other structures defined by Rock Ridge are not supported by i5/OS. To enable support to read Rock Ridge alternate name structure (if it exists), enter CHGOPTA EXTMEDFMT(*YES) prior to importing the media. If the Rock Ridge alternate name structures do not exist, entering this command will have no effect.

Volume, directory, and file names:

The volume identifier for the primary volume descriptor can be a maximum of 32 characters. The volume identifier must contain only alphabetic characters (A through Z), numeric characters (0 through 9), or the underscore (_).

Although not required, you can include one or more directories in the path name. Each element of the path can be a maximum of 32 characters with the total maximum path length of 256 characters. A path name can consist of any alphabetic characters (A through Z), numeric characters (0 through 9), or the underscore (_).

For ISO 9660 media containing Rock Ridge extensions, the length of each element name is not restricted, but the total maximum path length is still 256 characters. The path name characters are not restricted, but are recommended to consist of the POSIX portable file name character set (A through Z, a through z, 0 through 9, period (.), underscore (_), or hyphen (-)).

File name searches are not case sensitive, meaning that you can use either uppercase or lowercase characters to access existing files.

For ISO 9660 media containing Rock Ridge extensions, file searches are case-sensitive. If no case-sensitive match is found, a mixed case match is returned if it exists. If multiple mixed case matches exist on the volume, an error will be returned indicating that ambiguous names exist on the media. Some optical commands, such as Copy Optical (CPYOPT), are not supported when duplicate, ambiguous file names exist. For example Rock Ridge allows files ABC.ext and abc.EXT to exist in the same directory. This is not supported by CPYOPT and may produce unpredictable results.

Directory and file security

There is no direcotry- and file-level security for ISO 9660 media. Volume-level security is available through authorization lists.

Programming interfaces for ISO 9660:

The system can read files on ISO 9660 media by using either the hierarchical file system (HFS) application programming interface (API) or the integrated file system application programming interface (API).

High Performance Optical File System

High performance optical file system (HPOFS) is an IBM-developed media format architecture available to use when initializing optical media on the i5/OS.

i5/OS uses the WORM-based version of HPOFS. This media format is designed (and required) for WORM media, but you can use it (and it is the default) when initializing erasable optical media. HPOFS is a WORM media format. You can write each sector of the media only once when creating and updating files and directories. This unique characteristic of never rewriting the same sector allows all previous versions of every file to remain on the media. One drawback of this is that media consumption continues to grow as you update and even delete files.

This section contains detailed information on the i5/OS implementation of HPOFS for directly-attached optical media libraries. This section does not address HPOFS characteristics for LAN-attached optical media libraries.

Detailed information on the i5/OS implementation of HPOFS for directly attached optical media libraries is available in the CL command support for media formats.

Related concepts

"CL command support for media formats" on page 81
This topic provides information on using i5/OS commands to save and restore data and some of the restrictions for the ISO 9660, High Performance Optical File System (HPOFS), and universal disk format (UDF) media formats.

Volume, directory, and file names for HPOFS:

HPOFS volume identifiers can be a maximum of 32 characters and must contain only alphabetic characters (A through Z), numeric characters (0 through 9), a hyphen (-), or a period (.).

The first character of the volume identifier must be alphabetic or numeric and the identifier cannot contain imbedded blanks. Although not required, you can include one or more directories in the path name. Each element of the path can be a maximum of 255 characters with the total maximum path length of 256 characters. A path name can consist of any of the EBCDIC characters except hex 00-3F, hex FF, quotation marks (⌂), apostrophe (*), greater than symbol (<), less than symbol (>), question mark (?), and slash (\).

The system stores all alphabetic characters for directory and file names to the media in uppercase. File name searches are case-insensitive meaning that you can use either uppercase or lowercase characters to access existing files.

Directory and file security

There is no directory and file-level security for high performance optical file system (HPOFS) media. Volume level security is available through authorization lists.

Space reclaim:

You can update or delete files even though HPOFS is a write-once read-many (WORM) media format.

When a file is changed or deleted, a new version of the file is written, and the old version still exists on the media. This is true for both WORM and erasable media. The old file versions will always exist on WORM and will exist on erasable until the entire volume is reinitialized. When you change or delete a file, the system does not reclaim the space that was used by the old file. Media consumption continues to increase on HPOFS media until you reinitialize the volume (for erasable media). You can never reclaim deleted space for WORM

Programming interfaces (HPOFS):

You can create or read files on HPOFS media by using either the Hierarchical File System (HFS) application programming interface (API) or the integrated file system application programming interface (API).

The following are items specific to the i5/OS implementation of the HPOFS media format that application developers need to know.

National Language Support

The integrated file system interfaces assume that the coded character set identifier (CCSID) represents the path in effect for the job. The system then converts the path from the job CCSID to an internally used CCSID. The HFS interface makes no assumption about the CCSID of the path; therefore, the system performs no character set conversion on the path. This could produce undesirable side effects if an application used the two API sets interchangeably or if the application changed from using one API set to the other.

A program should not create files through HFS and then try to read them by using the integrated file system APIs. Depending on the characters that are used in the path name, this could result in a `File not found` error. This type of problem can be avoided if the application uses only invariant characters (for example A-Z 0-9 + = % & ( ) , _ . : ;) for path names. Invariant characters are graphic characters that map to the same code point in all character sets.

Held optical files

When the system writes an optical file that it cannot close normally, the system may create a held optical file. The held file exists on i5/OS internal disk storage and contains the data written to the file. You can then save or release the held file through an API or command interface. The system creates held files only when files fail to archive on HPOFS media.

Synchronous writes

You can open files on HPOFS through HFS by specifying that all write operations be synchronous. When specified, write operations will be synchronous to i5/OS internal disk storage, not to the optical media. In the event of a power failure the data is recoverable from a held optical file.

Similarly for the HFS Force Buffered Data API and the integrated file system fsync() API, data will be forced to i5/OS internal disk storage, not to optical. Again, in the event of a power failure, the data is recoverable from a held optical file.

File sharing

Multiple jobs or threads can share files. The system fully recognizes files that share modes as specified on the open request. For example, assume that a job opens a file that specifies it to share only with readers. This means that you can perform other opens only as long as the access requested remains read only.

Extended file attributes

The system supports extended file attributes for files on HPOFS media. Extended attributes can be written to files using the HFS Change Directory Entry Attributes API as well as through some integrated file system interfaces.

Directory structure and performance (HPOFS):

HPOFS volumes have a dual directory structure to access files. Both a hash and hierarchical structure exist to provide a primary and secondary path to the file data. If the primary directory structure becomes damaged, the secondary path is used.

The hash directory structure is designed to reduce the amount of media I/O required, which improves performance for file access. Because of this hash directory structure, directory depth has less effect on performance than if the directory were searched hierarchically. For example, if /DIRECTORY1 contains 1000 files and /DIRECTORY2 contains 100 files, file search times for files in /DIRECTORY1 will generally take no longer than file searches in /DIRECTORY2. This is because the system performs the searches by using the hash structure, not the hierarchical structure.

Directory depth has less effect on performance for a hash search than for a hierarchical search. However, the overall directory depths and total number of files on a volume will effect performance. In general, a volume with fewer files on it will result in better file performance than a volume with more files.

Media interchange between LAN and direct attach libraries:

This topic lists how HPOFS formatted optical media created in a LAN-attached optical library can be accessed.

HPOFS formatted optical media created in a direct-attached optical library can be accessed in a LAN-attached optical library assuming that the media type is supported. Conversely, optical media created in a LAN-attached optical library can be accessed in a direct-attached if the media type is WORM or re-writable. Re-writable optical volumes initialized as re-writable media are not interchangeable between LAN and direct attached libraries. UDF formatted optical media created in a direct-attached optical library cannot be accessed in a LAN-attached optical library device.

Universal disk format

UDF (Universal Disk Format) is the OSTA (Optical Storage Technology Association) supported subset of ISO/IEC 13346.

UDF also addresses ECMA-167 which is equivalent to ISO 13346. UDF is a writable file format that provides true space reclaim capabilities as well as file and directory level security. This section contains detailed information on the i5/OS implementation of UDF for direct-attached (C4x) 3995 optical media libraries as well as a DVD-RAM device.

Note: Although not accessible through i5/OS, CD and DVD media that are created using the supplementary volume descriptor of ISO 9660 may be accessible in an iSeries server. You can access them through an integrated server. For more information, see the *Windows® environment on iSeries* and *Linux® on an Integrated xSeries® Solution* topics.

Volume, directory, and file names:

Volume identifiers can be a maximum of 30 characters and must contain only alphabetic characters (A through Z), numeric characters (0 through 9), a hyphen (-), or a period (.). The first character must be alphabetic or numeric, and the identifier cannot contain imbedded blanks.

Although not required, you can include one or more directories in the path name. Each element of the path can be a maximum of 254 characters with the total maximum path length of 256 characters. A path name can consist of any of the EBCDIC characters except x00-x3F, xFF, ⌂, *, <, >, ?, and \.

The system stores all alphabetic characters for directory and file names to the media in uppercase when created through HFS or the i5/OS save interfaces. The system stores all alphabetic characters for directory and file names to the media in mixed case when created through the integrated file system interfaces. File name searches are case-insensitive meaning that you can use either uppercase or lowercase characters to access existing files.

File searches on UDF volumes created by i5/OS are case-insensitive. For UDF media created or updated by another operating system platform, a case sensitive search is performed. If no case-sensitive match is found, a case-insensitve match is returned if it exists. If multiple case-insensitive matches exist on the UDF volume, an error will be returned indicating that ambiguous names exist on the media. Some optical commands, such as Copy Optical (CPYOPT), are not supported when duplicate, ambiguous file names exist. For example, UDF created on another operating system may allow files ABC.ext and abc.EXT to exist in the same directory. This is not supported by CPYOPT and may produce unpredictable results.

Programming interfaces UDF:

You can create files or read files on UDF media by using either the Hierarchical File System (HFS) application programming interface (API) or the integrated file system programming interface. There are things specific to the i5/OS implementation of the UDF media format that application developers need to know.

National Language Support

The integrated file system interfaces assume that the CCSID (coded character set identifier) represents the path in effect for the job. The system then converts the path from the job CCSID to an internally used CCSID. The HFS API interface makes no assumption about the CCSID of the path; therefore, the system performs no character set conversion on the path. This could produce undesirable side effects if an application used the two API sets interchangably or if the application changed from using one API set to the other.

You should not create files through HFS and then try to read them by using the integrated file system APIs. Depending on the characters that are used in the path name, a File not found error could result. This type of problem can be avoided if the application uses only invariant characters (for example, A-Z 0-9 + = % & ( ) , _ . : ;) for path names. Invariant characters are graphic characters that map to the same code point in all character sets.

Since UDF is an industry-standard media format, NLS compliance could be important because of the increased opportunity for media interchange across different operating system platforms. This causes the system to limit HFS interfaces to UDF media. Additionally, the system uses invariant characters to reduce the chance of media interchange problems that are related to file names. Assume that an HFS-based application absolutely requires the use of variant characters. You can use the Change Optical Attributes (CHGOPTA) CL command to allow variant characters through the HFS interface by specifying CHGOPTA ALWVRNT(*YES). After the system allows variant characters through HFS, there is no guarantee that path names will interchange correctly if

accessed from another operating system. There is also no guarantee that path names will be consistent between the HFS and integrated file system interfaces.

Held optical files

The system does not create held files for UDF media. When a file fails to close on UDF, the system signals an error to the application. This error then closes the file without writing the data to optical disk. The application must rewrite the file (open, write, close) to ensure that the data is on optical disk. The exception to this is if the application did a Force Buffered Data or fsync() API (QHFFRCSF) prior to the close operation.

These APIs will force the writing of the data to the optical disk.

File sharing

Multiple jobs or threads can share files for read, but writers are always exclusive. If one job or thread is writing to a file on UDF, you cannot use any other jobs or threads to open that file.

Therefore, when using integrated file system open() or open64() APIs, the sharing modes O_SHARE_RDONLY, O_SHARE_WRONLY, and O_SHARE_RDWR do not provide the requested level of sharing when the access mode is O_RDWR or O_WRONLY. When the access method is O_RDWR or O_WRONLY, the resulting sharing mode will be equivalent to O_SHARE_NONE.

When using the HFS Open Stream File API, the lock modes deny none, deny write, and deny read do not provide the requested level of sharing when the access mode is write only or read/write. When the access method is write only or read/write, the resulting lock mode will be deny read/write.

Mixed-case file name

When created through the integrated file system interfaces, files and directories created on UDF volumes will preserve the case specified on the create. For example, if file Abc is specified on the open() API, Abc will be created on the media in the mixed-case form. Even though the system preserves file case, file searches are case-insensitive meaning that the system can read the file that uses any case such as ABC or abc.

When created through the HFS or save and restore interfaces, the system stores files and directories that are created on the UDF volumes in uppercase. For example, if you specify file Abc on the Open Stream File API, the system creates ABC on the media. Again, file searches are case-insensitive so you can specify any case to read the file.

File searches on UDF volumes created by i5/OS are case-insensitive. For UDF media created or updated by another operating system platform, a case sensitive search is performed. If no case-sensitive match is found, a case-insensitve match is returned if it exists. If multiple case-insensitive matches exist on the UDF volume, an error is returned indicating that ambiguous names exist on the media.

Directory and file security:

Directory and file-level security is available for UDF volumes. The system maintains the data authorities of optical directories and files for three groups of users; owner, group, and public. Volume level security is also available through authorization lists.

Directory and file-level security is not guaranteed when volumes are removed and transported to and from other systems. Security information recorded in the UDF structures on the media may not have the same meaning on another system as it does on the system where it was written.

Related concepts

"Manage optical security and auditing" on page 126
You can secure information on optical media by using i5/OS security functions.

"CL command support for media formats"
This topic provides information on using i5/OS commands to save and restore data and some of the restrictions for the ISO 9660, High Performance Optical File System (HPOFS), and universal disk format (UDF) media formats.

Media interchange:

UDF media created on i5/OS is UDF Version 2.01. This media will interchange to other operating system platforms that support this version of UDF.

UDF-compliant media that is created with UDF Version 1.5 or less is accessible by i5/OS as read only. Media created with UDF Version 2.0 and UDF 2.01 is accessible by i5/OS for read and write.

Directory structure and performance UDF:

UDF volumes have a single (hierarchical) directory structure to access files. Because of this hierarchical directory structure, the depth of a directory tree has a direct impact on file performance. For example, if /DIRECTORY1 contains 1000 files and /DIRECTORY2 contains 100 files, file search times for files in /DIRECTORY1, in general, take longer than file searches in /DIRECTORY2. This is because the system performs file searches hierarchically, which may require looking at every entry in the directory.

In general, file performance is better for UDF if you evenly distribute files across several directories and subdirectories.

CL command support for media formats

This topic provides information on using i5/OS commands to save and restore data and some of the restrictions for the ISO 9660, High Performance Optical File System (HPOFS), and universal disk format (UDF) media formats.

ISO 9660
You can use i5/OS restore commands to restore data from ISO 9660 media. This is true only when the media was correctly mastered from a save image on tape. There are some restrictions on which optical commands are supported for ISO 9660 media.

HPOFS
i5/OS save and restore commands can be used to save and restore data on HPOFS optical media. Refer to Appendix B, "Optical Save and Restore," on page 129 for more information about save and restore to HPOFS volumes. There are no restrictions on which optical commands the system supports for the HPOFS media.

UDF i5/OS save and restore commands can be used to save and restore data on UDF optical media. There are some restrictions on which optical commands are supported to UDF volumes. For example, the system does not support Work with Optical Directories (WRKOPTDIR) and Work with Optical Files (WRKOPTF) commands. The Display Optical (DSPOPT) command has some restrictions when used for UDF volumes. You should use the integrated file system commands Work with Object Links (WRKLNK) and Display Object Links (DSPLNK) instead of the optical commands.

Some optical commands have no meaning when used with certain optical media formats. No support exists for other commands with certain optical media formats. This table lists all of the volume-related optical commands and the media formats to which they apply.

Command	ISO 9660	UDF	HPOFS-Attached device	HPOFS in LAN-Attached Device
CHGOPTVOL	Partially supported [1]	Partially supported	Supported	Partially supported
CHKOPTVOL	Supported	Supported	Supported	Not supported

Command	ISO 9660	UDF	HPOFS-Attached device	HPOFS in LAN-Attached Device
CPYOPT	Supported	Supported	Supported	Not supported
CVTOPTBKU		Supported		
DSPOPT	Supported	Partially supported	Partially supported	Partially supported
DSPOPTLCK	Supported	Supported	Supported	Partially supported
DUPOPT	Not Supported	Supported	Supported	Partially supported
INZOPT		Supported	Supported	Not supported
WRKHLDOPTF		Supported		Not supported
WRKOPTDIR	Supported	Supported	Not supported	
WRKOPTF	Supported	Supported	Not supported	Partially supported
WRKOPTVOL	Supported	Supported	Supported	Partially supported
1. Partially supported indicates that not all command parameters may apply when used with the indicated device.				

Related concepts

"High Performance Optical File System" on page 76
High performance optical file system (HPOFS) is an IBM-developed media format architecture available to use when initializing optical media on the i5/OS.

"Directory and file security" on page 80
Directory and file-level security is available for UDF volumes. The system maintains the data authorities of optical directories and files for three groups of users; owner, group, and public. Volume level security is also available through authorization lists.

Configure optical devices

This topic provides information on configuring your CD-ROM, DVD-ROM, DVD-RAM devices, and optical medial libraries. iSeries servers come 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.

Directly attached optical media libraries are attached to the iSeries system through the small computer system interface (SCSI). On i5/OS, multiple users can access data on optical media libraries concurrently. These interfaces are available to access the data on the CD and DVD devices and optical media libraries:

- Save and restore interface
- Hierarchical file system (HFS)
- Application programming interface (API)
- Integrated file system interfaces
- Optical commands and utility displays

Note: The CD-ROM and DVD-ROM drives on the iSeries server are not enabled for the digital audio disk format.

Connectivity of non_IBM library devices

In addition to IBM optical libraries, you can now attach some non-IBM optical library devices to iSeries. For more information on which devices are supported and system configuration requirements, see the Optical Storage web site.

Configure your optical drive

Depending on the model of iSeries server, you can position the CD-ROM or DVD drive either horizontally or vertically in the system.

Before you use the CD-ROM or DVD drive, you must have a device description for it. The system can create the device description automatically during an IPL if auto-configuration is on. Alternatively, you create it manually by using the Create Device Description Optical (CRTDEVOPT) command. Either method is acceptable. Once you create the device description, you can vary the configuration by using the Vary Configuration (VRYCFG) command. The configuration description for the CD-ROM or DVD device is *OPT. When the device description is varied on, it displays a status of ACTIVE.

Configure directly attached optical media libraries

To create a device description for an optical media library device, use the Create Device Description (Media Library) (CRTDEVMLB) command. Specify device class *OPT. For example:

```
CRTDEVMLB DEVD(OPTMLB01) DEVCLS(*OPT) RSRCNAME(OPTMLB01)
```

The configuration description for an optical media libraby device (MLD) is *OPTMLB. In addition, you can use the following commands to work with device descriptions:

- To change the device description, use the Change Device Description (Media Library) (CHGDEVMLB) command.
- To vary the device description, use the Vary Configuration (VRYCFG) command.
- To delete the device description, use the Delete Device Description (DLTDEVD) command.
- To work with the configuration status, use the Work with Configuration Status (WRKCFGSTS) command.

Label optical cartridges

Each optical disk cartridge contains two sides. Each side corresponds to an optical volume. There are two techniques to associate a volume ID label with the correct side of the optical cartridge. This is important to know when you set the write-protect switch.

The optical cartridge should be labeled the first time the cartridge is added to an optical media library. This prevents any confusion in the future when you are attempting to determine which volume goes with which side.

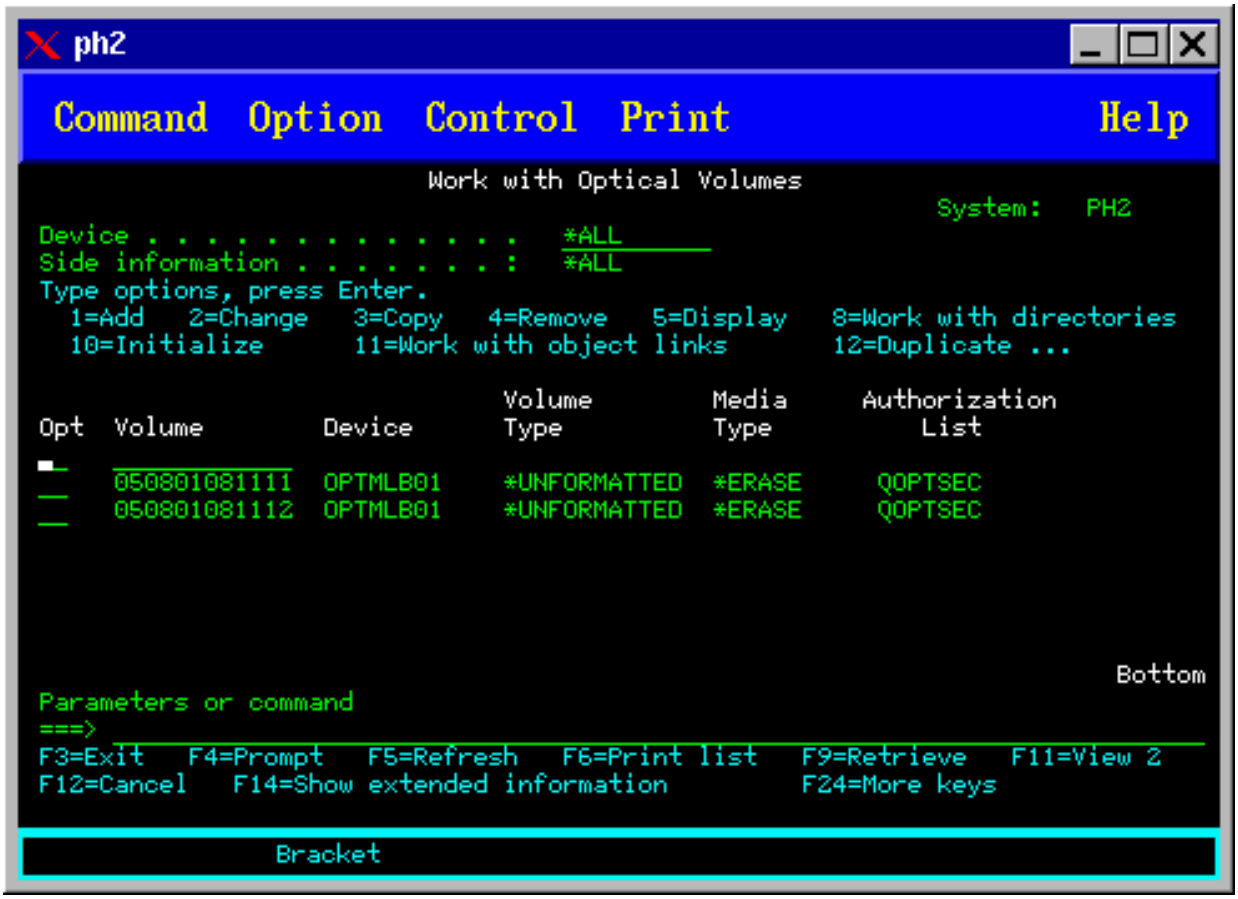
Related concepts

"Example: Add optical cartridges to an optical media library" on page 85
This example provides information about adding optical cartridges to an optical media library.

Label a new optical cartridge with uninitialized volumes:

Several steps are necessary to label a cartridge that is new (both volumes are uninitialized). The options are selected from the Work with Optical Volumes display.

1. Label sides A and B with the volume names you will use when initializing them.
2. Place the cartridge in the input/output station with side A facing up.
3. Select option 1 (Add). After you have added the cartridge, the volume names appear on the Work with Optical Volumes display (see the graphic) as system-generated IDs that consist of the system date and time.



The earlier time corresponds to the side that was facing up in the input/output station. Therefore, if side A was facing up in the input/output station, then side A will have the earlier date and time of the two volumes.

4. Initialize the volume that corresponds to side A by choosing option 10 (Initialize) next to the system-generated volume ID. Use the labeled name. Repeat this step for side B.

Label an optical cartridge with an initialized volume:

To label a cartridge that has at least one initialized volume on it, follow these steps. The options are selected from the Work with Optical Volumes display.

1. If the cartridge resides in an optical media library, remove it by typing option 4 (Remove) next to the volume ID.
2. After the cartridge is removed, set one side of the cartridge to write-protected and the other side to write-enable.
3. Add the cartridge to an optical media library by typing option 1 (Add).
4. Press F11 (View 2) to see the write-protected status of the newly added volumes.
5. Determine which volume is write-protected and make a record of this volume ID.
6. Remove the optical cartridge by typing option 4 (Remove) next to the volume ID.
7. Label the write-protected side of the cartridge to the volume ID you previously recorded.

Related tasks

"Set write protection" on page 109
The write-protect function prevents writing on the disk.

Get started with optical cartridges and volumes

This topic introduces you to some of the optical support functions and familiarizes you with using optical cartridges and volumes.

Through these examples you can learn how to:

- Work with optical volumes
- Add optical cartridges to an optical media library
- Initialize optical volumes
- Remove optical cartridges from an optical media library

Note: The device, volume, and directory names that are used in these examples are for illustrative purposes only. Your applications may require different volume names or different directory names. Additionally, your optical devices might have different names.

Only some of the available optical commands are discussed here. Do not use these topics as the primary reference for these commands because they do not describe all of the functions that are available. These topics provide a tutorial on getting started by using the optical utilities.

The following examples assume that you have a new optical disk cartridge available to use and your optical media library is empty.

Example: Add optical cartridges to an optical media library:

This example provides information about adding optical cartridges to an optical media library.

To add an optical cartridge to the optical media library that you have attached to your iSeries server, place the optical cartridge with side A up in the input/output station of the optical library dataserver. Make sure the cartridge is seated properly. Use a new optical cartridge if one is available.

1. Type 1 (Add) in the options field and press the Enter key. The Add Optical Cartridge display appears.
2. Type the name of the optical media library to which you want to add the cartridge. This is the name of the library description that was created during installation. If you have more than one library attached, you need to know the optical media library association and configuration. To view your optical configurations, type WRKMLBSTS MLB(*OPTMLB).
3. When all parameters are entered, press the Enter key.

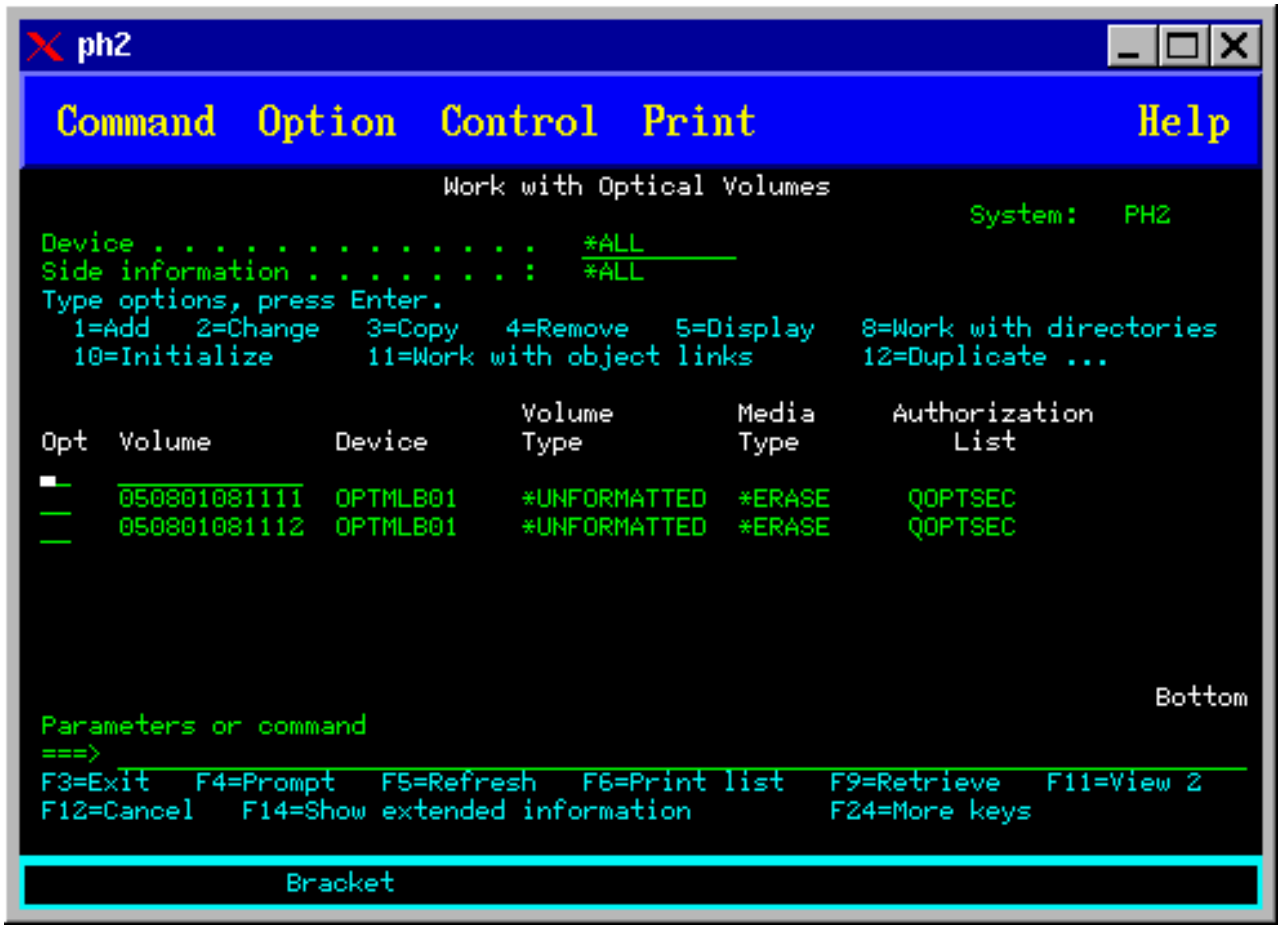
Related concepts

"Label optical cartridges" on page 83
Each optical disk cartridge contains two sides. Each side corresponds to an optical volume. There are two techniques to associate a volume ID label with the correct side of the optical cartridge. This is important to know when you set the write-protect switch.

Example: Initialize optical volumes:

This example provides information about initializing optical volumes in an optical media library.

If the cartridge you added was a new cartridge, you will see something similar to the display shown below. This indicates that the optical cartridge has two uninitialized volumes on it.



An uninitialized volume is an optical volume that has never been formatted or initialized. It is similar to a new diskette that needs to be formatted. If a volume has not been initialized, it has a volume type of *UNFORMATTED (uninitialized).

An uninitialized volume does not have a volume name written to it. When an uninitialized volume is added to an optical media library, a volume name that consists of a date and time (YYMMDDHHMMSS) is assigned to it. Optical volumes cannot be written to or read from until they are initialized.

On the Work with Optical Volumes display, you see that two volumes were added, one for each side of the optical disk cartridge. If either of the volumes was initialized, the volume type would indicate *PRIMARY or *BACKUP, and most likely the volume ID would be different from the ones in the example. An optical disk can contain one volume that is initialized and one volume that is uninitialized. The volumes are treated independently even though they exist on the same cartridge.

If both volumes are uninitialized, the earlier date and time for the volume names indicate the volume that was facing up in the input/output station. In this example, because side A was facing up when the add operation was performed, we know that 941215111729 is side A. This is important to know so the volume can be properly labeled when removed from the library.

To initialize the volume you determined to be side A, enter option 10 (Initialize) in the Opt field beside that volume. Press the Enter key.

Note: Initializing a previously initialized volume makes all existing data on that volume inaccessible. If you typed 10 next to a volume that is already initialized and you do not want to lose the data on that volume, do not continue with this function. Use a volume that is uninitialized.

Complete the following fields on the Initialize Optical Volume display:

Volume identifier
This is the existing volume ID of the volume that you are going to initialize. For uninitialized volumes, this name is a system-generated name that consists of the date and time. This is only a temporary name until the volume initializes.

New volume identifier
Type the new name for the specified volume. This is the name that users and applications will use when referring to the volume.

Volume-full threshold
Leave this set to the default value. Use this value to give the volume a logical volume-full threshold.

Check for active volume
Leave this set to *YES to verify that the optical volume was previously initialized.

Clear Leave this set to *NO. This specifies whether or not existing data on the volume will be cleared during the initiating process. This parameter only applies when the volume media type is *DVD-RAM. Specifying CLEAR(*YES) can cause this operation to take up to one hour.

Text description
Enter a short description of the volume. Fifty characters are available for this field.

Press the Enter key to initialize the volume.

Note: Initializing an erasable optical volume can take up to 30 minutes.

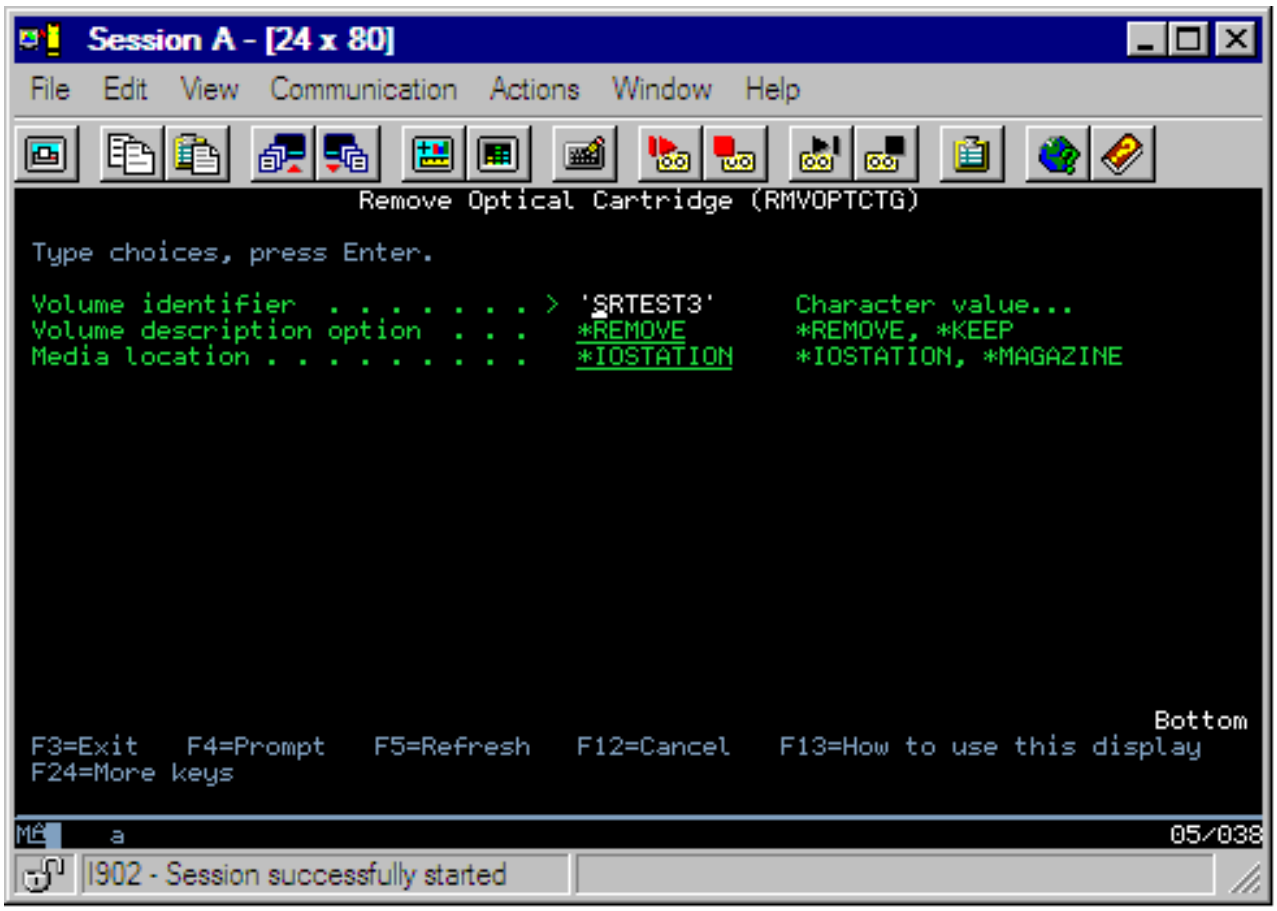
After the volume is initialized, the Work with Optical Volumes display reappears and the previously uninitialized volume is now initialized. The type has changed from *UNFORMATTED to *PRIMARY, and the volume is now available for reading and writing files and directories

From this display, you can select the following options:
- **1** - Add an optical cartridge
- **2** - Change the volume attributes
- **3** - Copy a volume
- **4** - Remove an optical cartridge
- **5** - Display volume information
- **6** - Print volume information
- **7** - Rename a volume
- **8** - Work with directories on the volume
- **9** - Delete volume information for a previously removed volume
- **10** - Initialize or reinitialize a volume
- **11** - Work with directories and files on the volume
- **12** - Duplicate a volume to another optical media
- **13** - Check the volume for damaged files and return a count of the directories and files

Example: Remove an optical disk cartridge:

This example shows how to remove the optical disk cartridge from the optical media library.

Because there are two volumes on a cartridge, removing a cartridge actually removes two volumes. Therefore, specifying option 4 (Remove) on any of the volumes shown in the example below produces the same result.



Before removing a cartridge, make sure that the input/output station is empty. The optical media library cannot remove a cartridge if the input/output station is occupied by another cartridge.

1. Type 4 (Remove) in the Opt field next to the cartridge you want to remove and press the Enter key. The Remove Optical Cartridge display appears. Complete the fields of the Remove Optical Cartridge display as follows:
   - **Volume Identifier:** This is the volume you selected on the Work with Optical Volume display.
   - **Volume description option:** Specify *REMOVE for this field to remove the volume descriptions from the optical index database files after the cartridge has been removed.

     Specify *KEEP for this field to save the volume descriptions for initialized volumes in the optical index database files. This causes the system to consider the volumes as *REMOVED.
2. Press the Enter key to remove the optical disk cartridge. The optical disk cartridge has now been moved to the input/output station of the optical library dataserver.
3. Press F3 (Exit) to return to the optical support main menu. The resulting display shows that the optical disk cartridge is no longer available.
4. Press F3 again to return to the i5/OS command line.

Use optical devices

You can display the primary menu for optical support by entering GO OPTICAL on the i5/OS command line. System administrators and programmers can access most optical commands through this menu. It is also convenient to enter many of the optical commands directly on the command line.

These commands offer the following functions:

- Display optical volumes in a directly attached or LAN attached optical media libraby device (MLD), CD device, or DVD device.
- Display files and directories that are contained in any directory in any optical volume.
- Display the file attributes of any optical file.
- Import or export media in a directly attached optical media library, CD-ROM device, or DVD device.
- Make backup copies of a volume, directories, or files that are contained in a directly attached optical devices.
- Initialize a volume that is contained in a DVD-RAM drive or in a directly attached optical media library.
- Work with devices that represent optical media libraries, optical servers, CD drives, and DVD drives.
- Add, remove, or change the status of any LAN attached optical server.
- Duplicate one optical volume to another.
- Copy files and directories from one optical volume to another.
- Check a volume for damaged directories and files.

When you enter GO CMDOPT on the command line, a complete list of optical commands appears. Many of these commands are accessible through the previous GO OPTICAL menu.

The following topics provide information about configuring your CD-ROM, DVD-ROM, or DVD-RAM device as well as tips for loading and unloading media.

Load and unload CD-ROM and DVD media

Loading a CD-ROM or DVD media into a drive causes the system to read the media to retrieve the volume identifier.

The system stores this volume identifier in an optical index database file to expedite future access to the media. After the volume identifier is in the optical index, you can access the media through save and restore options, as well as the application programming interfaces. Unloading the media from the drive removes the volume identifier from the optical index. The system adds the volume identifier to the optical index database in one of two ways:

- When the CD-ROM or DVD is loaded into a varied-on device, aCD-ROM or DVD can be loaded into a varied-off device. However, the optical index is not updated until you vary on the device description.
- When the user varies on a CD-ROM or DVD device description with media in it.

Additional processing could take several seconds after the tray slides in before the CD-ROM or DVD is usable. This is true for varying on as well. Even if the vary-on operation completes successfully, the CD-ROM or DVD is not usable until the system reads and stores the media information in the optical index. This may take several seconds after the vary-on operation is completed.

When the user successfully loads a CD-ROM or DVD into a drive, the system sends the following message to the QSYSOPR message queue:

```
Volume VOLID01 added to optical device.
```

When a CD-ROM or DVD is successfully removed from a drive, the system sends the following message to the QSYSOPR message queue:

```
Volume VOLID01 removed from optical device.
```

You can use the Work with Optical Volumes (WRKOPTVOL) command to verify the successful adding or removing of the CD-ROM or DVD.

You can also use the Display Optical (DSPOPT) command to display optical volume information.

Occasionally media may fail to load successfully into the drive. Some of the possible causes for an unsuccessful load are listed below.

- Media or drive error occured.
- The media format is not supported (digital audio CD-ROM).
- The system encountered a duplicate volume identifier.

Depending on the error, the tray may or may not eject if a CD-ROM or DVD fails to load. A failure to load the CD-ROM or DVD might not be obvious. Your first indication may be that you received one of the following messages when trying to access the CD-ROM:

```
Optical volume format not recognized.
Optical volume not found.
```

If an error does occur when loading media or varying on the drive, the system signals an error message to the QSYSOPR message queue. This message describes the reason for the failure.

The processing for the load, unload, and vary-on operations runs in job QJOBSCD. If errors occur during these operations, view the job log of QJOBSCD to see the detailed messages.

Allocate the device description

The process of loading the CD-ROM or DVD media requires shared update (*SHRUPD) use of the device description.

The, QJOBSCD must be able to obtain a *SHRUPD lock on the device description for the load to complete successfully. If another job is holding a conflicting lock on the device description, the load processing will fail with the following errors in the QJOBSCD job log.

```
Optical device xxxxx in use.
Add optical disk cartridge failed to complete successfully.
```

As an example, assume that some job allocates OPT01 with an Exclusive Allow Read lock as follows:

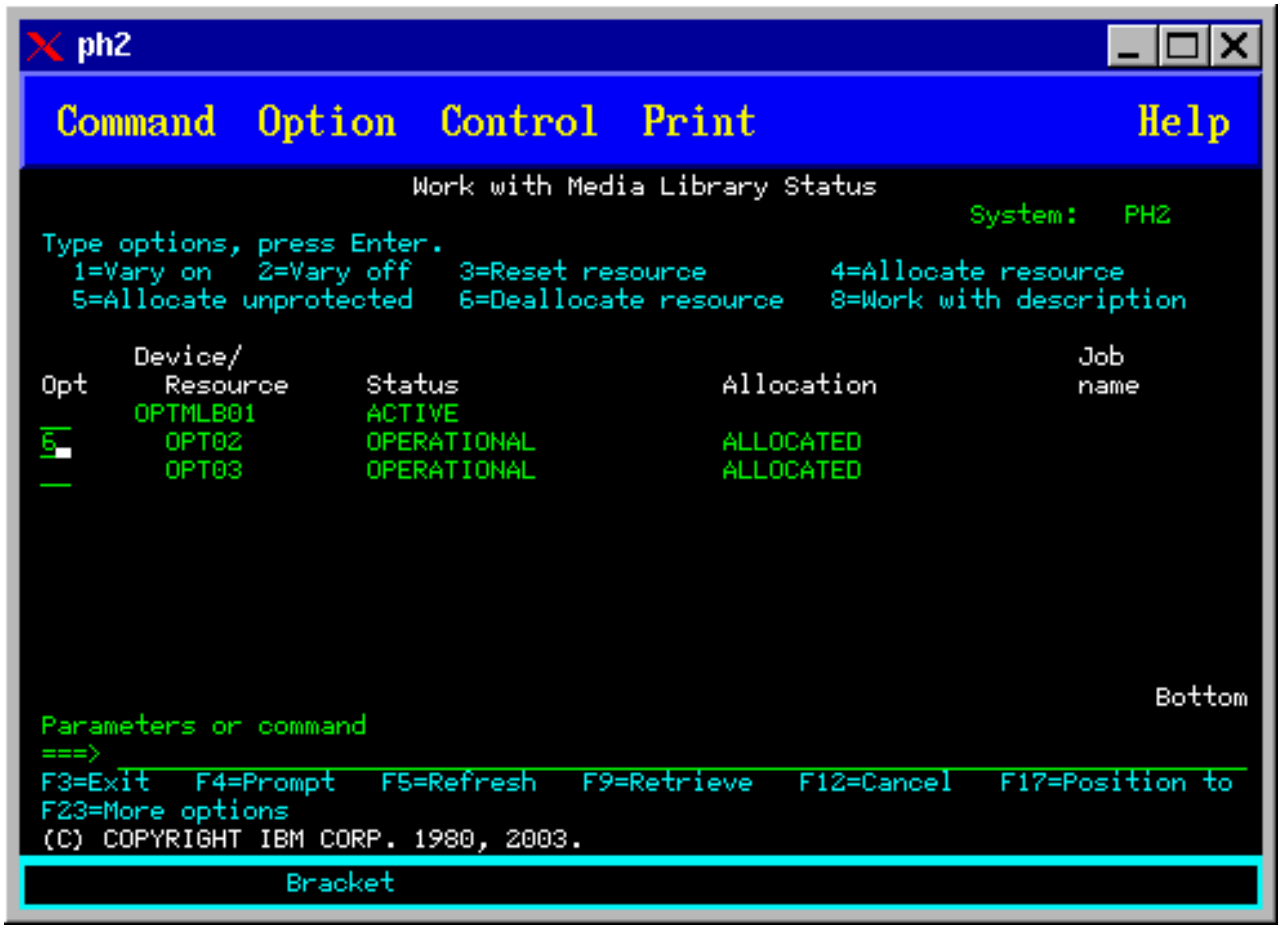
```
ALCOBJ OBJ((OPT01 *DEVD *EXCLRD))
```

As long as the system holds this lock, CD-ROM and DVD loads will fail in QJOBSCD.

Allocate/Deallocate Optical Drive

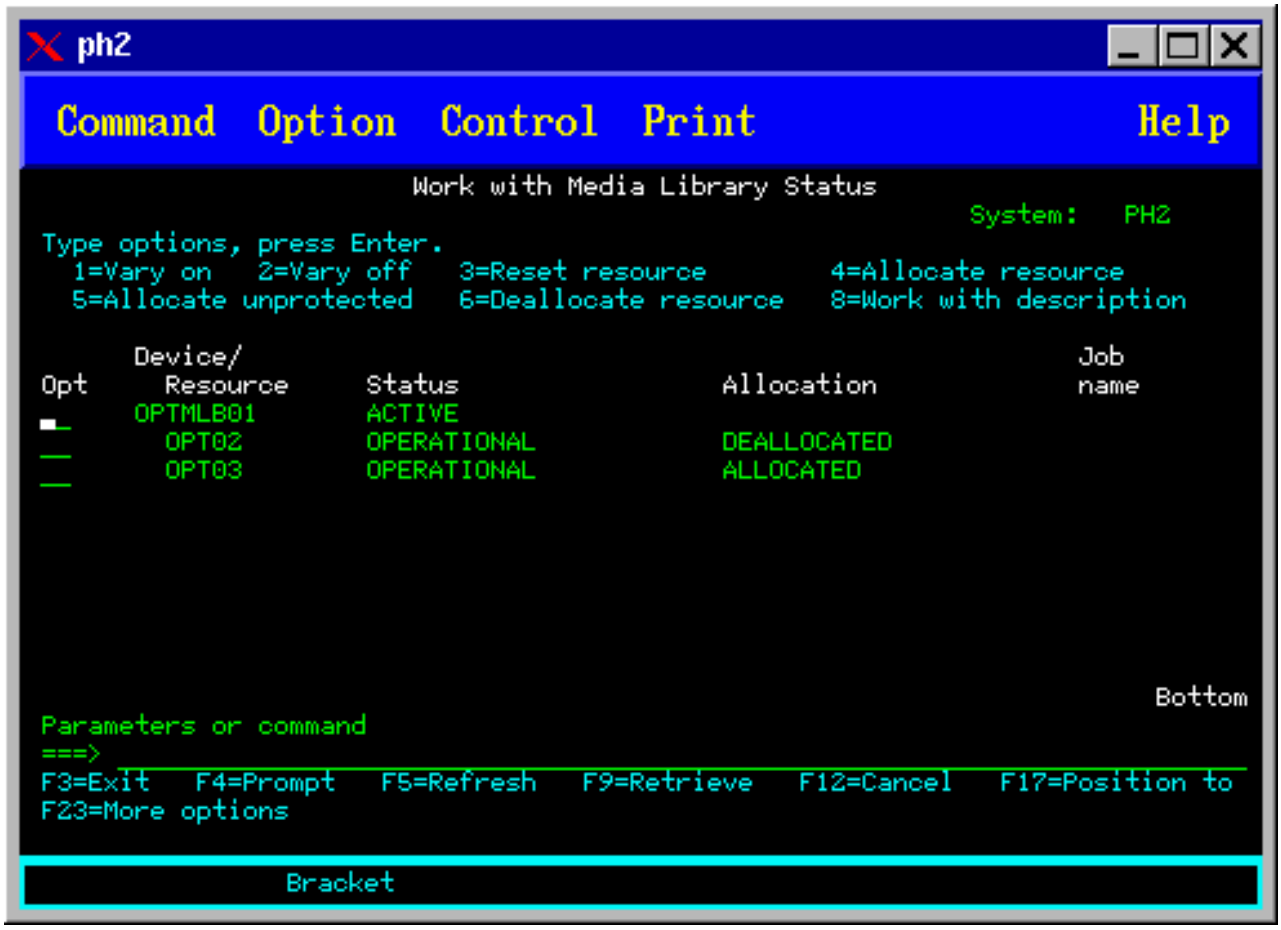
Optical media libraries range from a model that has a single drive to a model that has twelve drives. Use the Work with Media Library Status (WRKMLBSTS) command to see the allocation status of each drive within a media library. The allocation status for a drive can be ALLOCATED, DEALLOCATED or *UNKNOWN.

The default allocation status for an optical drive is ALLOCATED, which means that the drive is available for use by the optical media library. The system sets this default value at IPL time. You can only change it using the Work with Media Library Status (WRKMLBSTS) command. DEALLOCATED means that the drive becomes unavailable for use by the optical media library. The allocation status for drives in a varied off optical media library is *UNKNOWN.



There are times when a drive should be removed from serving the optical media library such as when it is suspected of needing repair. To do this, you need to change the drive allocation status to DEALLOCATED. This will make the drive unavailable for use by the optical media library.

To deallocate a drive, select option 6 (Deallocate resource) on the desired device or resource.



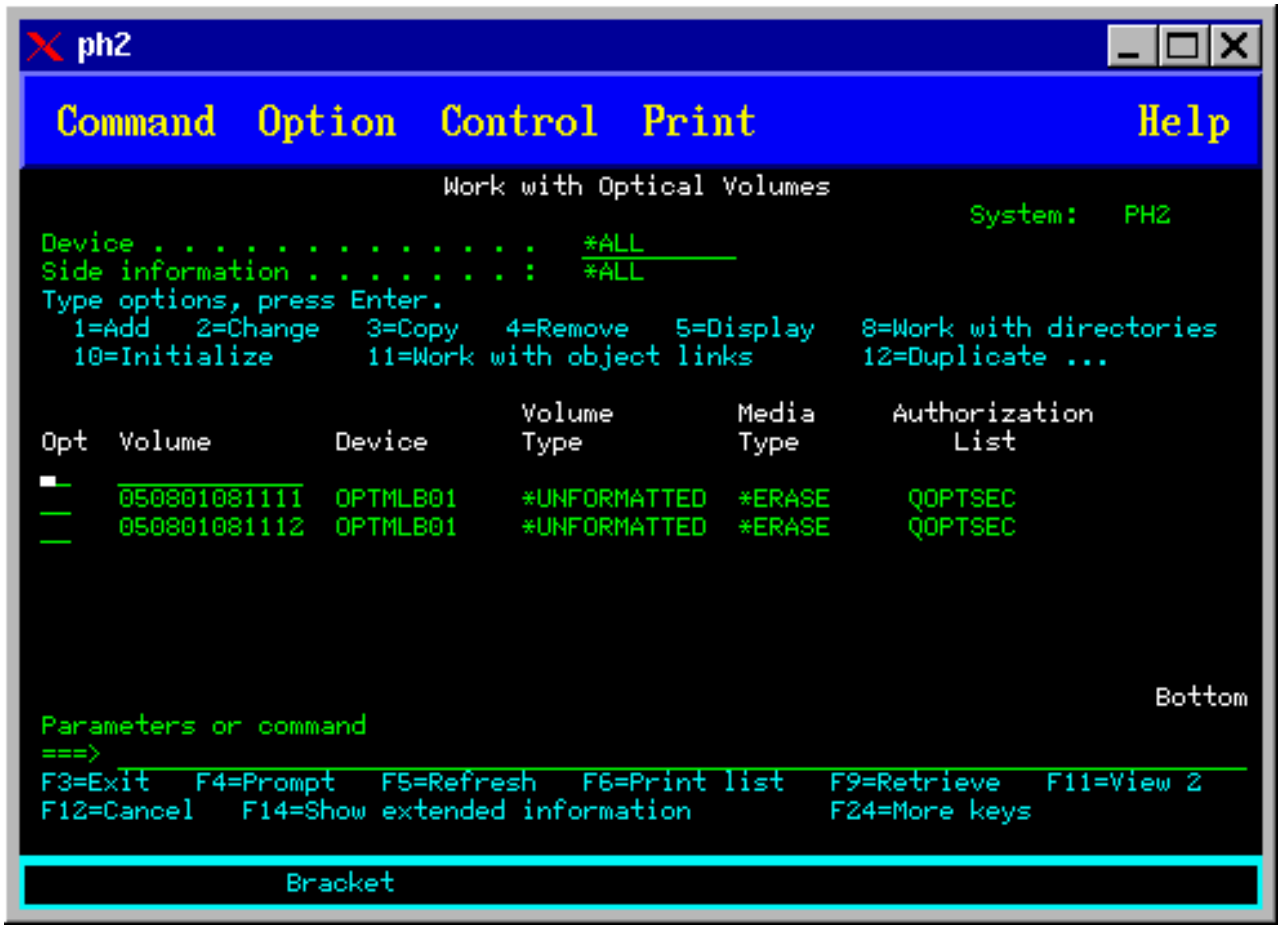
The device allocation status of DEALLOCATED will remain until the drive is allocated again or the iSeries server is IPLed.

Use optical volumes

These topics describe the Work with Optical Volumes options on the Optical Support Utilities main menu.

These options are organized hierarchically, with volumes as the highest in the order and files as the lowest in the order. You can use the appropriate "Work with..." command to access these panels directly without having to go through the Optical Support Utilities main menu. Each display presents the selected information and the options that are available. Some options might not apply to all optical devices or volumes.

The primary menu for working with optical volumes is the Work with Optical Volumes display (see screen shot). There are several variations of this display to accommodate alternate formats and extended attribute information.



You can select the Work with Optical Volumes display by choosing option 1 (Work with optical volumes) on the Optical Support Utilities menu. You can also run the Work with Optical Volumes (WRKOPTVOL) command on the command line.

The Work with Optical Volumes (WRKOPTVOL) command applies to the following volumes:

- Volumes in CD-ROM or DVD devices
- Volumes in optical media library devices
- Volumes in virtual optical devices
- Volumes in LAN-attached optical library devices

Display optical volumes

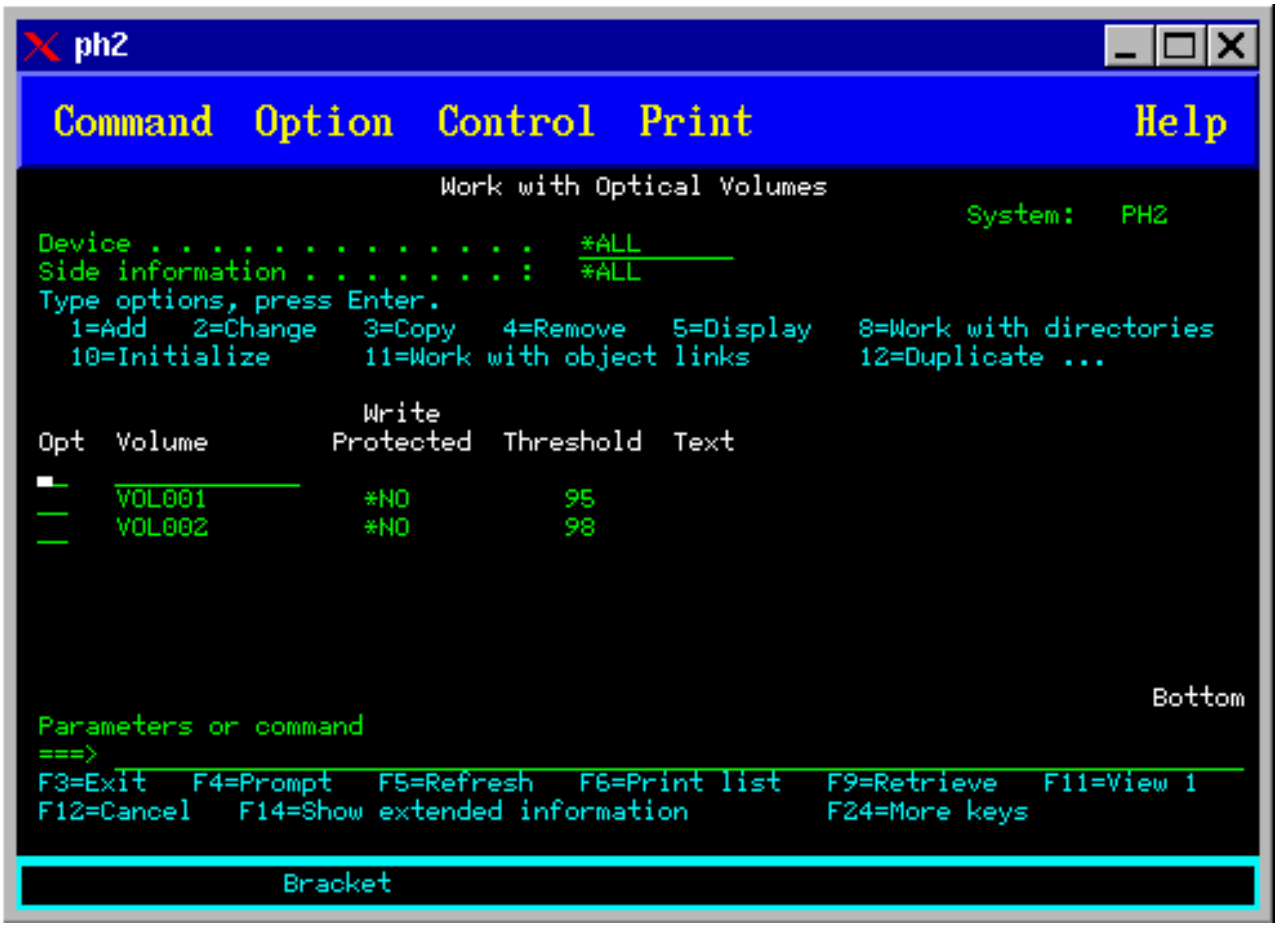
When the Work with Optical Volumes display first appears, it includes a list of all volumes in all CD-ROM devices, DVD devices, and optical media libraries, and LAN-attached devices.

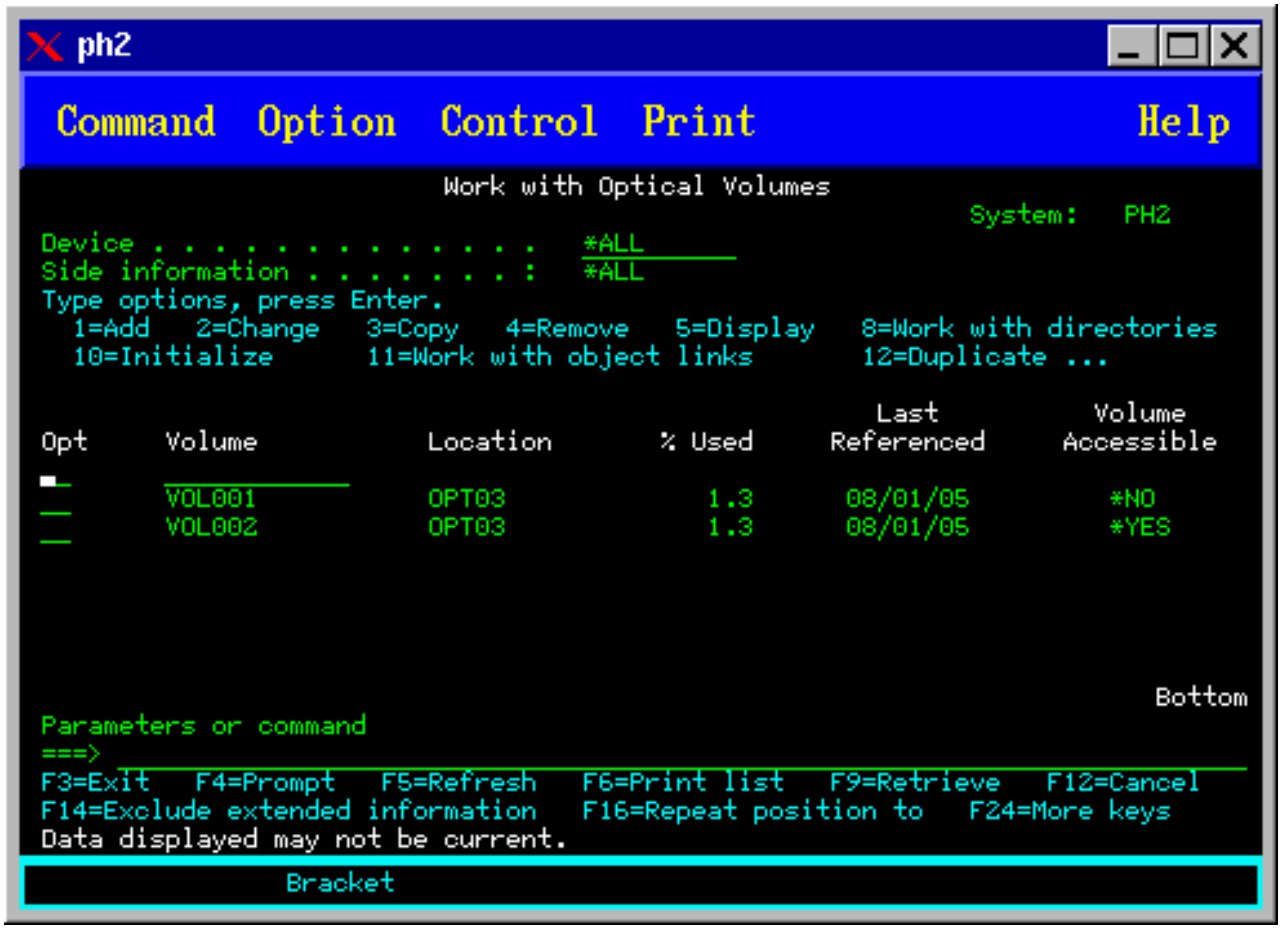
The volume names that are displayed are determined by what you type in the device (DEV) and CSI parameters. The following options are valid for the DEV parameter:

Option Explanation name

Name The name of a specific device. This lists all volumes in the specified device.

***ALL** The list of all volumes in all devices. The volumes are displayed in alphabetical order regardless of the device they are in. You can press F11 (View 2) on the Work with Optical Volumes display to view the text variation of this display as shown in the figure below.


ph2
Command Option Control Print Help
Work with Optical Volumes
System: PH2
Device . . . . . *ALL
Side information . . . . . : *ALL
Type options, press Enter.
1=Add 2=Change 3=Copy 4=Remove 5=Display 8=Work with directories
10=Initialize 11=Work with object links 12=Duplicate ...
Opt Volume Write Protected Threshold Text
VOL001 *NO 95
VOL002 *NO 98
Bottom
Parameters or command
===>
F3=Exit F4=Prompt F5=Refresh F6=Print list F9=Retrieve F11=View 1
F12=Cancel F14=Show extended information F24=More keys
Bracket



Press F11 (View 1) to return to the status variation.

A third variation of the Work with Optical Volumes display is the extended information display. To view this display, press F14 (Show extended information) on the Work with Optical Volumes display, or use the WRKOPTVOL command and set the extended information parameter to *YES. This display is shown in the figure below.

Unlike the status and text variations, this display requires that the optical device be varied on. If an optical device is not varied on, message `OPT1520, Data displayed may not be current,` is returned.

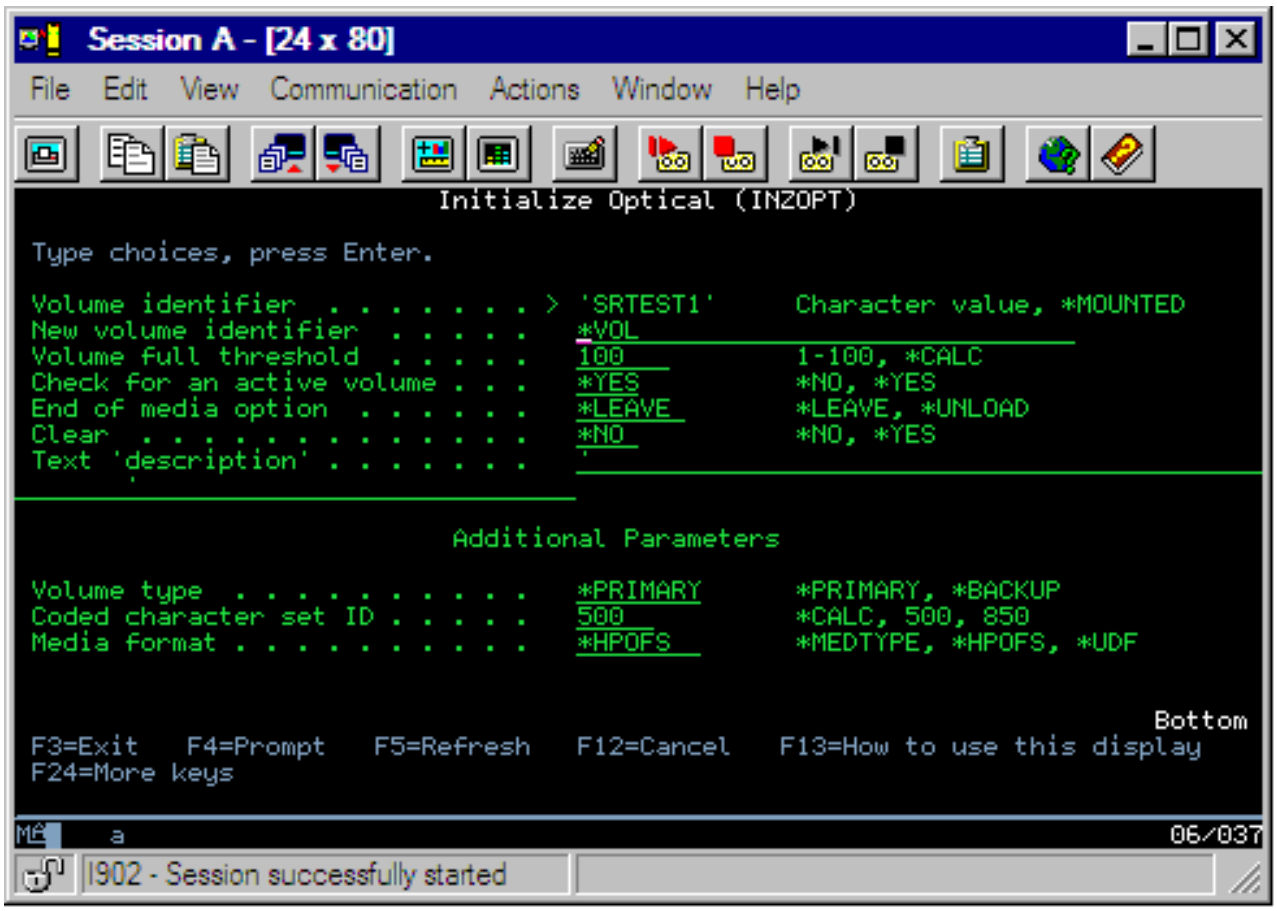
Initialize optical volumes

You must initialize the writable optical media before the system can create directories and files.

When you initialize a volume, a new volume identifier must be given which gets written to the media.

You initialize an optical volume using the Initialize Optical command. To select this command from the Work with Optical Volumes display, select option 10 (Initialize) in the Opt (Option) column next to the volume you want to initialize. The Initialize Optical Volume display appears and prompts you for required information. The figure below shows the Initialize Optical Volume display.

The Media Format parameter determines the media format of the volume. *MEDTYPE is the default which means that the media type determines the media format. The two media formats available are universal disk format (UDF) and high performance optical file system HPOFS.



Attention: When you initialize an optical volume, all information previously written on the volume becomes inaccessible.

The Initialize Optical (INZOPT) command applies to the following volumes:

- Volumes in directly-attached optical media libraries
- Volumes on writable media in DVD devices
- Volumes in virtual optical devices.

Rename optical volumes

You can rename an optical volume without losing the information on the volume.

To rename a volume, select option 7 (Rename) in the Opt (Option) column on the Work with Optical Volumes display. The fields on this display show the following information for renaming optical volumes:

- *Volume:*The current name of the optical volume for renaming appears in this field.
- *New Name:*Specify the new name of the optical volume. The new name automatically becomes the current volume name.

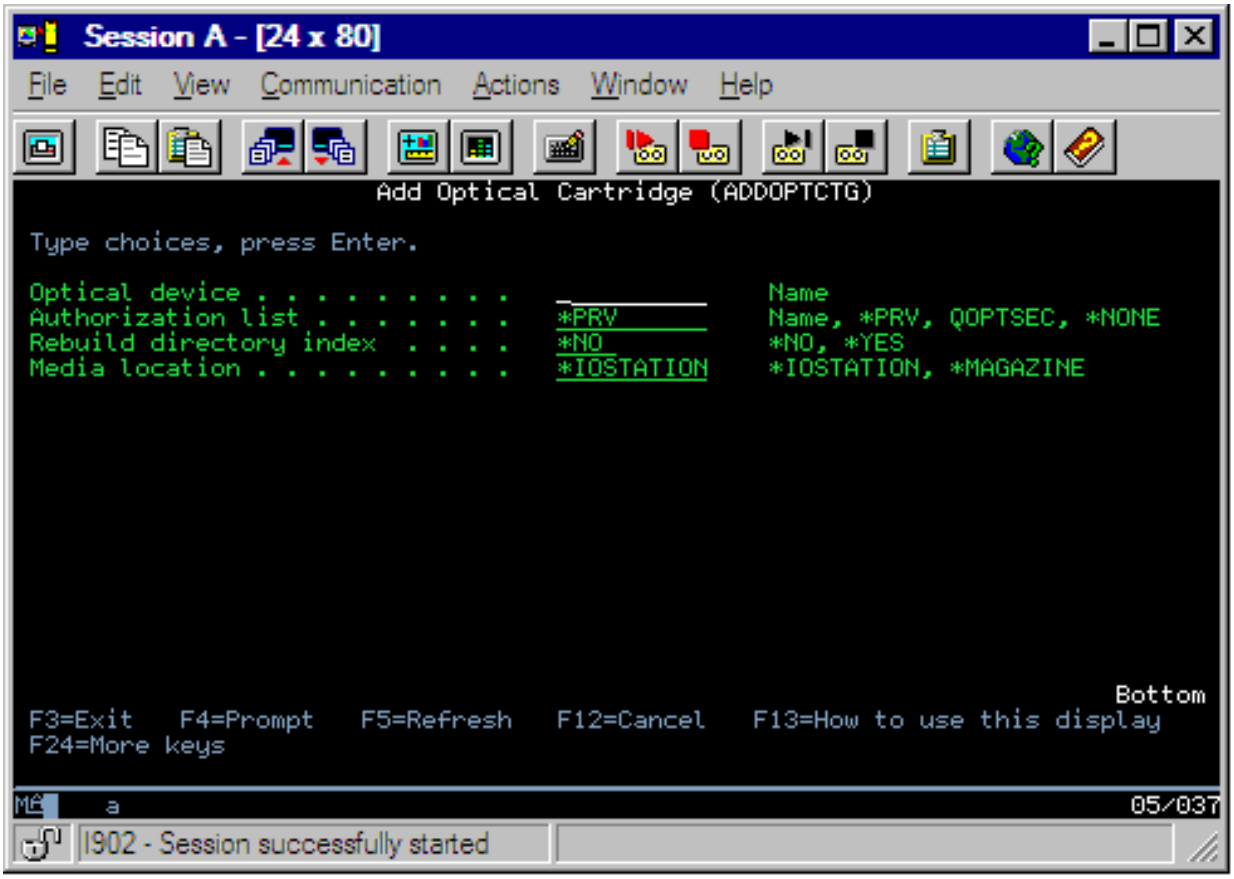
Note: You can rename unformatted (uninitialized and unknown) volumes. When an unformatted volume is renamed, the new name acts as an alias to the unformatted volume. The new name will not be written to the media and will not be preserved if the volume is exported from the device. The name is only a temporary volume identifier used to refer to this volume.

Add optical disk cartridges

Use this procedure to add an optical disk cartridge to an optical volume.

To add an optical disk cartridge, perform the following steps:

1. On the Work with Optical Volumes display, select option 1 (Add) in the Opt column next to the blank volume name.



2. In the Add Optical Cartridge display, enter:
   - Optical media library (required)
   - Authorization list
   - Rebuild directory index
   - Media location

   Note:

   - Specifying *NO for Rebuild Directory Index can improve the performance of the Add Optical Cartridge (ADDOPTCTG) command by deferring the rebuilding of the optical directory index until a later time.
   - Some 399F models support adding multiple media through the bulk magazine. *MAGAZINE can be specified to use this feature if available for the device.

You do not need to provide a volume identifier. The system supplies a date and time stamp as the volume identifier. The date and time stamp is used to track each volume until it is read. If the volume is not initialized, the date and time stamp serves as its identifier until the volume is initialized with a user-supplied name.

Note: The Add Optical Cartridge (ADDOPTCTG) command applies to:

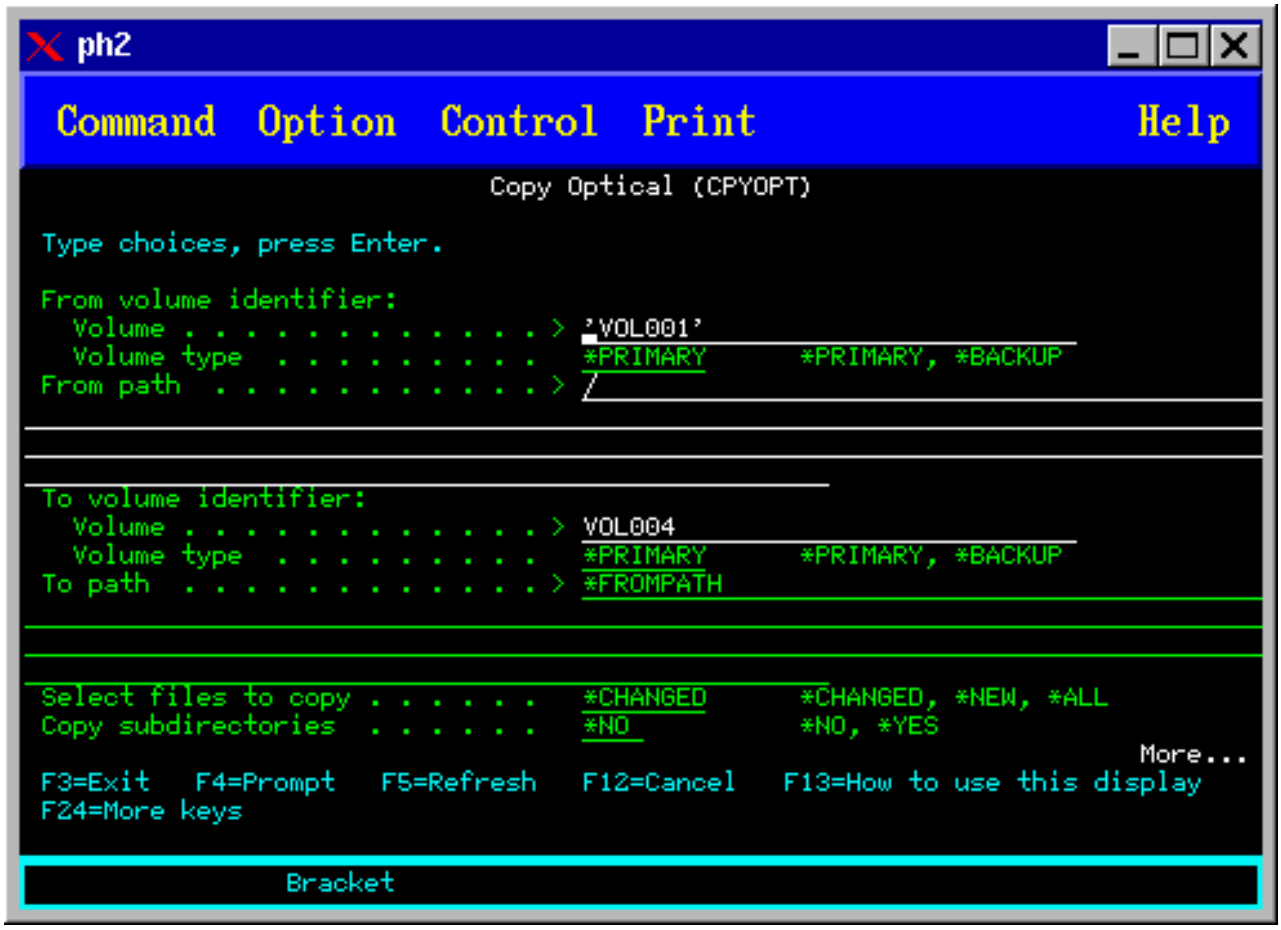
- Directly-attached optical media libraries
- CD and DVD devices

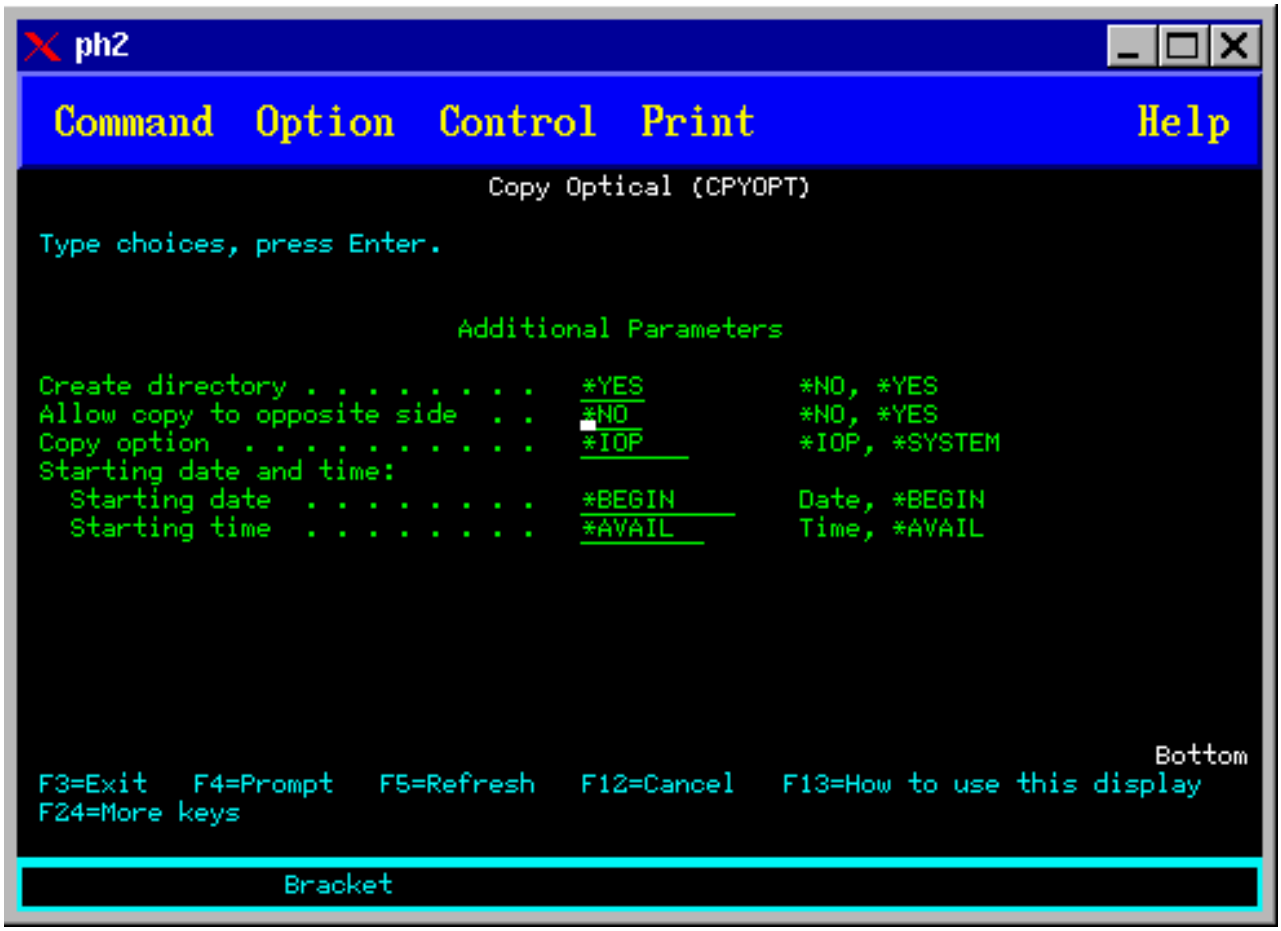
Copying optical volume data

Optical files can be copied from one or more volumes or directories to other volumes or directories.

To copy optical files in one or all of the directories on a volume to another volume or directory, select option 3 (Copy) in the Opt column on the Work with Optical Volumes display next to the volume with the directory you want copied.

The Copy Optical (CPYOPT) display shown in the figure below appears and prompts you for more information.





This command is not allowed for LAN-attached optical devices. If you attempt to use a LAN-attached optical device, and error message is issued.

The name of the volume appears on the display. You must specify the name of the directory to be copied from and the volume to receive the copy (the volume must be initialized before copying). If you are copying a full volume, specify an unused volume to receive the copied files to be sure that enough space is available.

This command does not delete files for you. Therefore, if you use this command to make additional copies, you must delete files from the target volume that have been deleted from the source volume.

When the copy request is completed, a message is added to the job log stating the number of files copied successfully and the number of files that were not copied. For each file that is not copied, a message stating the full file name is added to the job log. For each directory processed, a message is added to the job log stating the number of files copied successfully and the number of files that were not copied successfully.

Select files to copy (SLTFILE) parameter

The Select files to copy (SLTFILE) parameter indicates how files are to be selected for copying. You can select whether to replace files that already exist on the volume to which you are copying. A value of *CHANGED specifies that a file is copied if it does not exist on the target volume, or if the file is more current than the one on the target volume. A value of *NEW specifies that only files that do not already exist on the **To volume identifier** field are copied. A value of *ALL specifies that all files are copied, even if they exist with the same creation date.

Copy option (COPYTYPE) parameter

The Copy option (COPYTYPE) parameter indicates which resources are used to perform the copy operation. A value of *IOP specifies that the copy operation will have better performance but will slow down other requests to the optical media library. A value of *SYSTEM specifies that the copy request will share the optical media library resources with other requests but will cause the copy request to take longer.

Starting date and time (FROMTIME) parameter

The starting date and time (FROMTIME) parameter is optional and can be used to further restrict the number of files that are copied. Files from the source volume that have a creation or modification date and time greater than or equal to the date and time entered on this parameter are selected to be copied.

Example: Copy optical volume data

To make a complete copy of VOLA on VOLB, use the following command:

```
CPYOPT FROMVOL(VOLA) FROMDIR('/') TOVOL(VOLB) TODIR(*FROMDIR) SLTFILE(*CHANGED)
CPYSUBDIR(*YES) CRTDIR(*YES) ALWCPYOPP(*NO) COPYTYPE(*IOP)
```

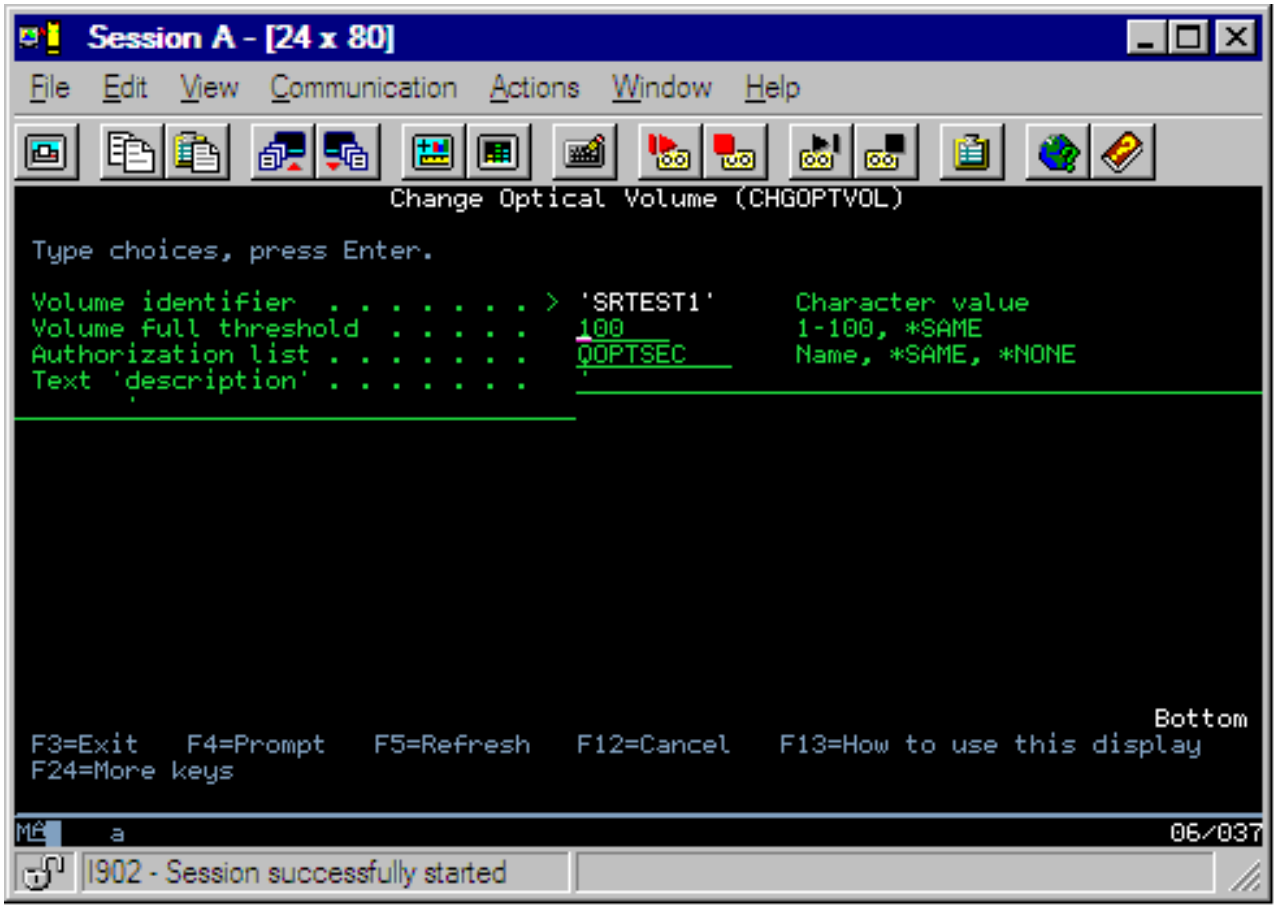
The Copy Optical (CPYOPT) command applies to:

- Volumes in directly attached optical media libraries
- Volumes in CD-ROM or DVD devices
- Volumes in virtual optical devices

Changing optical volume attributes

You can change the attributes of a volume by typing a 2 (Change) in the Opt (Option) column of the Work with Optical Volumes display.

The Change Optical Volume (CHGOPTVOL) display shown in the figure below appears and prompts you to type your changes for the volume you selected.



You can change the following attributes with this command:

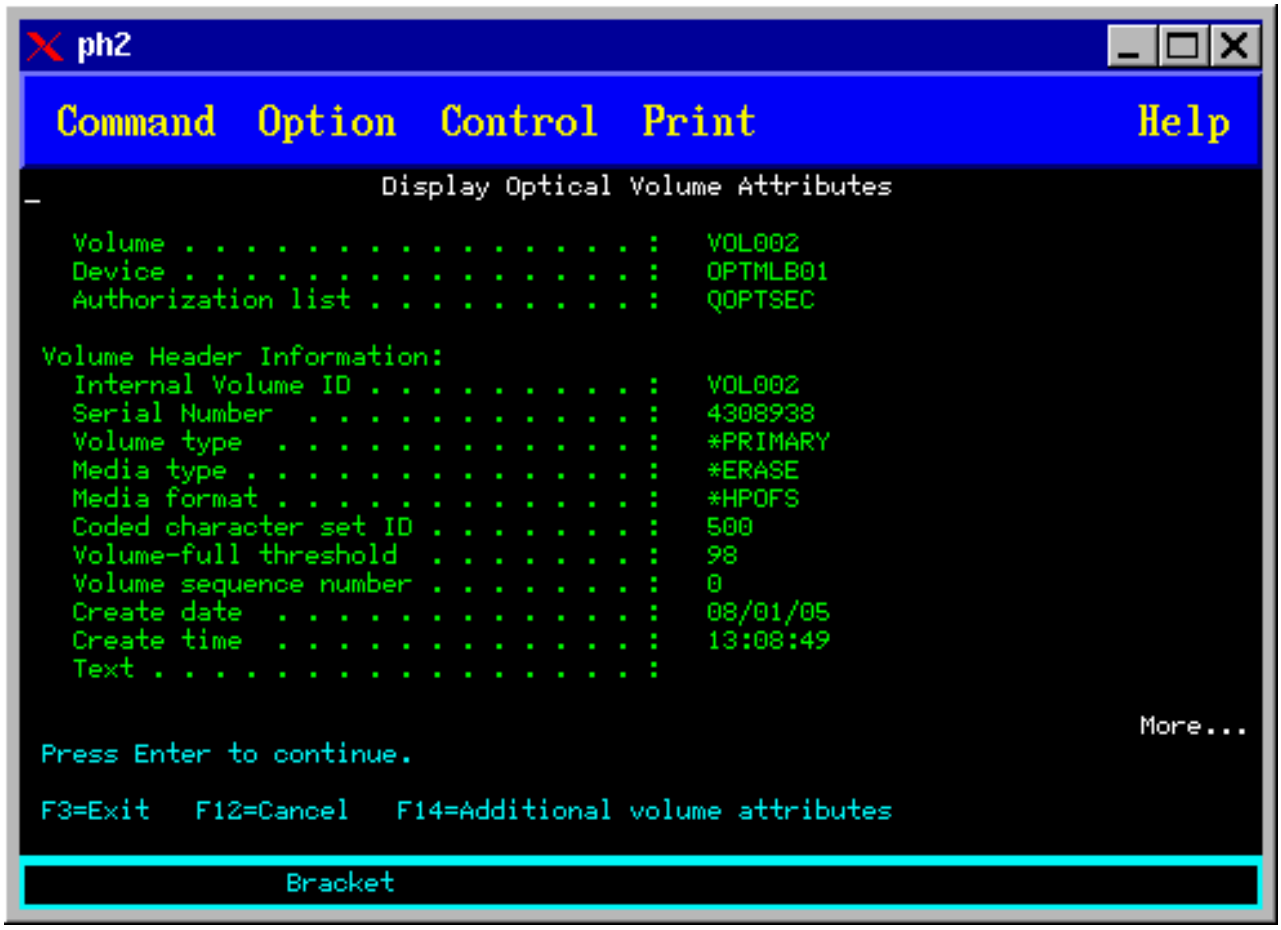
- Volume-full threshold percentage for volumes in directly attached media libraries
- Authorization list that is used to secure the volume

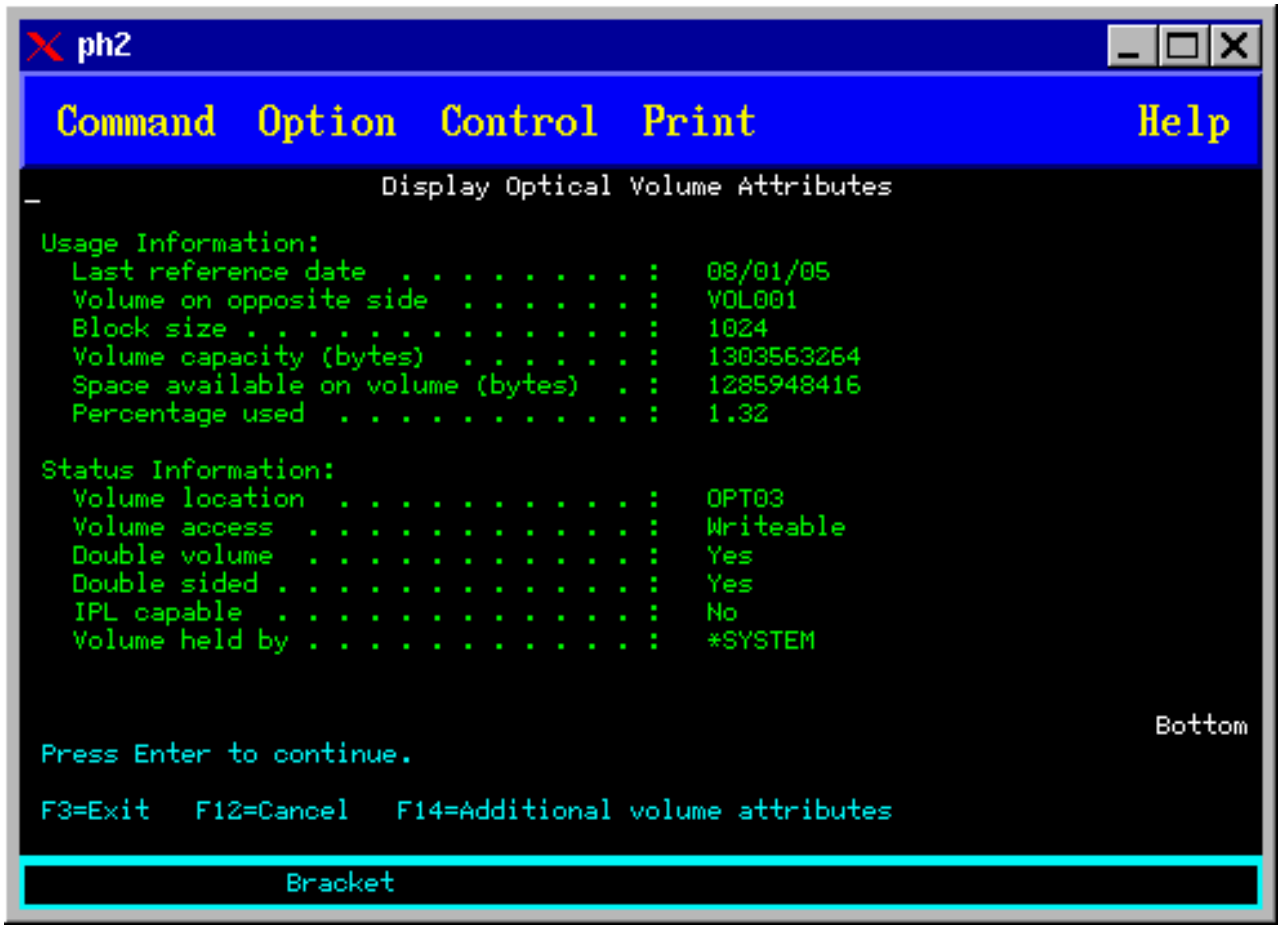
  Note: If the volume is in a stand-alone device (CD-ROM or DVD drive), the authorization list secures the volume for the duration that the media is in the device. Ejecting the media from the device and immediately re-inserting it again resets the authorization list to the QOPTSEC default. The system does not maintain the authorization list for volumes that are removed from a stand-alone optical device. For volumes in an optical media libraby device (MLD), you can only maintain the authorization list when removing the media by specifying VOLOPT(*KEEP) on the Remove Optical Cartridge (RMVOPTCTG) CL command. The authorization list is not written to the optical disk but instead is maintained internally on the server.
- Volume description of the volume for DVD-RAM volumes and volumes in directly attached media libraries

Displaying and Printing Optical Volume Attributes

These topics provide information about viewing and printing the attributes of a volume.

Optical volume attributes


ph2
Command Option Control Print Help
Display Optical Volume Attributes
Volume . . . . . : VOL002
Device . . . . . : OPTMLB01
Authorization list . . . . . : QOPTSEC
Volume Header Information:
Internal Volume ID . . . . . : VOL002
Serial Number . . . . . : 4308938
Volume type . . . . . : *PRIMARY
Media type . . . . . : *ERASE
Media format . . . . . : *HPOFS
Coded character set ID . . . . . : 500
Volume-full threshold . . . . . : 98
Volume sequence number . . . . . : 0
Create date . . . . . : 08/01/05
Create time . . . . . : 13:08:49
Text . . . . . :
More...
Press Enter to continue.
F3=Exit F12=Cancel F14=Additional volume attributes
Bracket



You cannot change any information on either of these displays.

A third display is possible if the optical volume type is *BACKUP. If the display indicates More... in the bottom right-hand corner, press the Page Down key to view the third display. (This display shows information that is unique to optical backup volumes.)

Press F14 to see the Additional Volume Attribute displays.

Printing Optical Volume Attributes

You can print volume attributes by typing a 6 (Print) in the Opt column next to a volume listed on the Work with Optical Volumes display.

The output is written to a spooled file, which can be found in the output queue for the job.

The Display Optical (DSPOPT) command applies to:

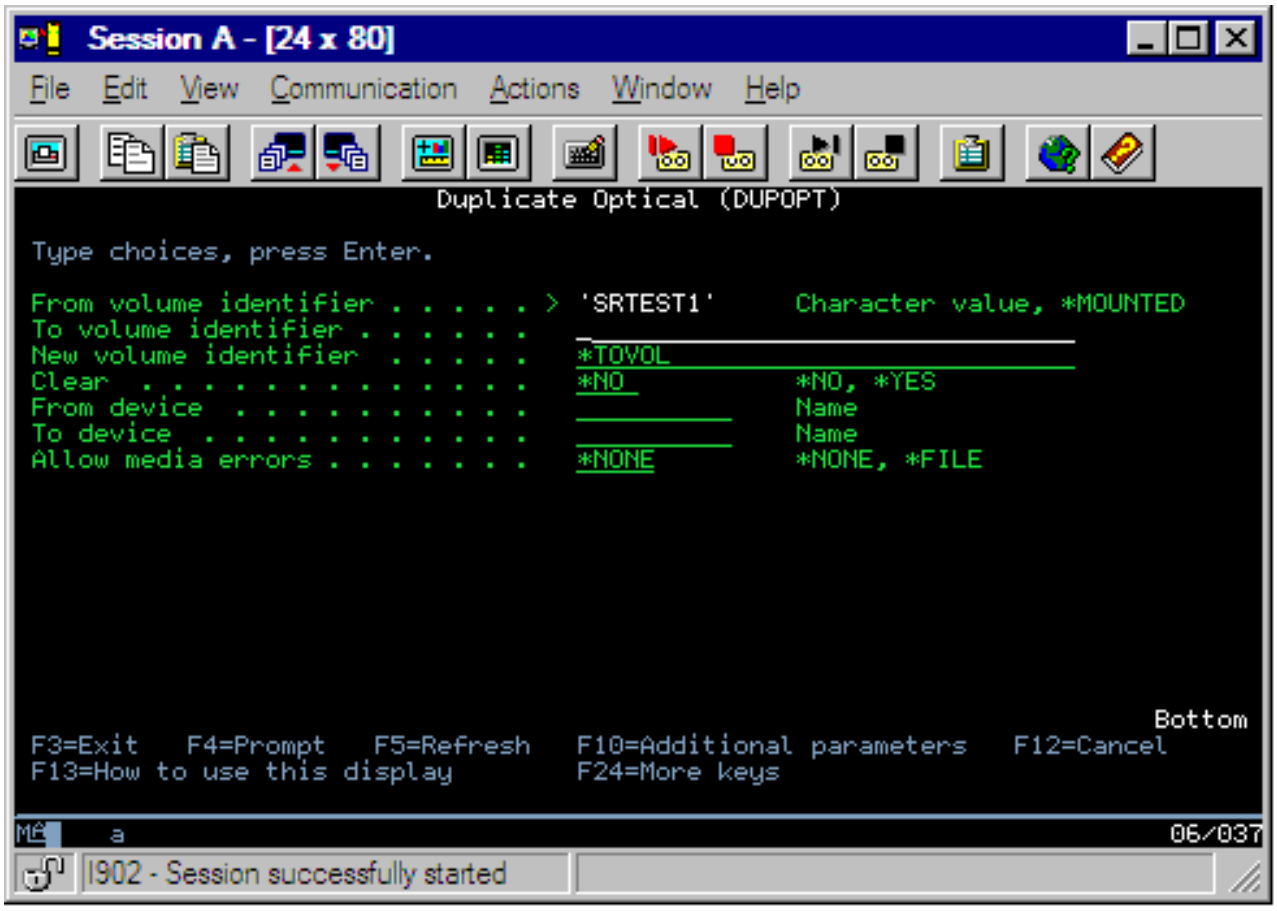
- Volumes in optical CD-ROM or DVD media devices.
- Volumes in directly-attached optical media libraries.
- Volumes in virtual optical devices
- Volumes in LAN-attached optical media libraries

Duplicate optical volumes

This topic explains how to create a backup of an optical volume.

An efficient method to create a backup of an optical volume is to use the Duplicate Optical (DUPOPT) CL command. This command performs sector copies to create a volume that is identical to the source except for the volume identifier and creation date and time.

The duplicate optical display is shown below.



Enter the information for the following fields:

- From volume identifier
- To volume identifier
- New volume indentifier
- Clear

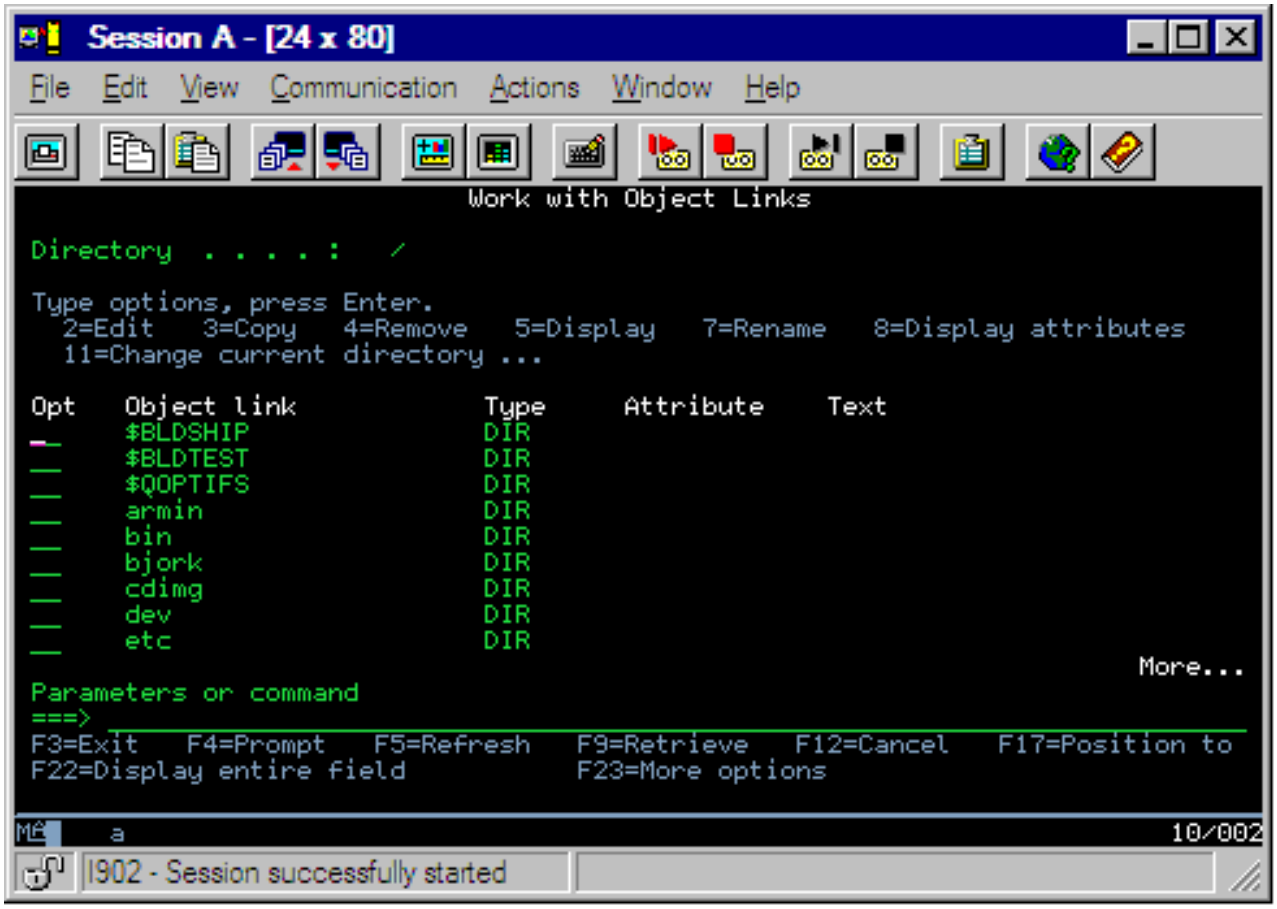
The DUPOPT command applies to the volumes in directly-attached optical media library devices and DVD devices.

View directory and file information

There are two methods to view directory and file information through the optical support panels and commands: Work with Object Links (WRKLNK) and Work with Optical Directories (WRKOPTDIR).

Work with object links

Work with Object Links (WRKLNK) works with directories and files. This command gives a PC-like hierarchical view of the directories and files on the volume. Both directories and files at the given level in the path hierarchy will display as shown below. The system shows directories as type DIR and files as type DSTMF.



The Work with Object Links (WRKLNK) command applies to the following conditions:

- Volumes in CD-ROM or DVD devices
- Volumes in directly-attached optical media library devices
- Volumes in virtual optical devices

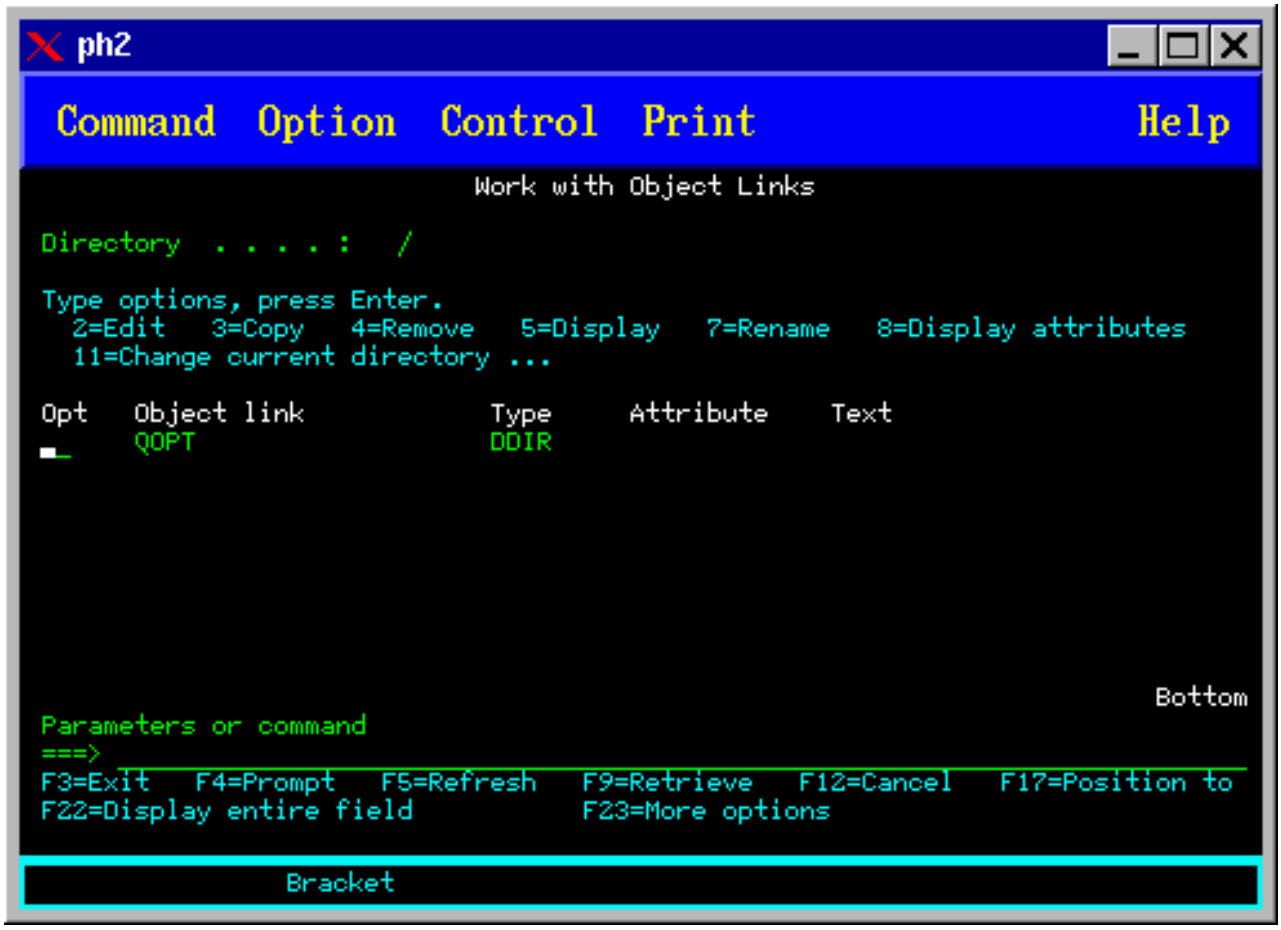
Work with optical directories and files

The Work with Optical Directories (WRKOPTDIR) command works only with directories. You can display all directories and subdirectories, or just display certain levels if desired. This command requires creating the optical directory index if it was not created while adding an optical cartdrige. The Work with Optical Files (WRKOPTF) command works with optical files.

The WRKOPTDIR command and WRKOPTF command apply to the following conditions:

- Volumes in directly-attached optical media library devices
- CD-ROM volumes in either CD-ROM or DVD devices
- Volumes in LAN-attached optical media library devices

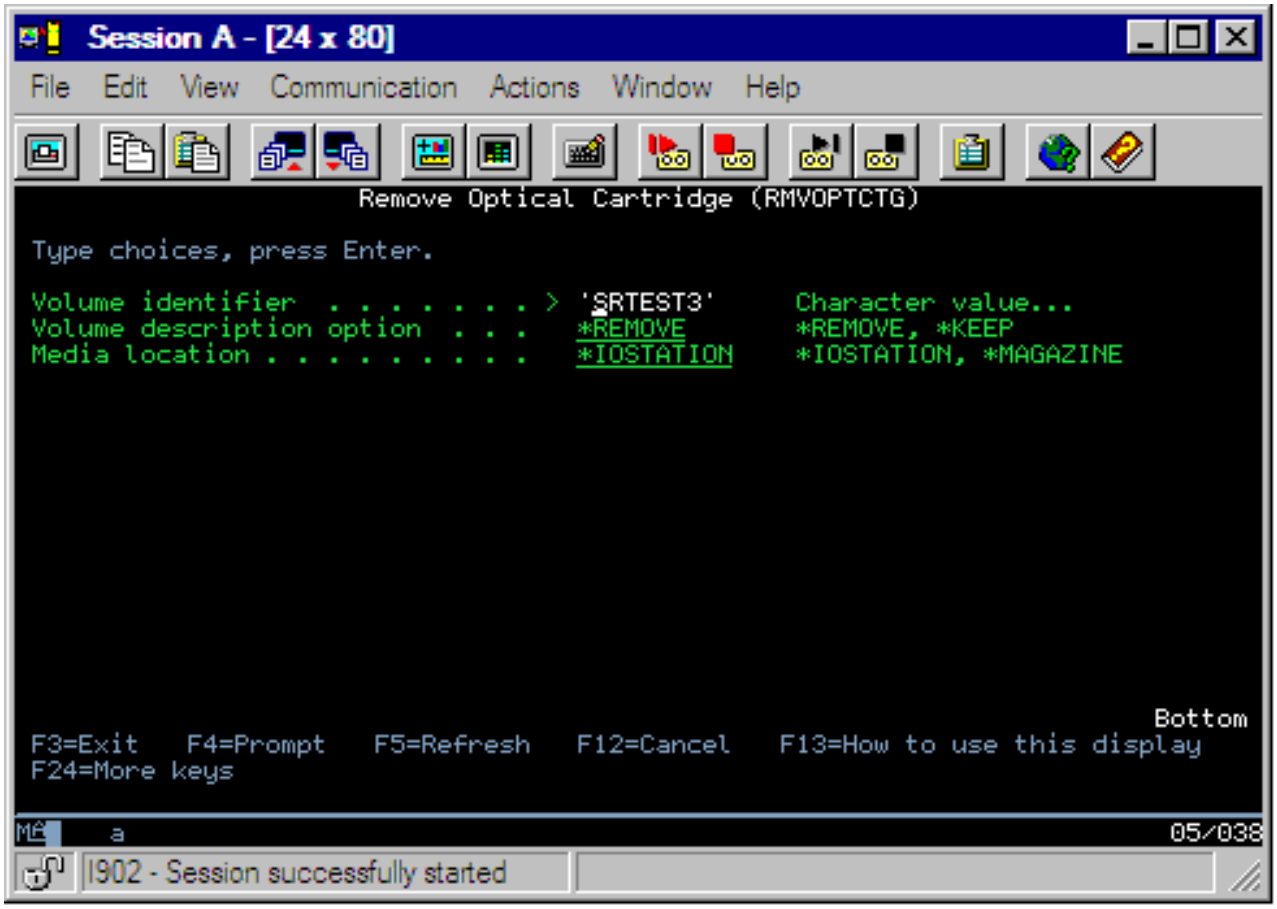
Note: Volumes that are created in universal disk format (UDF) do not support the WRKOPTDIR and WRKOPTF commands.



Remove optical volumes

To remove a volume, select option 4 (Remove) in the Opt (Option) column next to the volume you want to remove on the Work with Optical Volumes display.

You can then remove an optical volume by physically removing the optical disk cartridge from the optical library dataserver. The Remove Optical Cartridge display in the figure below appears and prompts you for additional information.



Enter the information for the following fields:

- Volume identifier
- Volume description option
- Removed cartridge location (if *KEEP was specified as the volume description option)
- Media location: Some 399F models support removing media to the bulk magazine. *MAGAZINE can be specified to use this feature if it is available for the device. The magazine can be removed by specifying VOL(*MAGAZINE) on this command.

Because there are two volumes on each optical disk, the options selected on the Remove Optical Cartridge display apply to both volumes.

Note: The Remove Cartridge (RMVOPTCTG) command applies to:

- Volumes in directly-attached optical media libraries
- Volumes in CD-ROM and DVD devices
- Volumes in virtual optical devices

Deleting removed volumes from the optical index database

If you removed (*REMOVED) the volume but saved the volume description information, you can later delete that information by selecting option 9 (Delete). The delete option can also be used if a volume has been marked as being in an offline device. The delete option removes a single volume, and not both volumes of an optical cartridge.

Note: The delete option applies to:

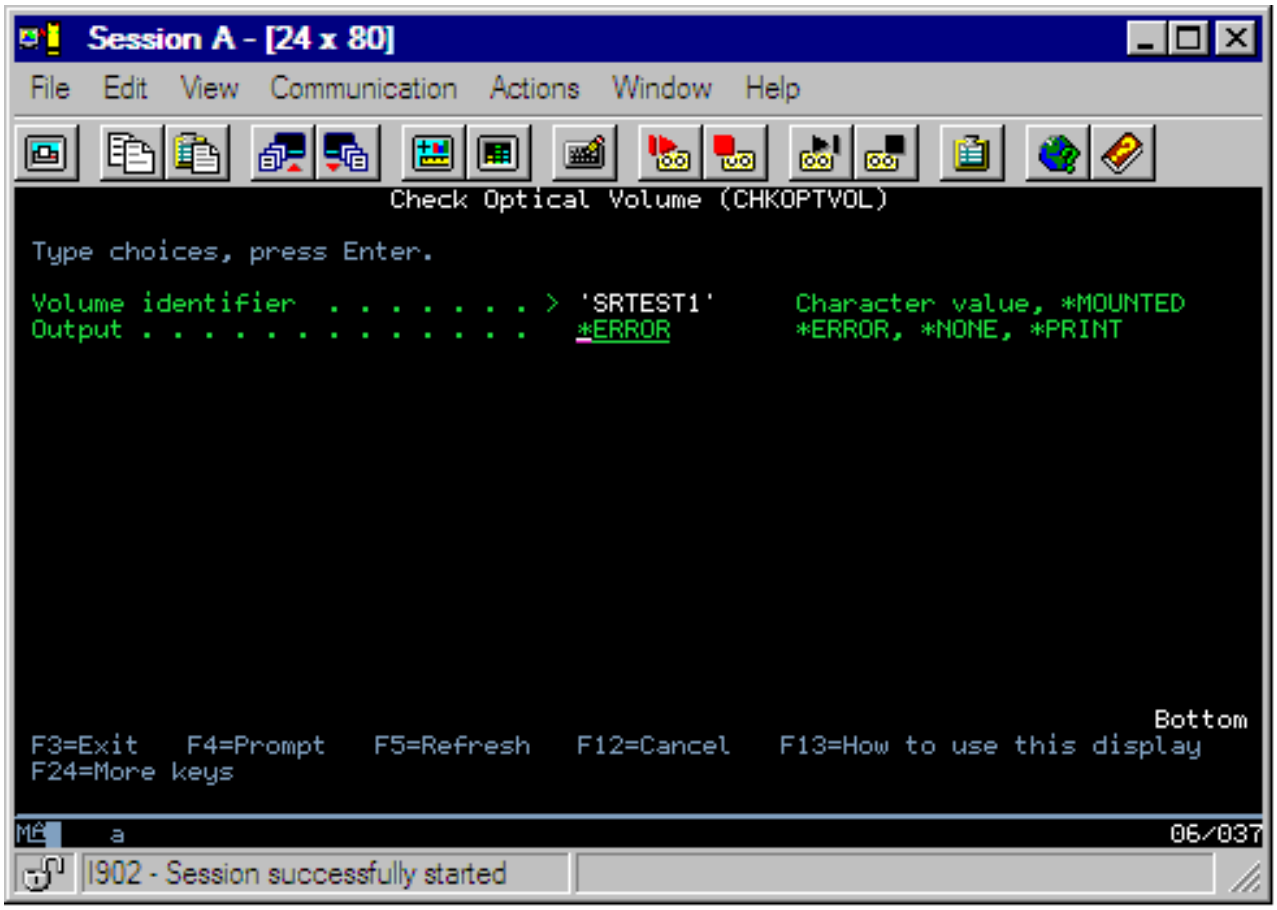
- Removed volumes from an optical media libraries

- Volumes in an offline optical media libraries
- Volumes in an offline optical LAN device

Check optical volume

To validate the integrity of the directories and files on the volume, select option 13 (Check) in the Opt (Option) column next to the volume identifier.

This command can be used to verify that all files can be read and will print a list of damaged files if any exist. In addition, a count of damaged and undamaged files can be displayed depending on the value of the OUTPUT parameter.



Enter the information for the following fields:

- Volume identifier
- Output: Specifies conditions to print output
- Optical device: Required only if the Volume identifier parameter is *MOUNTED

Note: The Check Optical Volume (CHKOPTVOL) command applies to:

- Volumes in directly-attached optical media libraries
- Volumes in CD-ROM and DVD devices
- Volumes in virtual optical

Changing optical environment parameters

The Change Optical Attributes (CHGOPTA) command can be used to change specific optical configuration parameters that affect all jobs using the optical file system.

The following parameters can be set according to your desired configuration.

Copy attributes
Specifies whether to copy the file attributes of the source file when copying or moving files between the QDLS and the QOPT file systems using the HFS Copy or Move Stream File APIs. This parameter is ignored when copying or moving files within the optical file system and is not valid for LAN-attached optical libraries. This value should be set to *NO when applications do not require the file attributes to be maintained when copying between the QOPT and QDLS file systems. Using this option improves the performance of move and copy operations and reduces the optical storage requirements when writing to an optical disk.

Held file attribute
Specifies whether held optical file support is enabled or disabled for the /QOPT file system. When held optical file support is disabled it is up to the user to ensure that correct recovery procedures are followed when there is a close file error condition.

Allow variant characters
Indicates whether or not variant characters can be specified for path names when accessing files on optical volumes in universal disk format (UDF) through the hierarchical file system (HFS) interfaces. This parameter does not affect access to optical volumes formatted in High Performance Optical File System (HPOFS) or ISO 9660 formats. It also has no effect on integrated file system interfaces for all optical media formats.

Support extended media formats
Indicates which media format to use when a media is added to an optical device. Some media have both a primary and extended media format. For instance, a UDF-Bridge Disk has ISO 9660 as the basic format and UDF as the extended format. Rock Ridge alternate name structures is another format that is supported. With this parameter, you can choose which format is to be used when a media is added to a device.

Related concepts

"Recover held optical files" on page 133
A held optical file is an optical file that could not be closed normally.

Set write protection

The write-protect function prevents writing on the disk.

A write-protect window shows when write protection is either on or off.

To use the write-protect function, do the following:

1. Locate the write-protect switch on the cartridge.
2. Set the disk to read/write or read-only.
   - To make the disk read/write, move the write-protect switch to the off position. The write-protect window will be closed. You can write data on the disk.
   - To make the disk read-only, move the write-protect switch to the on position. The write-protect window will be open and data cannot be written on the disk.

A separate Write-Protect switch exists for each volume (side) on the cartridge.

Related tasks

"Label an optical cartridge with an initialized volume" on page 84
To label a cartridge that has at least one initialized volume on it, follow these steps. The options are selected from the Work with Optical Volumes display.

Create a master CD-ROM

See the Optical Storage page for instructions on CD premastering for iSeries.

Optical Storage

Optical Volume Backup

This concept describes the methods that you can use to back up optical data from one optical volume to another optical volume or tape.

Included in this topic is information on defining your backup strategy, your backup options, and using the backup commands.

Defining Your Backup Strategy

This topic describes the step necessary to define a backup strategy.

There is no one perfect backup strategy that meets everyone's needs. Therefore, it is important to define your backup requirements before you decide on a backup strategy. Use the following questions to help you determine your backup:

- Do I need backups?
  - Could information be re-created easily?
  - If I do not have backups, how will that affect my business?
  - Am I legally required to have backups?
- How frequently should my backups be done?
  - Daily
  - Weekly
  - Monthly
  - Only when a volume is full
- How will backups be done?
  - Incremental backup
  - Partial or selective backups
  - Complete backups
- When do I want the system to perform the backups?
  - During first, second, or third shift
  - On the weekend
  - Will there be other contentions for the optical drives?
- Will target volume contain backups for one or multiple volumes?
- How long do I retain source information after a backup has completed?
- What type of availability is needed for volumes?
  - In optical media library
  - Out of optical media library, but on-site
  - Out of optical media library, and off-site

This is not a complete list of items to consider when deciding on a backup strategy, but rather a foundation on which you can build.

Duplicate Optical (DUPOPT)

The Duplicate Optical (DUPOPT) command creates a duplicate optical volume.

The created duplicate volume is identical to the original volume except for the volume identifier and the time created.

Performance improves significantly when you use DUPOPT instead of CPYOPT to back up an entire volume from scratch. The DUPOPT command has the following requirements:

- Two optical drives are required.

- The source and target volumes must have the same sector size.
- The source and target volumes can not be on opposite sides of the same cartridge.
- The source and target device types must be the same type (for example, optical library to optical library or optical stand-alone device to optical stand-alone device).
- If the source media type is *WORM, the target media type can be either *WORM or *ERASE. v If the source media type is *ERASE, the target media type must be *ERASE.
- If the source media type is *DVD-RAM, the target media type must be *DVD-RAM.
- If the target media type is *WORM, it must be uninitialized.
- If the target media type is *ERASE, all data currently on the target volume will be lost.
- Once the DUPOPT command begins operation, the system will not interrupt the process. The system will not schedule any other work in the drives until the command completes.

Use the DUPOPT command when you want to copy the entire volume or for incremental backups of your source volume. For an entire backup, wait until your source volume is full before you use the DUPOPT CL command.

DUPOPT always makes a complete copy of your source volume. However, you could use it to make incremental backups of your optical volumes in the following manner:

1. Determine how often you wish to backup your source and how many backup copies you wish to keep.
2. Use DUPOPT to duplicate your source media to a target media that has a media type of *ERASE. This will give you an exact copy of the source media.
3. Continue making duplicates of your source volume as often as you wish until your source volume becomes full.
4. Once the source media is full and you have a successful final copy, you can reuse all previous target media for backups of other source media.
5. If your source media type is *WORM, prior to your final backup determine whether or not your final target media type needs to be media type *WORM or *ERASE.

Caution: If the DUPOPT command does not complete successfully or it ends for any reason while processing, the backup is unsuccessful. In addition, if the target media type is *WORM, the target volume may no longer be usable.

Enhancements: Several enhancements have been made since the introduction of DUPOPT command:

- DUPOPT no longer requires the source and target volume to be in the same optical library.
- For target media with the *HPOFS media format, the target media capacity no longer has to be identical to the source media capacity. It can now be equal to or larger than the source media.
- For *WORM media the target media type no longer has to be *WORM. You can use either *WORM or *ERASE media.
- Improved device error recovery.
- Improved performance.
- The addition of the cross device support (library to library, stand-alone to stand-alone).
- The addition of the unload support for stand-alone devices.
- When duplicating a volume in a stand-alone or virtual device, you can create an exact copy with the same volume identifier as the source.

In the following example, the system duplicates the volume in optical device OPT01 to the volume in optical device OPT02. Upon completion, the target volume identifier will be MYBACKUP, and the system unloads the media from the device.

Note: Note: The system only supports the unload option for stand-alone devices.

> DUPOPT FROMVOL(*MOUNTED) TOVOL(*MOUNTED) NEWVOL(MYBACKUP)

FROMDEV(OPT01) TODEV(OPT02) FROMENDOPT(*LEAVE) TOENDOPT(*UNLOAD)

Copy optical (CPYOPT)

This topic discusses the Copy Optical (CPYOPT) CL command and some of the optional parameters which you can specify.

Use the CPYOPT command to copy optical files and directories between optical volumes. You can use CPYOPT to copy any of the following: v All files and directories for an entire volume. v All files and subdirectories for a directory. v All files for a directory. v A single file.There are two optical volumes types, and they are: *PRIMARY and *BACKUP. *PRIMARY is the normal volume type which can be written to by user applications. *BACKUP is a special volume type which only can be written to by special optical commands. You can use CPYOPT to copy files between the following volume types:

From Volume	To Volume
*PRIMARY	*PRIMARY
*PRIMARY	*BACKUP
*BACKUP	*PRIMARY

See the following links for additional detail about the CPYOPT command:

Key parameters:

There are several parameters which you can specify in order to help you select the files that you want copied.

The parameters include:

- Select files to copy (SLTFILE)
- Copy subdirectories (CPYSUBDIR)
- Starting date and time (FROMTIME)

To actually copy a file, it must meet all of the above three requirements.

You can use CPYOPT to perform a backup of your optical volumes, but is not the suggested way of doing so. Remember that CPYOPT works on a file basis, therefore if you are copying a large number of files your CPYOPT request could take hours to complete. What options you specify can also affect how long your copy request could run. Review the examples later in this chapter for a comparison of your options and how they may affect your copy request.

Select files to copy: Use the Select files to copy (SLTFILE) parameter to choose which files you want to copy.

- Your options are: v *CHANGED is the default option. The system will determine if the source file already exists on the target volume. If so, the system will copy the source file only if the source file has changed since performing the last copy. Two sets of dates and times determine if a file has changed: Either the date and time the file was last changed, or the date and time the file attributes were last changed. Specifying DATA(*FILATR) on the Display Optical (DSPOPT) CL command can display these dates and times.
- *ALL indicates that the system will copy all files on the source volume. The system will replace any files which may already exist on the target media by a new copy from the source volume.
- *NEW indicates that the system will copy only files which are not currently on the target volume.

If the target volume already contains files, choosing the *CHANGED or *NEW option may result in a longer running CPYOPT request. This is because the system has to make a list of files for both the source and target volume, and then compare them. The time required to do this can become excessive when the volumes contain thousands of files.

Copy subdirectories: Use the Copy subdirectories (CPYSUBDIR) parameter to indicate whether or not to process files in the subdirectories of the specified From path. Your options are:

- *NO indicates that only files in the specified From path are eligible to be copied. This is the default option.
- *YES indicates that files in all subdirectories of the specified From path are eligible to be copied. The system creates subdirectories on the target volume if they do not already exist. The newly created subdirectories have the same name as they did on the source volume, even though the parent directory name can be different. A system makes a check prior to the copy operation to ensure that any resulting new path name does not exceed the maximum path name length. The system prevents you from copying the subdirectories of one directory to a subdirectory of that directory on the same volume.

Starting date and time: The system will use the FROMTIME parameter to determine if a file is eligible for copying based on its creation or modification date. All files that were created, changed, or whose attributes have changed, on or after the starting date and time are eligible for copying. You can determine when a file was last created or changed by specifying DATA(*FILATR) on the Display Optical (DSPOPT) CL command. The default values: *BEGIN for Starting date and *AVAIL for Starting time indicates that all files meet the starting date and time requirement. Specifying a starting date and time identifies only files that were created or changed since that date and time as eligible for copying. You can use this parameter to greatly limit the number of files that require processing by CPYOPT. This decreases the time that is required to process the files. You could combine this parameter and the SLTFILE parameter to limit the number of files that need to be checked before copying. You could select only files that were *CHANGED or *NEW after a specified starting date and time.

Examples: Scenario 1 — Copy all files from the source volume: This example shows how to copy all files from the source volume VOL001 to a volume which currently does not contain any files or directories. The system will process all subdirectories of the source volume, create the subdirectories on the target volume, and copy all files.

```
> CPYOPT FROMVOL(VOL001) FROMPATH(/) TOVOL(CPYVOL001) SLTFILE(*ALL) CPYSUBDIR(*YES)
CRTDIR(*YES)
```

Scenario 2 — Copy all files form the source volume since the last copy request: For this example you have several different option which may take different lengths of time. Your first option would be to issue the same request as Scenario 1 but with a different target volume. The system will copy all the files and directories to the new target volume.

Your second option would be to use the *CHANGED option on the SLTFILE parameter.

```
> CPYOPT FROMVOL(VOL001) FROMPATH(/) TOVOL(CPYVOL001) SLTFILE(*CHANGED)
CPYSUBDIR(*YES) CRTDIR(*YES)
```

Depending on how many files are currently on the source and target media this request may take a long time to process. First, you must obtain a list of all files on the source media and the target media. Then compare the files in order to determine if any file has changed since the last CPYOPT request. Once that is done, the system will copy only the files that have changed.

The third option is using the *NEW option on the SLTFILE parameter, provided that no existing files changed, but simply added to the source volume.

```
> CPYOPT FROMVOL(VOL001) FROMPATH(/) TOVOL(CPYVOL001) SLTFILE(*NEW)
CPYSUBDIR(*YES) CRTDIR(*YES)
```

First, you must build option a list of all files that are on both the source and the target volume. Then compare the files before copying any new files.

Your fourth option would be to use one of the SLTFILE options in combination with specifying a starting date and time.

> CPYOPT FROMVOL(VOL001) FROMPATH(/) TOVOL(CPYVOL001) SLTFILE(*CHANGED) CPYSUBDIR(*YES) CRTDIR(*YES) FROMTIME('04/01/99' '00:00:00')

By specifying a starting time, the system copies only files that were created or changed after 04/01/99 to the target volume.

Using CPYOPT to Backup a volume:

You can use the Copy Optical (CPYOPT) command to do a complete or partial copy of your volume.

The following describes the special processing of the CPYOPT command when the target is a *PRIMARY or *BACKUP volume. Refer to the following list to decide how to best use the command.

- Copy completely or partially. You can copy a file, a directory, a directory with all of its sub directories, or an entire volume.
- Copy incrementally. You can copy only what has changed since the previous CPYOPT request.
- Copy specifying a starting date for selecting files. Only files that are created or changed on or after the specified date are eligible for copying.
- Replicate the hierarchical structure of the source volume on the target volume.CPYOPT requirements to volume type *PRIMARY When the target volume is type *PRIMARY, the CPYOPT command has the following unique requirements:

*CPYOPT requirements to volume type *PRIMARY:* When the target volume is type *PRIMARY, the CPYOPT command has the following unique requirements:

- The source volume can be either type *PRIMARY or *BACKUP.
- Because the target volume is *PRIMARY, all API requests and most optical commands and utilities can access the volume.
- Because utilities and user programs can update the *PRIMARY volume, you need to determine how to protect directories and files from unauthorized change or deletion.
- The target volume could contain information for one or multiple optical *PRIMARY volumes. An easy way to manage multiple volumes on a single target volume would be to have a new first level directory. That directory name could be the name of the source-primary volume.
- You need a way of keeping track of when a volume or directory was last backed up. Use the CPYOPT command to do it automatically.
- The hierarchical structure on the target volume does not need to be identical to that of the optical *PRIMARY volume.
- The create date and time, and change date and time, of the file on the target volume will be different than their counterparts on the optical primary volume. The file creation data and time on the target volume is the date that the file was written.
- You can use directories and files on the target *PRIMARY volume directly. You do not have to copy applications back to a *PRIMARY optical volume.
- You can request that the system copy only new files on the source volume to the target volume. This might be useful if you never changes files on your source volume but only create new ones.

*CPYOPT requirements to volume type *BACKUP:* When the target volume is type *BACKUP, the Copy Optical (CPYOPT) command has the following unique requirements:

- The source volume must be type *PRIMARY.

- Only the CPYOPT and CVTOPTBKU commands can write to the target *BACKUP volume. APIs, utilities, and user programs cannot write to an optical *BACKUP volume.
- An optical *BACKUP volume can contain information for only one optical *PRIMARY volume. This prevents two primary volumes from sharing the same optical backup volume.
- You cannot delete directories or files from an optical *BACKUP volume. This ensures data integrity of the optical backup volume.
- The system maintains the file create date and time, and change date and time for the *PRIMARY volume on the optical *BACKUP volume.
- A user application cannot directly use a file or directory on a *BACKUP volume. First, you must copy the file or directory to an optical *PRIMARY volume by using CPYOPT.
- If the optical *PRIMARY volume is damaged or lost, you can convert the optical *BACKUP volume to an optical *PRIMARY volume. You can do this by using the Convert Optical Backup (CVTOPTBKU) CL command.
- To maintain control information about the status of backup requests, optical *BACKUP volumes require additional media usage. Because of this, a *PRIMARY volume that is 100% used may not fit on an optical *BACKUP volume.
- The system always initializes *BACKUP volumes with a 99% volume threshold.

Suggestions on which CPYOPT volume type to use: Here is a list of items that you can use to determine if you should use a target volume type of *PRIMARY or *BACKUP.

- In general, the CPYOPT to a type *PRIMARY volume gives you more flexibility, but it requires more management of your backup volumes.
- The CPYOPT to a type *BACKUP volume provides more management and security for your optical backup volumes, but it is less flexible.
- Use the CPYOPT command, and specify a type *PRIMARY volume, if you want to copy data from several volumes to a single volume.
- Use the CPYOPT command, and specify a type *BACKUP volume, if you want better security for your backup volumes. The system cannot write volumes with type *BACKUP to with normal optical commands or user programs.
- Use the CPYOPT command and specify a type *BACKUP volume to save information such as when the system copied directories and volumes, and the success status of those copies.
- The biggest advantage of using the CPYOPT to a type *BACKUP volume is that the system stores the backup control information on the backup volume. This information includes the relationship between files on the backup volume and the files on the primary volume. This information can be very useful if you ever need to recover the lost source data is from the backup volume.
- Use the CPYOPT command, and specify a type *BACKUP volume, if you want the source and target file dates (creation and change) to be identical.
- One disadvantage in using the CPYOPT command to a type *BACKUP volume is that the system uses extra space on the backup volume to store control information. The amount that is used is approximately 3 times the sector size for each directory. Therefore, if CPYOPT copies 100 directories from a primary volume to a backup volume where the sector size on the backup volume is 2KB, the backup volume uses an additional 600KB of space. In this example 600KB of space is used every time the command is run.

Volume type *BACKUP:

This section discusses the *BACKUP volume type and the unique backup process that are associated with a *BACKUP volume.

Remember that using Copy Optical (CPYOPT) to a *BACKUP volume is no longer the suggested way of backing up your volumes because of the time required. Duplicate Optical (DUPOPT) is the recommended way of backing up your volumes.

The *BACKUP volume type supports the backing up and protection of information from optical *PRIMARY volumes. The system does not allow user programs or APIs to write to optical *BACKUP volumes. Only a limited set of optical commands can update *BACKUP volumes. Once the system creates a directory or file on an optical *BACKUP volume, the only way to delete them is to reinitialize the volume. Doing this prevents either accidental or intentional deletion.

Backup volumes and directories contain a Complete Backup Range file which contains date information about prior copy requests to the optical *BACKUP volume. These dates are helpful in determining the contents of backup directories and volumes with respect to the contents of their primary counterparts. These control dates make it easier to recover by providing a time checkpoint. Each backup directory has its own control dates. Each backup volume also has its own control dates, which include:

- Complete starting date and time
- Complete ending date and time
- Last changed date and time

The system writes these dates to the backup volumes in a reserved file within each backup directory. Since the system writes the dates to the media, the backup volumes are self-contained. Not only is the backup data on the media, but the recovery information is there as well.

Complete Backup Range:

When an optical *PRIMARY volume to copied to an optical *BACKUP volume a special file called a Complete Backup Range is written to the *BACKUP volume.

This file indicates the last time a backup was done. The system keeps backup control information for the volume as well as each directory on the volume. If the volume or directory was successfully backed up the Complete Backup Range will contain both a starting and ending date and time. When a range exists for an optical backup volume or directory, it has a specific meaning: The backup directory or volume has a copy of all the created or changed files within the date range that correspond to the primary directory or volume.

For example, volume BVOL1 is an optical *BACKUP volume for *PRIMARY volume PVOL1. BVOL1 contains directory /DIR1 that has a Complete Backup Range as follows:

- Start Date: 1/1/99
- Start Time: 09:00:00
- End Date: 1/30/99
- End Time: 22:00:00

This means that the system backe up all the changed or created files in /DIR1 on PVOL1 since 9:00 a.m. on 1 January 1999. The system backed up files to /DIR1 on BVOL1 at 10:00 p.m. on 30 January 1999. Any files that were created or changed on *PRIMARY volume PVOL1 in directory /DIR1 after 22:00:00 on 1/30/99 would not yet have been backed up.

Complete Backup Range for Directories: The Complete Backup Range for a directory does not encompass all subdirectories of the directory. In other words, each directory has its own unique Complete Backup Range. For example, assume that directory /A has a Complete Backup Range of 1 March 1999 through 1 May 1999. This does not necessarily mean that directory /A/B has the same complete range. In fact, /A/B might have no Complete Backup Range at all. The complete range does not reflect a hierarchical range over all directories within that subtree.

The system updates the Complete Backup Range for a backup directory after it copies all eligible files in the primary directory.

Note: Note: Use the SLTFILE parameter on the CPYOPT command to determine if a file is eligible. If you use *ALL, all files are eligible to copy. If you use *CHANGED, only those files that were created or changed since the last CPYOPT command are eligible. If you specified *NEW, the system copies files only if they do not exist on the target volume.

For example, FILE.001 gets copied on 1 March 1999 as a result of a complete backup of directory /DIR1. At this time /DIR1 is given an ending range of 1 March 1999. On 1 April 1999, the user has the system back up directory /DIR1 again by specifying SLTFILE(*CHANGED). However, the back up affects only the files that have changed. If FILE.001 has not changed since the previous CPYOPT command, this file is not eligible to copy. However, the system updates the ending range for /DIR1 to 1 April 1999 if none of the eligible files fail to copy.

Complete Backup Range for Optical Volumes: The Complete Backup Range for an optical volume is very similar to that of an optical directory. The complete range for a directory represents the relationship between the files in a backup directory and those in the primary directory. Likewise, the complete range for an optical backup volume represents the relationship between the files on an optical backup volume and those on the primary volume. You must back up all eligible files on a volume to update the complete range of the volume.

You can update the complete range for a volume only if the CPYOPT command specifies the FROMPATH(/) and CPYSUBDIR(*YES) variables. This ensures that the system will process all files on the *PRIMARY volume.

Complete Backup Range — Starting Date and Time:

You can specify a starting date and time on the Copy Optical (CPYOPT) command.

The starting date and time of a Complete Backup Range for an optical backup volume or directory is the earliest time that is specified on a CPYOPT command when all eligible files on the volume or directory were successfully copied.

This system uses time to select the files from the primary volume to copy to the optical backup volume. The system copies any files that are created or changed on or after this time. First, the system must successfully copy all eligible files for a directory or volume. Then the system sets the starting date and time for the corresponding optical backup volume or directory to the specified time. The definition indicates that this value is the earliest time that is specified on a CPYOPT command. Consider the following example.

Starting Date and Time — Scenario: A user issues the CPYOPT command for directory /DIR1 by specifying 1 May 1999 as the starting date. If all eligible files successfully copy, then the system sets the complete starting date for the backup directory /DIR1 to 1 May 1999.

Now assume that the user issues the CPYOPT command again for /DIR1. This time the system sets the starting date to 1 April 1999. This request copies any files that have changed since the last CPYOPT command. Additionally, it copies any files that were created between 1 April 1999 and 1 May 1999 that were not selected on the previous request. If all eligible files again copy successfully, then the starting date for backup directory /DIR1 changes to 1 April 1999. Future copies specifying earlier starting dates would produce similar results.

Use *BEGIN and *AVAIL for the starting date and time on the CPYOPT command. This will copy all the files from a primary directory or volume, regardless of the create or change time for the file.

Complete Backup Range — Ending Date and Time:

The CPYOPT command does not allow you to specify an ending date and time. The system always uses the date and time of the copy request as the ending date and time.

Therefore, the system uses the date and time of the request for the complete ending date and time for a backup directory or volume.

The ending date and time of a Complete Backup Range for an optical backup volume or directory is one of the following conditions:

- The last time a CPYOPT command completed.
- When the system successfully copies all eligible files in that volume or directory.
- When the starting date and time of the request is not after the existing complete range.

The definition of the ending date and time field has two parts. First, this date is the last time a CPYOPT command completed for the directory or volume with no failures. Second, the complete ending date and time will not update if the range of the request does not overlap the existing range. This is true even if all eligible files copy successfully.

Ending Date and Time — Scenario: On 1 July 1999, the user issued the CPYOPT command for directory /DIR1 that specifies 1 February 1999 as the starting date. If all eligible files successfully copy, the system sets the complete starting date for the backup directory /DIR1 to 1 February 1999. The system sets the complete ending date to 1 July 1999.

Now, the system issues a second CPYOPT command for directory /DIR1 on 15 September 1999, specifying 1 June 1999 as the starting date. If all eligible files successfully copy, the complete starting date for backup directory /DIR1 remains 1 February 1999. The complete ending date is moved out to 15 September 1999. This is the normal situation that takes into account only the first part of the definition above.

On 1 December 1999, the user issues the CPYOPT command again for the /DIR1 directory. This time the use specifies 1 October 1999 as the starting date. Even if all eligible files copy successfully, the complete range will not change. The complete range cannot be expanded to include the new ending date. This is because the files that were created or changed between 15 September 1999 and 1 October 1999 are not accounted for.

Complete Backup Range — Lasted Changed Date and Time:

Using the CPYOPT command causes the system to write the last changed date and time of an optical backup volume or directory.

This includes any time that the system wrote files or directory attributes to the directory or volume.

The last changed date and time for that directory and volume will always reflect the date and time of the request. This remains true even if the system writes a file to a backup directory.

Last Changed Date and Time — Scenario One: On 1 July 1999, the user issues the CPYOPT command for directory /DIR1 by specifying *BEGIN as the starting date. If the system successfully copies all the eligible files, then the dates are as follows:

- The system sets the complete starting date for backup directory /DIR1 to *BEGIN.
- The system sets the complete ending date to 1 July 1999.

If the system copied at least one file to /DIR1 as a result of this request, the last changed date is also 1 July 1999.

The system does not necessarily update the last changed date and time as the result of a successful copy. If the system did not write any files to the backup directory, the system may update the complete range, but not the last changed date.

Last Changed Date and Time — Scenario Two: In “Last Changed Date and Time — Scenario One,” the backup directory /DIR1 has the following as dates after the request:

- A starting date of *BEGIN.
- An ending date of 1 July 1999.
- The last changed date of 1 July 1999.

On 1 October 1999, the user issues the CPYOPT command again for directory /DIR1. This time the command specifies SLTFILE(*CHANGED) to copy only the files that have changed since the last CPYOPT request. Assume that no files have changed since the last backup on 1 July 1999. Since no files are eligible to copy, the system writes no files to the backup directory /DIR1. Therefore, the last changed date remains 1 July 1999. However, since no eligible files failed, the complete range for /DIR1 expands to have an ending date of 1 October 1999. The last changed date and time becomes most important when it is set beyond the complete range. This would happen if some files were actually copied but other eligible files failed to copy for some reason.

Last Changed Date and Time — Scenario Three: In “Last Changed Date and Time — Scenario Two,” the backup directory /DIR1 has the following dates after the request:

- A starting date of *BEGIN.
- An ending date of 1 October 1999.
- A last changed date of 1 July 1999.

On 1 December 1999, the user issues the CPYOPT command again for directory /DIR1. Assume that 10 files were changed or added to primary directory /DIR1 since the last CPYOPT request on 1 October 1999. Assume that only eight files successfully copy to /DIR1 and that two of the eligible files failed. Since the system did not copy all eligible files, the complete range stays the same with a starting date of *BEGIN and an ending date of 10/1/99. However, since /DIR1 changed, the last changed date gets updated to 1 December 1999. Since the last changed date is outside the complete range, a complete copy of /DIR1 from *BEGIN to 1 October 1999 may not exist. A more recent copy by the change on 1 December 1999 might have replaced one of those files.

*Copying to Optical *BACKUP Volume — Example:*

This example shows the system that backs up the *PRIMARY volume VOL01 to the *BACKUP volume BKP-VOL01.

This will copy all the files in all the subdirectories. Once the system writes to volume BKP-VOL01,the system will use the volume in one of the following ways:

- For further backups of volume VOL01.
- For converting from *BACKUP volume BKP-VOL to *PRIMARY volume VOL01.

```
> CPYOPT FROMVOL(VOL01) FROMPATH(/) TOVOL('BKP-VOL01' *BACKUP) SLTFILE(*ALL)
CPYSUBDIR(*YES)
```

*Converting an Optical *BACKUP Volume:*

Use the Convert Optical Backup (CVTOPTBKU) command to convert an optical *BACKUP volume to an optical *PRIMARY volume.

You would typically use this function when the *PRIMARY optical volume is either damaged or missing. The conversion eliminates the necessity of copying all information from the optical *BACKUP volume to a new *PRIMARY volume. After the system converts the volume to a *PRIMARY volume, it will allow all write requests to the volume.

Once the system converts an optical *BACKUP volume to a *PRIMARY volume, there is no way to convert it back to an optical *BACKUP volume. To convert backup volumes, select option 6 (Convert optical backup volume) from the Optical Backup/Recovery display or use the CVTOPTBKU CL command.

Before you attempt to convert, you should verify the name of the *PRIMARY volume for which this volume is a backup. You can do this by displaying the volume attributes of the optical *BACKUP volume. You can do this by using the Display Optical Volume Attributes (DSPOPT) command or by selecting option 5 (Display) from the Work with Volumes display.

There may be previously deleted *PRIMARY volume directories and files on the optical *BACKUP volume. Therefore, when converting the optical *BACKUP volume to a *PRIMARY volume, it might be necessary to manually delete directories and files from the volume. You perform this function in order to accurately reflect what was on the *PRIMARY volume. If you never delete directories and files from a *PRIMARY volume, this should not be a concern.

CPYOPT Performance:

This topic discusses the fact that performance is a complex subject with many interdependent components.

By changing one component, you may adversely affect another. This interdependence and the other factors that affect performance, prohibits providing a formula for computing the time required to copy a given number of files. It is simply a guideline to help you estimate how long your CPYOPT might take.

You may need to estimate how long it takes to copy an entire optical volume when using the CPYOPT command. You can start by copying a single directory that contains a known number of average sized files. Then take the difference between the ending time and starting time to determine an elapsed time. Take the elapsed time and divide by the number of files that are copied to figure the average seconds per file. You can use this number as a basis to determine the amount of time that is required to copy the entire volume of average size files.

To maximize copy performance, use the following set of guidelines as a starting point:

- Having too few directories with too many files can affect performance. Having too many directories with too few files can affect performance also. Try to keep the number of files in a directory to less than 6000 files.
- Consider performance when determining file size.
- Avoid use of extended attributes on files. When a file has extended attributes, they are storied separately from the data. When copying the data, the must copy the attributes also. It is similar to copying a second file for each user file copied.
- Keep the source and target volumes in the same library.
- Avoid copying to the opposite side of an optical cartridge.
- If the copy processes can have dedicated use of the optical drives, use the COPYTYPE *IOP parameter on the CPYOPT command.
- Avoid optical drive contention from other optical processes.
- Dedicate the use of two optical drives for copy activity.

Drive Contention: The following conditions can severely affect copy performance:

- Having only one drive available for use.
- Copying from one side of an optical cartridge to the opposite side.
- Having other optical processes that are running that attempt to use the available drives.
- A large number of files on source volume.

To remove a volume, to store it in a slot, to retrieve a new volume, and to mount it requires from 8-15 seconds. You should try to do your copy requests when the process can have dedicated use of the optical drives.

You should not try to copy a large number of files from one side of an optical cartridge to the other side. Optical drives have only one read/write head. The following conditions occur when copying from one side of an optical cartridge to another:

- The system mounts the source volume.
- A limited number of files that are to be copied are read and stored on i5/OS temporary storage.
- The source volume is removed, and the system mounts the target volume by turning over the optical cartridge.
- Files are read from i5/OS temporary storage and written to the target volume.
- If there are more files to copy, the system removes target volume and mounts the source volume again by turning over the optical cartridge.
- The system repeats this process until it copies all the files. You may need to turn the optical cartridge over many times to copy all the files.

Copy performance is always better when both the source and target volumes are in the same library and when setting the COPYTYPE parameter for that library controller to *IOP. Two conditions exist that require n extra processing step. The first one is that the source and target volumes are in different libraries. The second involves setting the COPYTYPE parameter to *SYSTEM and having the volumes exist in the same library. This extra step requires moving the files you want to copy to temporary storage on the iSeries server before writing them to the target volume. You do not need to use temporary storage when the system meets both of the following conditions:

- Both optical volumes are in the same library.
- You set the COPYTYPE parameter on the CPYOPT command to *IOP.

This allows for the direct transfer of data between the two optical drives.

Save/Restore (SAV/RST) commands

The SAV command can be used to create a backup of an optical volume image. The volume image is restored using the RST command.

An optical volume image is a copy of the entire optical volume in *SAVRST format. Using SAV, the volume image can be saved to any supported save/restore device including tape, diskette, optical, or save file.

Subsequently, when the volume image is restored using the RST command, the entire image must be restored to an existing optical volume either in a stand-alone device or an optical media library.

An optical volume image has unique properties that require the entire volume image to be saved or restored in a single operation. Once saved you cannot restore individual files or directories.

Once an optical volume image is saved, it can be viewed with DSPTAP, DSPDKT, DSPOPT, or DSPSAVF, depending on the save/restore device used. When the volume save/restore entry is displayed, option 8 can be used to display the additional information panel, which includes media specific information such as media type, volume capacity, sector size, and security attribute information. You cannot see the individual files and directories that make up the volume image.

Use of the generic SAV command to save optical data can be easily incorporated into an existing system backup strategy without requiring a separate command such as DUPOPT to perform the save operation. SAV provides a good alternative to DUPOPT because it allows a volume to be saved from a one drive optical media library or from a standalone device without requiring the allocation of a second optical device. SAV provides a viable incremental backup solution by periodically backing up volumes not yet at

capacity to a save/restore device such as tape. When the volume is full it can be duplicated for archival purposes by either restoring the full volume to create a copy or by issuing DUPOPT to duplicate the volume.

Saving and then restoring an optical volume image creates an exact copy of the saved volume including the volume name. DUPOPT creates a copy of the source volume but the volume name is changed.

To save and restore an optical volume the following authority is required:

- *USE authority to the optical device.
- *SAVSYS special authority OR *OBJEXIST authority through the optical volumes authorization list.
- If the media format is UDF *RWX authority is also required to the root directory of the volume. The device will be locked shared (LSRD) read while a SAV or RST is active.

Auditing records created during a SAV or RST request.

- **OR** Object Restored
- **RZ** Change primary group during restore. Saved value different from target. Value on target remains unchanged. (UDF only)
- **RO** Change owner during restore. Saved value different from target. Value on target media remains unchanged. (UDF only).
- **O1** Successful open for save (S/R/S) Storage/Read/Save. Successful open for restore (S/U/R) Storage/Update/Restore

Save (SAV) command Support:

SAV can be used to save HPOFS or Universal Disk Format (UDF) formatted volumes.

This function will not support the backup of a ISO9660 formatted media.

Select a volume or volumes to save. The SAV command prevents the implicit saving of all optical volume images in the QOPT file system when the OBJ parameter includes the entry '/*'. The file system QOPT cannot be saved; however, volumes below the file system can be saved. If you want to save all volumes within the QOPT file system, '/QOPT/*' must be explicitly specified on the OBJ parameter. If all volumes are selected, be aware that this SAV operation could take a long time to complete depending on the number of volumes being saved. See the "Parameters" section for additional restrictions on the OBJ parameter.

In order to specify that a volume image is to be saved, you must specify a value of *STG on the SUBTREE parameter.

Saving an optical volume image to another optical volume is allowed; however, the target volume cannot be the opposite side of the saved volume.

The performance of SAV is comparable to DUPOPT, although it depends on the target device chosen.

Parameters:

- **OBJ** Specify a single or multiple path names. The path name cannot be extended beyond the volume level. Examples of invalid path names include, '/QOPT/VOL/*' or '/QOPT/VOL/DIR/FILE'.
- **SUBTREE** Must be *STG when saving optical volume images.
- **CHGPRIOD** Start Date, Start time, End Date and End time must all be *ALL.
- **UPDHST** Must be *NO.
- **SAVACT** Parameter is ignored when attempting to save optical volume images.
- **PRECHK** Must be *NO.

- **TGTRLS** Value cannot precede V5R2M0. Refer to the CL topic in the Programming category in the Information Center for a further explanation of parameter values and their meaning.

Refer to the CL topic in the Programming category in the Information Center for a further explanation of parameter values and their meaning.

Examples:

- Save all volumes within the QOPT file system to a save file.
  SAV DEV('/qsys.lib/xyz.lib/xzysavfile.file') OBJ(('/qopt/*')) SUBTREE(*STG)
- Save all volumes beginning with vola and volb to a save file.
  SAV DEV('/qsys.lib/xyz.lib/xzysavfile.file') OBJ(('qopt/vola*') ('/qopt/volb*')) SUBTREE(*STG)
- Save one volume vol1 to a tape device.
  SAV DEV('/qsys.lib/tap01.devd') OBJ(('/qopt/vol1')) SUBTREE(*STG)

RST Support:

RST can be used to select a volume or volumes to restore.

The RST command protocol requires that all physical file systems adhere to a certain set of predefined rules governing how restore is handled, depending on whether or not the object exists on the system. For purposes of restoring an optical volume image, the target media must exist on the system, either mounted in a stand-alone device or imported into an optical media library. Also, it must be accessible by the name specified on the OBJ-New Path Name parameter. The OBJ-New Path Name must either match the name of the OBJ-Name parameter or be *SAME. This restriction will require that unformatted volumes be renamed before executing the RST command. Unformatted volumes can be renamed using option 7 from either the WRKOPTOL, WRKLNK display or by issuing the generic RNM command.

When an unformatted volume is renamed, the new name acts as an alias to the unformatted volume. The new name will not be written to the media and will not be preserved if the volume is removed from the device. The name is only a temporary volume identifier used to refer to this volume until the volume is restored.

Saved volumes can be restored to both unformatted and formatted volumes. If restoring to a formatted volume that contains active files and directories, an inquiry message is sent. If you proceed with the restore, all data on the target media will be lost.

Saved HPOFS volumes can be restored to Erasable media with matching sector sizes and a capacity equal to or greater than the saved volume.

Saved UDF volumes on DVD and Erasable can be restored onto DVD or eraseable media, but media capacity and sector size must be identical to the saved volume.

WORM volumes can be restored to either WORM or Erasable media as long as the capacity of the target media is greater than or equal to the saved volume capacity and the sector size is identical to the saved volume. When restoring to WORM, the target volume must be unformatted.

The performance of RST is comparable to DUPOPT, although it depends on the target device chosen.

Parameters: **OBJ Name** Name of the optical volume image or images to be restored from a save/restore device.

OBJ New Path Name Specify a single or multiple path names. The path name cannot be extended beyond the volume level. Examples of invalid path names include, '/QOPT/VOL/*' or '/QOPT/VOL/DIR/FILE'. Specify the names of existing volumes or *SAME.

SUBTREE Must be *STG when restoring optical volume images.

OPTION Must be *ALL or *OLD.

ALOWOBJDIF Select *OWNER, *PGP, *AUTL, *NONE, *ALL. The value selected determines what differences will be tolerated between the saved volume and the formatted target volume. If changes are allowed, an attempt will made to preserve the security attributes UID, GID and PERMS of a the UDF target volume root directory. The *OWNER and *PGP values are not checked when restoring to an uninitialized volume or when restoring to an initialized HPOFS volume.

Refer to the CL Reference guide for a further explanation of parameter values and their meaning.

Examples:

- Restore all volumes within the QOPT file system from a save file.
  RST DEV('/qsys.lib/xzylib.lib/xzysavefile.file') OBJ((* *INCLUDE *SAME)) SUBTREE(*STG).
- Restore all volumes beginning with vola and volb from a save file.
  RST DEV('/qsys.lib/xzylib.lib/xzysavefile.file') OBJ(('/qopt/vola*' *INCLUDE *same) ('/qopt/volb*' *INCLUDE *same)) SUBTREE(*STG)
- Restore one volume, vol1 to vol1.
  RST DEV('/qsys.lib/tap01.devd') OBJ(('/qopt/vol1' *INCLUDE *same)) SUBTREE(*STG)

Note: The OBJ-New Path Name must either match the name of the OBJ-Name parameter or be *SAME. This restriction will require that unformatted volumes be renamed prior to executing the RST command.

Manage performance in optical media libraries

This topic describes performance considerations for users of optical media libraries.

Several factors can affect the optical performance of both LAN-attached and directly-attached optical media libraries. This topic explains how these factors can influence optical performance.

Volume mounting and dismounting

Volume mounting and dismounting are important factors that affect optical performance. It takes approximately 8 to 15 seconds to remove a volume, store it in a slot, retrieve a new volume, and mount it. If you can minimize the number of volume mounts and dismounts that your application requires, optical performance will improve.

Drive contention

Performance can be severely affected by drive contention. The following conditions increase drive contention and should be avoided:

- Only one drive is available for use by applications libraries.
- Many optical processes are running that attempt to use different optical volumes at the same time.

Number of directories and files

Performance can be affected by having too few directories with too many files. Directories group related information to provide a means of quicker access. Typically, you get better performance from more directories with fewer files. Although there is no enforced limit on how many files there can be in a directory, you probably should not have more than 6000 for performance reasons.

File size

The size of a file has a direct effect on the amount of time it takes to read, write, or copy the file. In general, the larger the file, the longer the operation can be expected to take.

Add optical cartridge performance

Specifying *NO for the Rebuild Directory Index can improve the performance of Add Optical Cartridge (ADDOPTCTG) by deferring the build of the optical directory index until a later time.

Related concepts

Volume, directory, and file considerations

Expanding buffer I/O through HFS

Related information

Performance considerations

Performance considerations for directly-attached optical media libraries

This topic discusses performance considerations that are specific to directly-attached optical libraries.

When a file has extended attributes, they are stored separately from the data. When the data is written or copied, the attributes must also be written or copied. If file attributes are not required, attribute copying can be suppressed when copying between the QOPT and QDLS files systems by using the Change Optical (CHGOPTA) command. Setting the copy attributes (CPYATR) value on the CHGOPTA command to *NO suppresses the copying of attributes between the QOPT and QDLS file systems.

Expand buffer I/O with the HFS API:

Users of the HFS APIs can improve performance by taking advantage of the expanding buffer I/O option. Expanding the buffer I/O settings lets you control the amount of data that is read from the optical media when only parts of the entire file need to be read.

Related concepts

Expanding buffer I/O through HFS

Performance consideration for copying and duplicating optical volumes:

There are several performance considerations to be aware of when copying and duplication optical volumes.

Performance of the Copy Optical (CPYOPT) and Duplicate Optical (DUPOPT) commands is a complex subject with many interdependent components. By changing one component, you may adversely affect another.

Because of this interdependence and the other factors that affect copy and backup performance, refer to Optical Volume Backup, for additional information.

Volume mounting and dismounting schedule timers:

This topic provides information on how the iSeries server manages work requests to the directly attached optical library devices. It is a high-level view and does not include all program logic.

You can use the Change Device Description (CHGDEVMLB) command to change the queuing and scheduling logic used by the iSeries server for directly attached optical media libraries.

Two timer values are associated with optical media libraries that affect the scheduling of volume mounting and pre-emptive dismounts. You can change both timer values by using the CHGDEVMLB command. The first timer value (UNLOADWAIT) is the unload wait time. This value determines how

long the system waits for a new request for a mounted volume before removing it. The second timer value (MAXDEVTIME) is the maximum device wait time. This value determines how long a volume with active requests remains in a drive while other queued requests are waiting to use the drive.

By using these two timer values, you can adjust the volume mount scheduling that is used by the optical media library to match your application's use of optical volumes.

You can change these timer values at any time; however, the new timer values will not become effective until the next time the device is varied on.

System job priority and limit timers are used to schedule volume mounting. The maximum number of volumes that can be mounted is equal to the number of drives in the optical media library. Keep the following points in mind as you schedule volume mounting:

- A volume can remain mounted in an optical drive for the maximum device wait time if work requests with the same or lower job priority for a different volume have been received. An exception to this is when you are initializing a rewritable volume or using DUPOPT; the volume remains in the drive until the operation is completed.
- Work requests for mounted volumes are serviced before requests of the same or lower job priority for volumes not mounted.
- For a multiple job environment, volumes are mounted based on the job priority for the work request. A work request from a job with a higher system job priority causes the required volume to be mounted to handle that request. The volume remains mounted for the maximum device wait time if work requests continue, dismounts after unload wait time inactivity, or is overridden by a work request from a job with higher system priority. If you are initializing a rewritable volume or using DUPOPT, the volume remains mounted until the operation is completed.
- If the work on a drive is interrupted because of a higher priority request, the maximum device wait time timer for the currently mounted volume is canceled. All future requests for that volume are queued for normal processing by priority.
- If the volume needed for a work request is not mounted within the system timeout (typically 30 minutes), the job fails due to a timeout.

Change job priority on active jobs

Due to the work management method used by i5/OS optical support, changing run priorities of an active optical job at the user level can result in loss of time allocation and, in some cases, cause jobs to time out.

Manage optical security and auditing

You can secure information on optical media by using i5/OS security functions.

The level of security available depends on the optical media format of the volume. You can use an authorization list to secure all optical volumes. This includes all volumes in CD-ROM, DVD, LAN-attached, directly-attached, and virtual optical devices. Optical volumes formatted in universal disk format (UDF) provide direcotry- and file-level security in addition to authorization list security. Optical support provides ways to prevent unauthorized access and processing of data that is stored on optical volumes. Optical support does this by verifying a requester's rights to specific optical volumes before attempting the following requests:

- Open file or directory
- Create directory
- Delete file or directory
- Rename file
- Initialize or rename volume
- Remove cartridge

- Change or retrieve attributes
- Copy
- Backup or convert backup
- Save or release held files
- Read sectors
- Save optical volume storage
- Restore optical volume storage
- Check optical volume for damaged files

Along with security for optical volumes, directories, and files. Auditing of access to optical objects is also available.

Related concepts

"Directory and file security" on page 80
Directory and file-level security is available for UDF volumes. The system maintains the data authorities of optical directories and files for three groups of users; owner, group, and public. Volume level security is also available through authorization lists.

Use authorities required for optical functions

This topic describes the various levels of user authority and the types of access associated with them.

You must have *USE authority to an optical volume to use the following optical functions:

- Open file for read
- Open directory
- Retrieve file or directory attributes
- Read sector
- List paths or files
- Check optical volume for damaged files

You must have *CHANGE authority to an optical volume to use the following optical functions:

- Open for write or read write
- Create or delete directory
- Create, delete, or rename file
- Change file or directory attributes
- Save or release held optical file

You must have *ALL authority to an optical volume to use the following optical functions:

- Initialize volume (requires *CHANGE for DVD-RAM media)
- Rename volume (requires *CHANGE for DVD-RAM media)
- Convert backup volume to primary
- Duplicate optical volume (requires *CHANGE for DVD-RAM media)

You must have *USE authority to the source optical volume and *CHANGE authority to the target optical volume to use the following optical functions:

- Copy file
- Copy directory

You must have *CHANGE authority to the source optical volume and *CHANGE authority to the target optical volume to use the move file function:

You must have *AUTLMGT authority to an optical volume to us the following optical functions:

- Change authorization list used to secure the volume
- Add optical cartridge (if overriding an existing authorization list)

You must have *OBJEXIST authority to the source volume to use save optical volume optical function.

You must have *OBJEXIST authority to the target volume to use the restore optical volume function.

Note: All programs are shipped with PUBLIC(*EXCLUDE) authority, and most of the commands are shipped with PUBLIC(*USE) authority. The following commands are shipped with PUBLIC(*EXCLUDE) authority.
- Add Optical Cartridge (ADDOPTCTG)
- Remove Optical Cartridge (RMVOPTCTG)
- Add Optical Server (ADDOPTSVR)
- Remove Optical Server (RMVOPTSVR)
- Reclaim Optical (RCLOPT)
- Change Optical Attributes (CHGOPTA)

Specify an authorization list

This topic explains how to secure volumes with an authorization list during the import process.

The authorization list (AUTL) parameter on the Add Optical Cartridge (ADDOPTCTG) command allows the volumes being imported into an optical media library to be automatically secured with an authorization list as part of the import processing.

If no authorization list is specified for a new optical volume (one that has not been removed with the VOLOPT(*KEEP) option), the default optical authorization list (QOPTSEC) is used to secure the volume. If the volume was removed with the VOLOPT(*KEEP) option, the authorization list that previously secured the volume is used to secure the volume.

The user that adds the optical cartridge does not need to have any authority to the data on the volume being secured by the authorization list, as long as the user is not overriding the authorization list that previously secured a volume that was removed with the VOLOPT(*KEEP) option.

This method is different from the way authorization lists are used to secure system objects. For example, a system operator should be able to add the PAYROLL optical disk to the optical media library and secure it with the PAYROLL authorization list, but not be able to access the data on the PAYROLL optical disk.

To change the authorization list used to secure an optical volume that was previously removed with the VOLOPT(*KEEP) option, the user issuing the ADDOPTCTG command must have either *AUTLMGT authority to the authorization list that previously secured the volume or *ALLOBJ special authority.

Use authorization list assignment and the Add Optical Server (ADDOPTSRV) command

The Add Optical Server (ADDOPTSRV) command secures all volumes in the server with the default optical authorization list (QOPTSEC). The default optical authorization list is used unless a volume was previously secured with a different authorization list and then removed using the VOLOPT(*KEEP) option on the Remove Optical Server (RMVOPTSVR) command.

Change the authorization list to secure an optical volume

You can change the authorization list that is used to secure an optical volume in a CD-ROM device or an optical media library.

You can change the authorization list for an optical volume by using the Change Optical Volume (CHGOPTVOL) command.The user attempting to change the authorization list that is used to secure an optical volume must have either *AUTLMGT authority in the authorization list that is currently securing the volume or *ALLOBJ special authority. Specifying *NONE as the authorization list name causes access verification processing for the volume to be bypassed on the future access requests for the volume. If the new authorization list does not exist, the CHGOPTVOL command is rejected and a message is issued indicating that the new authorization list does not exist. Whenever the authorization list used to secure a volume is changed to a different authorization list or to *NONE, an audit entry is logged if optical auditing is active.

Retain the authorization list when removing optical volumes

The relationship between an optical volume and an authorization list is maintained in the optical index database.

This relationship is lost when a volume is exported with the *REMOVE option because the record is deleted. If the *KEEP option is specified when the volume is removed, the record is kept. By specifying *PREV on the Add Optical Cartridge (ADDOPTCTG) command, the authorization list that secured the optical volume before it was removed with the *KEEP option is used to secure the volume when it is re-added. The relationship between a CD-ROM volume and the authorization list securing it is lost when the CD-ROM is removed from the drive.

Map the authorization list to an optical volume

The name of the authorization list used to secure an optical volume is kept in an optical index database file.

If an authorization list used to secure an optical volume cannot be found when attempting to access the volume, the access is denied and a message is issued indicating that the authorization list for the volume could not be found. IF *NONE is specified as the authorization list used to secure an optical volume, no access verification is performed. The authorization list that secures an optical volume can be determined by using the Work with Optical Volumes (WRKOPTVOL) command.

Manage direcotry- and file-level security

Directory and file-level security is available for volumes formatted in universal disk format (UDF).

The system maintains the data authorities of optical directories and files for three groups of users: owner, group, and public. You can display, change, and manage these authorities by using the integrated file system authority commands Display Authority (DSPAUT), Change Authority (CHGAUT), and Work with Authority (WRKAUT). To change the owner and primary group for files and directories, use the integrated file system commands Change Owner (CHGOWN) and Change Primary Group (CHGPGP). You can also access these commands through the Work with Optical Volumes display by selecting option 11 (Work with object links) on the desired volume.

Related concepts

"Optical media formats" on page 75
i5/OS provides support for several optical media types and media formats.

Optical auditing

Many optical operations can be audited.

To enable optical auditing, the system value QAUDCTL must be set to *AUDLVL, and *OPTICAL must be specified in the QAUDLVL system value.

Use the *SEC value on the SYSVAL parameter of the Work with System Values (WRKSYSVAL) command to change these system values. *AUDIT special authority is required to change these values.

The following optical operations can be audited:

- Create, copy, or delete a directory

- Open file, including access mode (read only, write only, read and write)
- Copy, move, rename, or delete file
- Change or retrieve directory attributes
- Control file system (save or release held file, sector read) options
- Open a directory
- Back up optical volumes
- Initialize or rename an optical volume
- Convert a backup optical volume to a primary volume
- Add or remove an optical cartridge
- Change the authorization list, securing an optical volume
- Save an optical volume
- Restore an optical volume
- Check optical volume for damaged files

Related reference

iSeries Security Reference

Reclaim the optical index database

A system-level index, called the optical index database, keeps track of all optical volumes and directories known to the system.

The optical index database includes the optical volume index (QAMOVAR) and the optical directory index (QAMOPVR) physical files. You can use the Reclaim Optical (RCLOPT) command to re-create the optical index database if it is ever damaged or destroyed or whenever volumes that you know are in an optical media library, CD-ROM, or DVD device are reported as not found. To run the RCLOPT command, either select option 2 (Reclaim optical index) on the Optical Backup/Recovery display or enter the RCLOPT command. Doing either causes the Reclaim Optical (RCLOPT) display to appear.

Note: The RCLOPT command (shipped with a public authority of *EXCLUDE) applies to directly attached optical media libraries, CD-ROM, and DVD optical devices. You cannot issue the RCLOPT command to LAN-attached optical media libraries. To re-create the Optical Index Database for LAN-attached optical media libraries, use the Add Optical Server (ADDOPTSVR) command.

Reclaim the optical index for a stand-alone optical device

The optical index database re-creates entries for CD-ROM and DVD devices each time the device is varied on with media in the device.

The optical index database re-creates entries for CD-ROM and DVD devices each time the device is varied on with media in the device. The easiest way to reclaim the optical index for a stand-alone optical device is to vary the device description off and on again using the Vary Configuration (VRYCFG) command. Ejecting and re-inserting the media has the same effect. You can issue the Reclaim Optical (RCLOPT) command for stand-alone optical devices if you choose to do so.

Reclaim types

There are three possible types to select: *SYNC, *UPDATE, and *RESET.

Each successive reclaim type described in these topics is more extensive and takes longer to run. The *UPDATE and *RESET reclaim types allow you to optionally reclaim the optical directory index. The type of index problem that you are experiencing determines which reclaim option should be run.

Related concepts

"Choose the reclaim type to use" on page 133
This topic provides information about choosing which reclaim type to use and when the different options should be used.

Synchronize volume index with internal library index (*SYNC):

The synchronize option verifies that the entries in the optical index database are also in the internal library index.

Entries that are in both indexes are left unchanged. Only those optical volumes that are in the internal library index but not in the optical index database are mounted in an optical drive. If an entry is in the internal library index but not in the optical volume index, an entry is created for the volume in the optical volume index. Message OPT2105 `Optical index entries created for volume &2;` is issued, indicating that an optical volume index entry was created for the volume. If the volume is initialized, optical directory index entries are also created for each directory on the volume. If an entry is in the optical volume index but not in the internal library index, message OPT2115 `Optical volume &1;` is marked removed is issued. This indicates that the volume status for that volume has been changed to *REMOVED.

Update volume index from an optical volume (*UPDATE):

The update option re-creates the optical volume index entries for all volumes in a media library or a specific volume by reading the volume data from the media.

In addition, you can optionally rebuild the optical directory index by using the DIR parameter. If *ALL is specified in the Volume identifier field, the optical volume index is reclaimed for all volumes in the optical media library. If a specific volume name is entered in the Volume identifier field, the optical volume index is reclaimed for that volume only. The optical volume index is updated only for those volumes and libraries that are selected. Index information for other volumes and libraries remains unchanged. Each optical volume whose index is reclaimed will be mounted in an optical drive.

If all of the volumes in an optical media library are specified and an entry is in the internal library index but not in the optical volume index, an entry is created for the volume in the optical volume index and message OPT2105 is issued. If the volume is initialized, optical directory index entries are also created for each directory on the volume.

If an entry is in the optical volume index but not in the internal library index, message OPT2115 is issued. This message indicates that the volume status for that volume has been changed to *REMOVED.

Reset internal library index and reclaim volume index (*RESET):

The reset option performs basically the same processing as the update option, except that the internal library index is reclaimed before the optical volume index is reclaimed.

You can request that the internal library index and optical index database be re-created or updated either for a specific optical media library or for all optical media libraries. The optical volume index is updated only for those libraries that are selected. Index information for other libraries remains unchanged. Specifying the *RESET option will always reclaim the optical directory index. Each cartridge in the optical media library must be mounted at least once for you to use the *RESET option. The system does this to verify that the internal library index is correct.

If an entry is in the internal library index but not in the optical volume index, the system mounts and reads the volume again. The system creates an entry for the volume in the optical volume index and issues message OPT2105.

If an entry is in the optical volume index but not in the internal library index, the system issues message OPT2115. This message indicates that the volume was not located after the internal library index rebuild, and that the volume status for that volume is changed to *REMOVED.

Use the Reclaim Optical Directory Index option

The reset option lets you reclaim the optical directory index (QAMOPVR) file. The following values are available for parameter DIR:

- *YES indicates that the optical directory index is reclaimed for each volume in the specified library.
- *NO indicates that the system does not reclaim the optical directory index for the volume.

The *RESET type requires exclusive use of all libraries that are being reclaimed. Also, when you use the *RESET type, the Volume identifier field is not used.

Time required to complete reclaim optical index:

When either *RESET and VOLUME(*ALL) or *UPDATE and VOLUME(*ALL) together are selected, it may require several hours for the Reclaim Optical Index (RCLOPT) command to complete.

The time requirement is necessary because every volume in the optical media library that is specified must be mounted and then read. The requested databases are then updated before the next volume is mounted. The following factors affect how long it takes the command to complete:

- How many libraries are being reclaimed
- How many volumes are in each library
- What type of reclaim is requested
- How many directories are on each volume

After a reclaim command has started, it should not be canceled before it has completed. If a reclaim command is canceled before it completes, it might be necessary to run the RCLOPT again before the optical media library is in a usable state.

Optical index information

Optical index information regarding which volumes are in a particular optical media library and which directories are on each volume is kept at different levels within the system.

Optical index files are used to enhance performance by eliminating the need to access the optical media library or physical media each time the location of a volume or directory is needed.

Failures, system upgrades, and physically moving optical library devices from one system to another can cause these index files to become out of synchronization with the actual contents of a particular optical media library or volume. When this happens, messages are sent indicating that the optical index needs to be reclaimed, such as OPT1245, OPT1825, or OPT1330. These messages direct you to run the Reclaim Optical (RCLOPT) command. The following topics describe the optical index files that are kept at the different levels of the system. An understanding of the different optical indexes is helpful when deciding which type of reclaim optical index to run.

Optical index database files:

The optical indexes reside in the physical files QAMOVAR and QAMOPVR.

The QAMOVAR file is the optical volume index. It contains information about all optical volumes known to the system. This includes volumes that were previously removed from the optical media library with the volume description option of *KEEP. The QAMOPVR file is the optical directory index. It contains information about the directories on the volumes in directly attached optical media libraries or CD-ROM devices. This includes those volumes that were previously removed from directly attached libraries with the volume description option of *KEEP.

Information for volumes that are *OFFLINE or *REMOVED is retained by reclaim optical processing, but it cannot be rebuilt or verified because the physical volumes are no longer accessible. If the optical index

database is ever destroyed, information about *REMOVED volumes can be recovered by adding the cartridge that contains the volumes to an optical media library using the Add Optical Cartridge (ADDOPTCTG)

Internal library index:

Each optical media library keeps an internal library index of each volume that it contains.

The internal library index for each optical media library is controlled by the Licensed Internal Code. The information in this index is generally not accessible to users or application programs. However, this index must be kept synchronized with the optical index database. This index is re-created when the *RESET rebuild type is specified.

To select the optical media library or libraries that require rebuilding, enter the optical media library name in the Optical media library field on the Reclaim Optical (RCLOPT) display. The name that you enter must correspond to an optical media library that is currently configured on the system.

To reclaim more than one optical media library, issue separate RCLOPT commands for each device rather than using MLB(*ALL). Sequentially using the MLB(*ALL) command reclaims all of the optical media libraries one at a time. Issuing separate RCLOPT commands will allow the reclaiming operations to run in parallel, which will run faster.

Choose the reclaim type to use

This topic provides information about choosing which reclaim type to use and when the different options should be used.

Most optical support error messages that direct you to run the Reclaim Optical Index (RCLOPT) command specify the rebuild type you should use to recover from the error. However, occasionally you might suspect that the optical index needs to be reclaimed even though no error message has been issued. In this case, you need to determine which reclaim type should be run. If you are unsure which reclaim type you should use, run the RCLOPT command with the *SYNC option and then try the failing request again. If the request still fails, run the RCLOPT command with the *RESET option.

***SYNC**
: Use this option when you are getting messages indicating that a volume is not found (OPT1331, OPT1330 - reason code 2) or that a volume is removed (OPT1460) when you feel that the volume is indeed in the optical media library. Use this option after you upgrade to a new release of i5/OS or when you move a directly attached optical library device from one server to another.

***UPDATE**
: Use this option first if you see a message indicating that the optical tables are incorrect (OPT1825). You can also use this option if you are having problems with a particular volume not displaying all the directories when you use the Work with Optical Directories (WRKOPTDIR) command.

***RESET**
: Use this option when you get message OPT1330 with reason code 01. Unless otherwise instructed through an optical message, use this option as a last resort. It will generally take much longer to complete than either of the two previous options, but it will ensure that both the optical index database and the internal library index are correct. Specify DIR(*NO) unless you have a specific need to create the optical directory index. The only operations that require the directory index are Work with Optical Directories (WRKOPTDIR) and Display Optical (DSPOPT) when DATA(*DIRATR) is used. If you specify DIR(*NO), the directory index will be built on demand when one of these functions is issued.

Recover held optical files

A held optical file is an optical file that could not be closed normally.

The file contains buffered data that cannot be written to the optical disk. If the open file handle is still valid, the file is still open; otherwise, it is considered closed. This topic provides information on recovering held optical files.

Held optical files are only created for media format *HPOFS when the Change Optical Attributes (CHGOPTA) **Held file** attribute field is *YES. Held optical files are not created for media format *UDF or when the **Held file** attribute field for CHGOPTA is *NO.

Related concepts

"Changing optical environment parameters" on page 108
The Change Optical Attributes (CHGOPTA) command can be used to change specific optical configuration parameters that affect all jobs using the optical file system.

How optical files are used

An application can manipulate optical file data by using UNIX-type APIs or the hierarchical file system (HFS).

An application opens a file, operates on the file, and finally closes the file. When an application changes file data or attributes, the optical file system stores these changes in a temporary system object in i5/OS storage. The optical file system does not update the optical disk until the application closes the file. When two or more applications concurrently change file data or attributes, the optical file system updates the optical disk when the last updating application closes the file. The application may force file and attribute data to optical disk by issuing either the HFS Force Buffered Data API or UNIX-Type fsync() functions.

Implementing this process has the following benefits:

- Simulation of read and write access to optical files
- File locking and sharing
- Byte locking and sharing
- Random processing of optical file data
- Writing Variable-length data buffers to the optical file
- Reduction of input and output to the optical disk

Related information

Application programming interfaces (APIs)

Held optical files:

If the optical file system is unable to update the optical disk during a close function, the operation fails and the file is marked as held.

The optical file system might still consider the file to be open. If it considers the file open, the optical file system allows any application that already has the file open to continue operating. In any case, no new application can open a file while it remains held. If the system can correct the condition that caused the failure, and the file is still open, the application may attempt to close the file again. If the close function succeeds, the system no longer holds the file. (If an HFS application specified an open type of normal, it cannot access the file through the HFS API any longer. IBM provides online information on the open types that concern the Open Stream File command.

Note: The system does not create held files when files fail to close on UDF media.

Recover a held optical file:

This topic provides instructions on recovering held optical file.

If a close operation fails for an open optical file and the file becomes held, the held file can be handled in one or both of the following ways:

- You can attempt a save request
- You can release the file to allow it to be opened again.

However, if the cause for the close failure has been corrected, the file can now be closed as usual, without having to save or release it first. In this situation, the file is automatically saved and released, and the held status is lifted. After releasing a held file, you can close it if the open file handle is still valid.

Before saving or releasing a held optical file, you can view all of its open instances by selecting option 8 (Display Usage information) from the Work with Held Files Optical Files (WRKHLDOPTF) display. This can be an important step in determining the appropriate actions for the file. For example, before deciding not to save the latest version of a file, it is useful to know if other applications have been making concurrent updates to the same file. Updates would roll back for all users if the file were only released and no further updates were made before the last updating application closed the file.

Save a held optical file:

Saving a held optical file physically writes the data and file attributes to the optical disk. You can choose to save to the original volume, directory, and file name that you specified at open time, or to a new optical file path.

In some situations, you can save the file at the original storage destination. For example, if the file has been opened with a normal open type, the file is now inaccessible through the HFS API, rendering the open file handle no longer valid. However, the condition that caused the file to become held might have been corrected, giving you the ability to save the data by specifying the held file as the destination.

If the application specifies a different file path as the destination, the file must not already exist. If appropriate, you can delete such a file before attempting to save to that volume, directory, and file name.

After a held optical file is saved, it should be released to allow the file to be used by future applications.

Release a held optical file:

A held file can only be released if no locks are currently imposed on the file by other active jobs.

Releasing a held optical file clears the held status and allows new applications to open the file. It also releases the optical file system from its obligation to update the optical disk, unless some application makes further updates to the file. After the file has been released, it may be closed if the user's process is still active.

If one or more applications continue to change a file after it is released, the optical file system attempts to update the optical disk when the last updating application closes the file. However, if the cause for the close failure has not been corrected, the file can be expected to become held again.

A held file can be released after a save operation or without any save operation. If a successful save operation cannot be achieved, you can release the file simply to acknowledge that the data cannot be written to the disk and that this result is being accepted without taking further action aside from closing the file.

If you do not release the held optical file, it remains held even if the process ends, unless an automatic close is successful in saving the file at that time. For held files, this might only happen if the open type is permanent, and if the cause for the earlier close failure has been resolved.

Implement held optical file functions:

Before deciding whether to save or release a held optical file, you might want to view information that can influence save and release decisions.

The Work with Held Optical Files display provides this means, in addition to the ability to save and release held optical files. The save and release functions are also available as optical-specific functions of the HFS Control File System API.

The Work with Held Optical Files display provides a convenient way to list and manage any held optical files on the system. Use the Work with Held Optical Files (WRKHLDOPTF) command to access the Work with Held Optical Files display.

Options on the Work with Held Optical Files display are selected to display the use (open instances) of files, as well as to save and release held files. By default, using option 9 (Save) on the Work with Held Optical Files display causes the automatic release of a held file after it is saved.

The functions provided by option 9 (Save) and option 6 (Release) are also available as the optical-specific functions, Save Held Optical File and Release Held Optical File, of the Control File System API in the Programming topic.

Unlike option 9 (Save), the Save Held Optical File function of the Control File System API does not automatically release a held file after it is saved. Therefore, an explicit release request is needed afterward.

Disable held optical file support:

i5/OS is shipped with held optical file support enabled. If desired, you may disable it by using the Change Optical Attributes (CHGOPTA) command.

When held optical file support is disabled, a held file is not created when a file fails to be archived to optical disk. When using this option, it is up to the user application to manage recovery procedures for files that fail to be archived. Consider the following scenarios:

Scenario 1

The application opens an optical file for a write operation, and then writes data to the file. When you attempt to close the file, it fails because the optical disk is full.

Held file support enabled
The file is still open, but becomes held. The file closes when the job ends if it never closes successfully before the job ends. The file will remain held until it is released.

Held file support disabled
The file is still open, but is not held. The file closes when the job ends if it never closed successfully before the job ends. The file will not become held, and all resources (virtual optical file) associated with the held file will then be freed up.

Scenario 2

The application opens an optical file for write, and then writes data to the file. The application then issues a Force Buffered Data API to ensure the data is safe on nonvolatile storage. The iSeries server then loses power.

Held File Support Enabled
After the internal program load (IPL) of the iSeries server is completed the file exists as a held optical file. All data that was successfully forced to disk is recoverable. In other words, when you save the held file to optical storage, all data written before the Force buffered data request will be saved.

Held File Support Disabled
After the IPL of the iSeries server is completed, the file does not exist as a held optical file. All data written to this file on the previous open instance is lost. The force data request had no effect.

It is important to note that when held optical file support is disabled, forcing data to nonvolatile storage is meaningless. This is because data is written to optical storage after the file closes successfully. The Force buffered data function will force the data to the i5/OS disk, and you can use the held optical file to recover the data after a power loss. Held files are the only mechanism to recover data forced to nonvolatile storage after a power loss or other unexpected error. Held file support is needed to recover any data from an open instance that closes unsuccessfully. This effects the following application program interfaces.

- Force Buffered Data HFS API (QHFFRCSF)

  This API is allowed when held file support is disabled but it will have no effect.
- Synchronize File Changes IFS API fsync()

  This API is allowed when held file support is disabled but it will have no effect.
- Synchronous write-through flag on Open Stream File HFS API (QHFOPNSF)

  This value is allowed, but will be treated as an asynchronous write-through flag.

Use the CHGOPTA CL command to enable, disable or determine the current status of held optical file support. After held optical file support is disabled, it remains disabled for all optical users. You must enable held file support for it to become active again.

Optical save and restore

The i5/OS Save and Restore CL commands support directly-attached optical media library devices, CD-ROM, DVD-ROM, and DVD-RAM stand-alone devices.

The best use of optical storage devices is as a part of disaster recovery protection. The extraordinary long shelf life of optical media is well suited for the long term storage of critical data. You can provide extra protection by using permanent WORM media because you cannot alter data on the media. Tape devices may provide the optimal day-to-day backup mechanism. This depends on the amount of data that you want backed up, and the amount of system time available for backup. CD-ROM and DVD-RAM media are also well suited for software distribution. The save/restore command interface can be used as a part of installation procedures for programs, data, and program fixes. CD-ROM and DVD-RAM stand-alone drive optical devices also support the Load Run (LODRUN CL) command.

Related concepts

“High Performance Optical File System” on page 76
High performance optical file system (HPOFS) is an IBM-developed media format architecture available to use when initializing optical media on the i5/OS.

“Directory and file security” on page 80
Directory and file-level security is available for UDF volumes. The system maintains the data authorities of optical directories and files for three groups of users; owner, group, and public. Volume level security is also available through authorization lists.

Related reference

Save Restore (SAVRST)

Optical save and restore concepts

Optical devices support many of the most widely used i5/OS Save and Restore CL commands.

The DVD-RAM standalone optical drive device is an economical alternative to magnetic tape for save/restore operations on entry level iSeries servers. The DVD-RAM standalone drive device supports all major save/restore functions. The automated library device enhances ease of use of save and restore operations that require volume lists.

Optical media formats with save and restore operations:

This topic provides general information about different media formats in relation to save and restore volume list processing.

Save and Restore volume list processing differs for each optical media format. A volume list is used on a save or restore request when multiple optical volumes are required for the operation, thus creating a volume set. All volumes in a volume set must have the same optical media format. Volume sets are not supported for CD media formatted with ISO 9660.

You must initialize media of type permanent WORM and CCW WORM with the media format of HPOFS.

You can initialize media of type rewritable with a media format of HPOFS or UDF.

You must initialize the DVD type of media that is used by DVD-RAM standalone drive devices with a media format of UDF.

Organize save and restore data on optical devices:

This topic provides information about organizing save and restore data on optical devices according to path name lengths, naming conventions, and directory levels.

The save data on optical media is uniquely identified by a path name. This path name has the form: /directory name/subdirectory name/../filename. You may create and specify as many directory levels as is necessary to organize your save data to suit your needs. If no directory levels are specified, the save data file is placed in the root directory of the specified optical volume.

The optical path name may be up to 256 alphanumeric characters in length. Optical volume names may be up to 32 alphanumeric characters in length. Some caution is necessary when using long names. Many i5/OS save and restore displays, messages, reports, output files, and object descriptions, support a maximum of 6 characters for volume names, and 17 characters for path names. Longer names will appear truncated in these instances. Additionally, some automated data management software may not properly handle long volume names and long path names.

Performing a save operation to optical storage

You can save the i5/OS library DEVLIB01 to the optical volume SRVOL1 that is contained in library device OPTMLB02. You do this by using the following CL command:

```
SAVLIB LIB(DEVLIB01) DEV(OPTMLB02) VOL(SRVOL1) ('/DEVLIB01')
```

An optical file containing the save data, with the name DEVLIB01, will be created in the root directory of volume SRVOL1.

Display save and restore file information on optical storage: As an example, information concerning the save and restore files that are contained on a given optical volume can be displayed using the display optical (DSPOPT) CL command. The following CL command displays the information for all save and restore files that are found in the root directory of the optical volume SRVOL1:

```
DSPOPT VOL(SRVOL1) DATA(*SAVRST) PATH(/)
```

Use the OPTFILE parameter: The OPTFILE parameter is used in save and restore commands to designate the optical file path name to be used to contain the save data. The system dynamically creates any specified directory names that do not exist.

The OPTFILE parameter has a default value of (*). By using the default parameter value you will place the file in the root directory of the optical volume that is specified by the VOLUME parameter. Additionally, in commands other than SAV, the file name is the name of the i5/OS library that contains the objects that are saved.

For the SAV command, OPTFILE(*) generates a filename of the form SAVyyyymmddhhmmssmmm, where yyyymmddhhmmssmmm is the current date and time.

Use the media eject option: For standalone drive devices that are attached by PowerPC® I/O adapters, you can automatically open the media tray at the conclusion of a Save and Restore operation. You can do this by specifying the ENDOPT(*UNLOAD) parameter. The system ignores this parameter for optical library devices. The ENDOPT(*LEAVE) or ENDOPT(*REWIND) parameters have no effect on optical standalone drive devices or optical media library devices.

Volume list contents:

Volume lists allow a single Save and Restore operation to use many pieces of optical media to complete the requested operation.

Information relating to optical volumes that are a part of a save and restore volume list may be displayed using the display optical (DSPOPT) command.

Volume list information fields:

- **Continued from Previous Volume** flag
  - This field applies only to UDF media.
  - This flag indicates the save and restore file is continued from the previous volume in the volume list.
  - Only one file on a given volume can have this flag set on.
  - Use the DSPOPT DATA(*FILATR) command to display this flag.
- **Continued on Next Volume** flag
  - This field applies only to UDF media.
  - This flag indicates the save and restore file is continued to the next volume in the volume list.
  - Only one file on a given volume can have this flag set on.
  - Use the DSPOPT DATA(*FILATR) command to display this flag.
- **IPL Capable** flag
  - This flag indicates that the save system (SAVSYS) command created this volume and that you can use it for D-Mode IPL.
  - Use the DSPOPT DATA(*VOLATR) command to display this flag.
- **Last Volume in Volume List** flag
  - This flag indicates that the volume is the final volume in a volume list.
  - For HPOFS format volumes, the system does not allow save files that are unrelated to the volume list on the final volume. The remaining capacity does not affect this situation. UDF volumes do allow unrelated save files on the volume if sufficient free space exists.
  - Use the DSPOPT DATA(*VOLATR) command to display this flag.
- **Starting Volume ID** field
  - The Volume ID of the first volume in a multiple volume set in a volume list is located in the starting volume ID field. For UDF format volumes, the volume list might contain several different save files. Consequently, this field does not specify the starting volume of any given file that is contained in the set.
  - Use the DSPOPT DATA(*VOLATR) or DATA(*FILATR) command to display this flag.

Volume lists with HPOFS format media:

This topic describes volume list information specific to HPOFS format media.

Only one file in a multivolume set logically spans volumes. The last volume in the set does not accept additional save requests. The system does not maintain continued flags.

- Volume1 (Sequence#=1, Starting volid=Volume1, Last volume in set=No)
  - File1 (Continued from previous volume=NO, Continued on next volume=NO)

  - File2 (Continued from previous volume=NO, Continued on next volume=NO)
  - File3 (Continued from previous volume=NO, Continued on next volume=NO)
- Volume2 (Sequence#=2, Starting volid=Volume1, Last volume in set=No)
  - File3 (Continued from previous volume=NO, Continued on next volume=NO)
- Volume3 (Sequence#=3, Starting volid=Volume1, Last volume in set=Yes)
  - File3 (Continued from previous volume=NO, Continued on next volume=NO)

Note:

- No more saves are allowed to Volume1, Volume2, or Volume3. The system does not allow additional save files to Volume3, regardless of sufficient free space.
- Access to any previous save data is lost from Volume1, Volume2, and Volume3.
- All restore operations must begin on Volume1.

Volume lists with UDF format media:

This topic describes volume list information specific to universal disk format (UDF) media.

More than one file in a multi volume set can logically span volumes, but only one file per volume can span to the next volume in the volume list. The last volume in the set accepts additional save requests if space is available. The system maintains the continued flags for spanned files.

- Volume1 (Sequence#=1, Starting volid=Volume1, Last volume in set=No)
  - File1 (Continued from previous volume=NO, Continued on next volume=NO)
  - File2 (Continued from previous volume=NO, Continued on next volume=NO)
  - File3 (Continued from previous volume=NO, Continued on next volume=YES)
- Volume2 (Sequence#=2, Starting volid=Volume1, Last volume in set=No)
  - File3 (Continued from previous volume=YES, Continued on next volume=NO)
  - File4 (Continued from previous volume=NO, Continued on next volume=NO)
  - File5 (Continued from previous volume=NO, Continued on next volume=YES)
- Volume3 (Sequence#=3, Starting volid=Volume1, Last volume in set=No)
  - File5 (Continued from previous volume=YES, Continued on next volume=YES)
- Volume4 (Sequence#=4, Starting volid=Volume1, Last volume in set=Yes)
  - File5 (Continued from previous volume=YES, Continued on next volume=NO)
  - File6 (Continued from previous volume=NO, Continued on next volume=NO)

Note: Space permitting, additional saves are allowed to Volume4.

Note: A restore operation begins on the volume that contains the first occurrence of the specified file. For example, you can restore data from File4 on Volume2 without processing Volume1.

Note: The volume set for UDF formatted media described in this section is not related to the volume set or multi volume support that is defined in format specifications for UDF (ECMA 167 3rd Edition or UDF Revision 2.01). Support for volume sets as defined by these specifications is not currently provided by i5/OS.

Related concepts

"Clear media" on page 141
By specifying CLEAR(*ALL) you will clear all the files on the media.

Perform a save operation to optical storage

The following topics provide information about performing a save operation to DVD-RAM, UDF, and HPOFS media.

Specify optical file path names:

This topic provides information about specifying a path name for the optical file that is used for the save operation.

Optical storage operates in random mode and uses a hierarchical file structure when writing files to the media. Beginning with the root directory of the volume, you may specify a path name for the optical file that is used for the save operation. Specifying an asterisk (*) causes the system to generate an optical file name in the root directory (/). `Specifying optical_directory_path_name/*` causes the system to generate an optical file name in the specified directory of the optical volume. `Specifying optical_file_path_name` creates an optical file name. For example, specifying SAVLIB LIB(MYLIB) DEV(OPT01) OPTFILE('/mydir/*') creates an optical file name of mydir/MYLIB. If mydir directory does not exist, the system creates it.

When you use DVD-RAM media to save i5/OS information, the system checks for active files by using the CLEAR parameter on the save commands. Specify CLEAR(*NONE) to have the system search the DVD-RAM volume for any active optical files that have the same name. If an optical file of the same name exists, the system displays an inquiry message. You may cancel the processing, write over the existing file on the volume or insert a new cartridge. If no active files of the specified optical file exist and there is available space on your DVD-RAM volume, the system writes the file to your DVD-RAM media. If the system cannot find any available space on the media, it prompts you to insert a DVD-RAM volume in the device.

Clear media:

By specifying CLEAR(*ALL) you will clear all the files on the media.

By specifying CLEAR(*AFTER) you will automatically clear all media after the first volume. The system sends an inquiry message when it encounters the specified optical file on the first volume. This allows you to either end the save operation or replace the file. Specifying CLEAR(*REPLACE) automatically replaces the active data of the specified optical file on the media.

The only option on the CLEAR parameter that will clear all the files is CLEAR(*ALL). Otherwise, the system sends an inquiry message for each specified optical file name it encounters. Specifying CLEAR(*NONE) will send an inquiry message for each specified optical file name it encounters, not just the first one.

To avoid receiving an inquiry message during the save operation, you can perform either of the two following functions:

- Initialize the optical volume (INZOPT) first.
- Specify an option by using the CLEAR parameter on the save command.

Note: Do not use the CLEAR(*NONE) parameter, this sends an inquiry message. IBM provides online information on using the CLEAR parameter with the save commands.

Related concepts

"Volume lists with UDF format media" on page 140
This topic describes volume list information specific to universal disk format (UDF) media.

Save to multiple volumes:

If the system writes data to a second DVD-RAM volume, the system considers this a DVD set.

A set includes two or more volumes. The system can only write information on the last volume in the set. In a three-volume DVD-RAM set, the system cannot write information to the first or second volume.

The table below provides command support information according to optical device.

Command	Supported by optical device
SAVSTG	None
SAVS36F	None
SAVS36LIBM	None
SAVUSFCNR	None
RSTS36F	None
RSTS36FLR	None
RSTS36LIBM	None
RSTUSFCNR	None
SAVLICPGM	DVD (No optical libraries)
SAVSYS	DVD (No optical libraries)
RSTLICPGM	DVD (No optical libraries)
SAVCHGOBJ of more than one library, including LIB(*ALLUSR)	DVD and optical library devices with UDF formatted media
SAVDLO of more than one ASP	DVD and optical library devices with UDF formatted media
SAVLIB of more than one library, including LIB(*ALLUSR), LIB(*IBM), AND LIB(*NONSYS)	DVD and optical library devices with UDF formatted media
SAVCFG	All writable optical devices
SAVCHGOBJ of one library	All writable optical devices
SAVDLO of one ASP	All writable optical devices
SAVLIB of one library	All writable optical devices
SAVOBJ of one library	All writable optical devices
SAVSAVFDTA	All writable optical devices
SAVSECDTA	All writable optical devices
RSTCFG	All optical devices
RSTLIB	All optical devices
RSTOBJ	All optical devices
RSTUSRPRF	All optical devices
SAVAPARDTA	Not applicable, command does not use a device
RSTAUT	Not applicable, command does not use a device

Operational guidelines by optical device type

This topic provides information on operational guidelines by device type for optical library data servers and CD-ROM, DVD-ROM, and DVD-RAM standalone optical drive devices.

Optical library dataservers

- You cannot use the default value, *MOUNTED, for the volume identifier.
- Volumes that are provided in a volume list must all be in the same library device.
- A single save data file may span several volumes in a volume list.
- For HPOFS formatted media, any volume used in a volume list becomes unusable by any save or restore operation other than the operation originally processing the volume list.

  For example:

– Save command A writes save data fileA to volume volA.
– Save command B writes save data fileB to volume list: volC, volB, volA.
– Restore command A will not be able to restore from fileA on volume volA.
– Restore command B will be able to restore from fileB on the volume list: volC, volB, volA.

CD-ROM and DVD-ROM standalone optical drive devices

- CD-ROM and DVD-ROM are read-only devices. The system does not support save commands for these devices.
- Save files cannot span multiple CD-ROM or DVD-ROM media that contain ISO 9660 media format.
- You can specify the default value, *MOUNTED, for the volume identifier. It will process the optical volume currently in the specified stand-alone device.

DVD-RAM standalone optical drive devices

- DVD-RAM devices are read and write devices. Save and restore commands are supported for DVD-RAM devices.
- You can specify the default value, *MOUNTED, for the volume identifier. It will process the optical volume currently in the specified stand-alone device.
- Multiple save data files may span several volumes in a specified DVD_RAM volume list.

Note: Software compression and decompression might increase the save and restore times. It uses considerable processing resources which may affect the overall system performance.

Troubleshoot optical storage

This topic provides information about solutions related to optical storage.

In this topic several of the more common questions are answered, the steps to follow when a problem occurs are given, and the information that will be needed for problem analysis is listed.

Optical support FAQ

This topic provides information to help with some common problems and questions encountered with optical devices.

1. When writing objects, I receive a message indicating that there is not enough optical media space available. However, the volume is not full. What is wrong?
2. My backup volume is filling up before all objects from the primary have been stored. What is using up the extra space?
3. While backing up a platter, the task ends abnormally. When I restart the backup, I receive the OPT1210 message indicating that the directory already exists. However, the directory is not listed when I use the Work with Optical Directories (WRKOPTDIR) command. How can this be?
4. I received an OPT1115 message indicating that the file is not found when trying to retrieve an object. When I use the Work with Optical Files (WRKOPTF) command, the object is displayed. Why am I unable to retrieve the object?
5. My application appears to be storing objects correctly, but when I use the Work with Optical Files (WRKOPTF) command, not all of the objects are showing up. Where are the objects going?
6. My application program fails with message CPF1F83 indicating that the file system name /QOPT was not found when I attempt to copy a stream file using the CPYSF command. What is wrong?
7. There is a volume I want to use, but I cannot seem to access it. What can I do?
8. Messages are occurring which indicate that I should run Reclaim Optical (RCLOPT) command. A RCLOPT of type *RESET can take a long time. Is there a quicker way to recover?
9. What is the difference between volumes marked *OFFLINE and those marked *REMOVED?
10. When I add full optical volumes into my optical media library by using the Add Optical Cartridge (ADDOPTCTG) command, it takes a long time. Any suggestions?

11. I entered a CD-ROM volume into my CD-ROM device, but I received a message saying volume not found when I attempted to access it. I did not see any error messages. What went wrong?

When writing objects, I receive a message indicating that there is not enough optical media space available. However, the volume is not full. What is wrong?

Either the threshold is incorrectly set, the object being stored is bigger than the available space, or the *spares area* is full. Display the volume attributes of the volume that you are writing to using the display optical (DSPOPT) command. Verify that the threshold and space available values are valid. Also, verify that access to the volume access is *writeable*, and not *read only*. If it is read only, then the spares area may be full. The spares area is a set of sectors to which data is written when the original sector is damaged.

My backup volume is filling up before all objects from the primary volume have been stored. What is using up the extra space?

Several situations could cause this to happen:

- Device errors may have occurred when only part of a file was written. When the backup operation was restarted, the complete file was rewritten.
- If the backup volume type is WORM, it might have been initialized multiple times before the backup operation, thus wasting some volume space.
- If you are performing an incremental backup operation, you might have selected the wrong option on the SLTFILE parameter (*ALL instead of *CHANGED).
- If you created the primary volume on a pre-Version 2 Release 3 Modification 0 system, and the primary volume is over 98% full, then the Duplicate Optical (DUPOPT) command may be the only choice to back up this volume.
- The primary volume is a 2X media and the backup volume is 1X.

While backing up a volume, the task ends abnormally. When I restart the backup, I receive the OPT1210 message indicating that the directory already exists. However, the directory is not listed when I use the Work with Optical Directories (WRKOPTDIR) command. How can this be?

When the task ended abnormally, the directory was created on the volume, but the internal optical index files had not been updated yet. Remove the backup volume using the Remove Optical Cartridge (RMVOPTCTG) command and add it back in using the Add Optical Cartridge (ADDOPTCTG) command and specifying DIR(*YES)). The internal optical index will be updated with the new path.

I received message OPT1115 indicating that the file is not found when trying to retrieve an object. When I use the Work with Optical Files (WRKOPTF) command, the object is displayed. Why am I unable to retrieve the object?

The optical media may be dirty. Contact your next level of support (hardware) to get the media cleaned.

My application appears to be storing objects correctly, but when I use the Work with Optical Files (WRKOPTF) command, not all of the objects are showing up. Where are the objects going?

The files may be held optical files. Refer to Held optical files for more information on held optical files. In this case, the volume may have reached its threshold. Verify that your application is handling the OPT1345 message `Threshold reached on optical volume` or CPF1F61 message `No space available on media` correctly.

My application program fails with message CPF1F83 indicating that the file system name /QOPT was not found when I attempt to copy a stream file using the CPYSF command. What is wrong?

The file system portion of the path (/QOPT) must be specified in uppercase characters. The rest of the path can be in either uppercase or lowercase characters.

There is a volume I want to use, but I cannot seem to access it. What can I do?

Duplicate volume names might cause this. If the volume is in a LAN server, it may have the same name as a volume in a directly attached library or another server. If there are duplicate names, only the first volume found is usable.

Messages are occurring which indicate that I should run Reclaim Optical (RCLOPT) command. A RCLOPT of type *RESET can take a long time. Is there a quicker way to recover?

Yes. First read *Reclaiming the Optical Index Database* to gain a better understanding of the RCLOPT process. Then attempt one of the following:

- Run RCLOPT MLB *device_name* OPTION(*SYNC).
- Work with Optical Volumes (WRKOPTVOL) and press F14 (Show extended information). If any volumes show `moving` as the location, then do the following:
  1. Run RCLOPT MLB(device name) OPTION(*UPDATE) VOL *moving_volume_name*.
  2. Refresh the Work with Optical Volumes screen. If any volumes still show up as moving, repeat step 1.
- Run RCLOPT MLB *device name* OPTION(*RESET) DIR(*NO)

  Note: This choice takes longer than the first two, but by specifying DIR(*NO), it could cut the RCLOPT *RESET time in half.

What is the difference between volumes marked *OFFLINE and those marked *REMOVED?

*OFFLINE entries are volumes in optical devices that are either powered off, varied off, or no longer connected. *REMOVED entries are volumes that were removed from the optical media library with VOLOPT *KEEP specified.

When I add full optical volumes into my optical media library by using the Add Optical Cartridge (ADDOPTCTG) command, it takes a long time. Any suggestions?

When volumes are removed using the Remove Optical Cartridge (RMVOPTCTG) command, remove them specifying *KEEP on the VOLOPT parameter. The internal optical indexes save all information about these volumes, including the optical directory information. When volumes are added using the ADDOPTCTG command, specify *NO in the DIR parameter. The volumes are added and the directory index is not rebuilt. This speeds up the import process.

Note: This process should not be followed if changes were made to the removed volumes since the volumes were last removed from this system.

I entered a CD-ROM volume into my CD-ROM device, but I received a message saying volume not found when I attempted to access it. I did not see any error messages. What went wrong?

Refer to *CD-ROM and DVD on iSeries Servers* for information on loading CD-ROM media. In this case, you probably attempted to access the CD-ROM before it was fully loaded (wait 10-20 seconds after the tray slides in), or an error occurred during the load operation. Refer to the QSYSOPR message queue to see if the CD-ROM volume loaded successfully.

Collect information

If you need to call the next level of support, have the following information ready to help speed up the problem analysis process.

- Detailed description of problem, including each of the following items:
  1. Application that are running
  2. Wether the system or application is newly installed or has been running

3. Can the problem be reproduced?

- Type and model number of the dataservers
- Current PTF level
- Number of dataservers
- Number of volumes

Other system commands

The following system commands can help in gathering pertinent information for analyzing problems.

- The Display Job Log (DSPJOBLOG) command shows commands and related messages for a job while it is still active and has not yet been written.
- Display Log (DSPLOG) command shows the system history log (QHST). The history log contains information about the operation of the system and the system status.
- The Trace Job (TRCJOB) command controls traces of program calls and returns that occur in the current program, or the job being serviced.
- The Start Service Job (STRSRVJOB) command starts the remote service operation for a specified job so that other service commands can be entered to service the specified job.
- The End Service Job (ENDSRVJOB) command ends the remote job service operation. This command stops the service operation that began when the Start Service Job (STRSRVJOB) command was entered.
- The Analyze Problem (ANZPRB) command allows you to analyze, create problem records for, or report problems that were not detected by the system. If the problem is valid, a fix can be supplied by matching the problem description to an already known problem for which a PTF exists, or an APAR can be created.

See the Programming topic for more information about system commands.

Output File Support Structures

This topic describes the three possible record formats that are created by the Display Optical (DSPOPT) command when output is directed to either an output file or user space.

Only the fields that are set for a LAN volume (volume type 9) are indicated with an asterisk (*). The Volume Capacity and Volume Space Available fields have a different meaning for LAN volumes; this is because the Volume Full Threshold field is not available. The Volume Capacity field contains the current total free space on the volume. Total free space equals the free space available for the user's application plus the space reserved by the volume full threshold.

The Volume Space Available field contains the user free space on the volume. The user free space equals the total free space less the amount of space reserved by the volume-full threshold.

Output File Structure for Volume Attributes

Record format for QAMODVA (a * indicates a LAN or type 9 volume)		
	Attribute name	Attribute length
*	CENTURY	CHAR(1)
*	DATE	CHAR(6)
*	TIME	CHAR(6)
*	VOLUME NAME	CHAR(32)
	OPTICAL DEVICE	CHAR(10)
*	CSI	CHAR(8)
	CSI LIBRARY	CHAR(10)

Record format for QAMODVA (a * indicates a LAN or type 9 volume)		
*	AUTHORIZATION LIST	CHAR(10)
	INTERNAL VOLUME ID	CHAR(32)
	VOLUME SERIAL NUMBER	PACKED(11,0)
*	VOLUME TYPE	PACKED(3,0)
	VOLUME CCSID	CHAR(2)
*	MEDIA TYPE	PACKED(3,0)
	MEDIA FORMAT	PACKED(3,0)
	VOLUME FULL THRESHOLD	PACKED(5,0)
	VOLUME SEQUENCE NUMBER	PACKED(9,0)
	VOLUME CREATION DATE	CHAR(7)
	VOLUME CREATION TIME	CHAR(6)
	VOLUME DESCRIPTION TEXT	CHAR(50)
	VOLUME LAST REFERENCE DATE	CHAR(7)
*	OPPOSITE SIDE VOLUME NAME	CHAR(32)
	VOLUME BLOCK SIZE	PACKED(9,0)
*	VOLUME CAPACITY	PACKED(11,0)
*	VOLUME SPACE AVAILABLE	PACKED(11,0)
	VOLUME LOCATION	CHAR(1)
	VOLUME OFFLINE LOCATION	CHAR(50)
	VOLUME ACCESS	CHAR(1)
	VOLUME MEDIUM	CHAR(1)
	DOUBLE-SIDED MEDIUM	CHAR(1)
	IPL-CAPABLE	CHAR(1)
	LAST VOLUME OF SET	CHAR(1)
	RESERVED	CHAR(23)

When the volume type is backup, the following fields are used:	
PRIMARY VOLUME NAME	CHAR(32)
PRIMARY VOLUME SERIAL #	PACKED(11 ,0)
CMPLT RANGE START DATE	CHAR(7)
CMPLT RANGE START TIME	CHAR(6)
CMPLT RANGE END DATE	CHAR(7)
CMPLT RANGE END TIME	CHAR(6)
VOLUME CHANGED END DATE	CHAR(7)
VOLUME CHANGED END TIME	CHAR(6)

When the volume media is CD-ROM, the following fields are applicable:	
MODIFICATION DATE	CHAR(7)
MODIFICATION TIME	CHAR(6)
EXPIRATION DATE	CHAR(7)
EXPIRATION TIME	CHAR(6)

When the volume media is CD-ROM, the following fields are applicable:	
EFFECTIVE DATE	CHAR(7)
EFFECTIVE TIME	CHAR(6)
COPYRIGHT INFORMATION	CHAR(37)
ABSTRACT INFORMATION	CHAR(37)
BIBLIOGRAPHIC INFO	CHAR(37)
PUBLISHER KEY	CHAR(1)
PUBLISHER	CHAR(128)
PREPARER KEY	CHAR(1)
PREPARER	CHAR(128)
DATA SPECIFICATION KEY	CHAR(1)
DATA SPECIFICATION	CHAR(128)

VOLUME LOCATION			
	The following constants are used in the status fields:		
	OFFLINE	CHAR(1)	CONSTANT(″0″)
	SLOT	CHAR(1)	CONSTANT(″1″)
	DRIVE	CHAR(1)	CONSTANT(″2″)
	MOVING	CHAR(1)	CONSTANT(″3″)
	REMOVED	CHAR(1)	CONSTANT(″4″)

VOLUME ACCESS			
	READ ONLY	CHAR(1)	CONSTANT(″1″)
	WRITE PROTECTED	CHAR(1)	CONSTANT(″2″)
	WRITABLE	CHAR(1)	CONSTANT(″3″)

DOUBLE VOLUME MEDIUM			
	NO	CHAR(1)	CONSTANT(″0″)
	YES	CHAR(1)	CONSTANT(″1″)

DOUBLE-SIDED MEDIUM			
	NO	CHAR(1)	CONSTANT(″0″)
	YES	CHAR(1)	CONSTANT(″1″)

IPL-CAPABLE			
	NO	CHAR(1)	CONSTANT(″0″)
	YES	CHAR(1)	CONSTANT(″1″)

LAST VOLUME OF SET			
	NO	CHAR(1)	CONSTANT(″0″)
	YES	CHAR(1)	CONSTANT(″1″)

KEY (PUBLISHER, PREPARER, DATA SPECIFICATION)			
	CONTAINS DATA	CHAR(1)	CONSTANT(″0″)
	CONTAINS FILE NAME	CHAR(1)	CONSTANT(″1″)

VOLUME TYPE			
	PRIMARY	PACKED(3,0)	CONSTANT(000.)
	BACKUP	PACKED(3,0)	CONSTANT(001.)
	JOURNAL	PACKED(3,0)	CONSTANT(002.)
	MIRROR	PACKED(3,0)	CONSTANT(003.)
	UNFORMATTED	PACKED(3,0)	CONSTANT(004.)
	UNKNOWN	PACKED(3,0)	CONSTANT(005.)
	SERVER VOLUME	PACKED(3,0)	CONSTANT(009.)

MEDIA TYPE			
	WORM	PACKED(3,0)	CONSTANT(000.)
	ERASABLE	PACKED(3,0)	CONSTANT(001.)
	CD-ROM	PACKED(3,0)	CONSTANT(002.)
	DVD-ROM	PACKED(3,0)	CONSTANT(003.)
	DVD-RAM	PACKED(3,0)	CONSTANT(004.)
	UNKNOWN	PACKED(3,0)	CONSTANT(009.)

MEDIA FORMAT			
	UNITIALIZED	PACKED(3,0)	CONSTANT(000.)
	HPOFS	PACKED(3,0)	CONSTANT(001.)
	ISO9660	PACKED(3,0)	CONSTANT(002.)
	UNKNOWN	PACKED(3,0)	CONSTANT(003.)
	UDF	PACKED(3,0)	CONSTANT(004.)
	UDF PARTIAL	PACKED(3,0)	CONSTANT(005.)
	CE CARTRIDGE	PACKED(3,0)	CONSTANT(0254.)

Output File Structure for Directory Attributes

Record format for QAMODPA:	
Attribute name	Attribute length
CENTURY	CHAR(1)
DATE	CHAR(6)
TIME	CHAR(6)
DIRECTORY NAME	CHAR(256)
VOLUME NAME	CHAR(32)
OPTICAL LIBRARY	CHAR(10)
DIR CREATION DATE	CHAR(7)
DIR CREATION TIME	CHAR(6)

Record format for QAMODPA:	
RESERVED	CHAR(25)

Output File Structure for File Attributes

Record format for QAMODFA:	
Attribute name	Attribute length
CENTURY	CHAR(1)
DATE	CHAR(6)
TIME	CHAR(6)
PATH NAME	CHAR(256)
VOLUME NAME	CHAR(32)
OPTICAL DEVICE	CHAR(10)
FILE SIZE	PACKED(9,0)
FILE CREATION DATE	CHAR(7)
FILE CREATION TIME	CHAR(6)
FILE MODIFICATION DATE	CHAR(7)
FILE MODIFICATION TIME	CHAR(6)
FILE EXPIRATION DATE	CHAR(7)
FILE EXPIRATION TIME	CHAR(6)
CONT FROM PREVIOUS VOL	CHAR(1)
CONT ON NEXT VOLUME	CHAR(1)
STARTING VOLUME ID	CHAR(32)
ATTRIBUTE NAME	CHAR(25)
ATTRIBUTE DATA	CHAR(75)
FILE SIZE2	PACKED(15,0)
RESERVED	CHAR(17)

Note: If the file size is 999,999,999 bytes or less, FILE SIZE and FILE SIZE 2 will both contain the correct size of the file. If the file size is larger than 999,999,999 bytes, FILE SIZE will be set to 999,999,999 and FILE SIZE 2 will contain the correct file size.

Note: If a file has extended file attributes, there will be one record per extended attribute until all attributes of the file have been listed.

Constants used in the status fields.

CONTINUATION INDICATOR		
	NO	CHAR(1)
	YES	CHAR(1)

Virtual storage

Virtual storage consists of objects that, when used together, imitate tape, CD, DVD, and write-once read-many (WORM) media on your disk units. The imitated media appear to the server to be *actual* media.

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Concepts for virtual storage

This topic provides general information about virtual storage, including descriptions and instructions for use.

When you use virtual storage, you create virtual tape, CD, or DVD images that exist on your server disk units. The objects that virtual storage uses are as follows:

Virtual storage device

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

You create a virtual tape device by selecting the RSRCNAME(*VRT) or TYPE(63B0) parameters on the Create Device Description (Tape) or (CRTDEVTAP) command.

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

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

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.

For optical use only

Note: If the access for an optical image catalog entry is *READWRITE, you set the write protection switch to Y or N. If the access for the optical 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. The WRKIMGCLGE command indicates if the image catalog is in a Ready state or a Not ready state, and you can use this command to change image catalog entries whether 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.

Virtual image

A **virtual image** is an object that contains the data that is typically on physical media. The virtual image is a stream file that resides in the integrated file system. In a backup and recovery scenario, you can also span virtual images.

Related reference

Work with Image Catalogs (WRKIMGCLG)

Work with Image Catalog Entries (WRKIMGCLGE)

Load/Unload/Mount IMGCLG Entry (LODIMGCLGE)

Related information

iSeries Security Reference

Benefits of virtual storage

Virtual storage can help eliminate media errors and user intervention and can increase system availability.

Virtual storage also provides the following advantages:

Electronic distribution

You can use virtual storage to simplify software and data distribution by creating tape, CD or DVD images on your server. You can distribute these images electronically using file transfer protocol (FTP, FTP SSL) 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, i5/OS 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. You need to create a digital signature to use object signing and signature verification.

CD, DVD, and tape creation

You can use virtual storage to create actual media using the DUPOPT and DUPTAP commands to duplicate the virtual images to physical media.

Related concepts

Object signing and signature verification

Catalog Shadowing

Use catalog shadowing to create a copy of an existing image catalog.

Use the Create Image Catalog (CRTIMGCLG) command to create a copy of an image catalog. The reference image catalog contains information about images. The dependent image catalog is a copy of the reference image catalog at a single point in time when the Create Image Catalog (CRTIMGCLG) command was performed.

Use this command to create a dependent image catalog of your reference catalog:

```
CRTIMGCLG IMGCLG(dependent) DIR(*refimgclg) REFIMGCLG(reference)
```

There can be up to 35 ready dependent catalogs pointing to one reference catalog. Each of the tape reference catalogs are read only and write accessible. However optical reference and all dependent image catalogs are read-only and can be used for restore operations.

In order to delete the reference catalog or to delete any one image file all of the dependent image catalogs must be deleted first. The volume name for the optical dependent catalogs has a four character prefix. The prefix is added once the optical dependent catalog is made ready. Use the Work with Image Catalog Entries (WRKIMGCLGE) to find the optical dependent volume name.

Virtual tape

When you use virtual tape devices, you create virtual tape volumes that exist on your server disk units.

Virtual tape devices can perform the same tasks as physical tape except for the following:

- Install of base i5/OS (RSTLICPGM is supported)
- SAVSTG
- Dump to media from SST and DST

Image catalog entry for virtual tape storage

An **image catalog entry** displays information about the virtual volume within an image catalog and contains information about a virtual image 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.

Possible statuses of an image catalog entry are:

Mounted
: The virtual image associated with the selected image catalog entry is active or loaded in the virtual device. The mounted virtual image is specified by selecting *MOUNTED in the using volume parameter. Only one virtual tape volume can be in mounted status at a time.

Loaded
: The virtual tape volume associated with the selected image catalog entry is available for use by the virtual tape device.

Unloaded
The virtual image associated with the selected image catalog entry is not available for use by the virtual tape device.

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.

Volume spanning for virtual tape storage

Spanning occurs when the volumes have files that continue from one volume to the next.

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 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.

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 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. In either case, you should allow for enough volumes to complete the save operation.

If *MOUNTED is specified the volume that is mounted will be used. If there are no volumes mounted, the next loaded volume in the image catalog will be mounted automatically.

If *MOUNTED is specified for a save, a new volume will be automatically created when the end of the image catalog is reached.

If a volume list is specified for a save, message CPA 6798 will be displayed when the volume list is exhausted. You can provide a new volume at this time.

Note: If the new volume specified in reply to message CPA6798 does not exist, it will be automatically created.

If you allow the server to create a new volume for you, the server does the following:

- Adds a *NEW volume and inserts it at position 256 in the image catalog
- Mounts the volume in the virtual device
- Continues the save

When the server creates a new volume, the server gives the new virtual image a name. The server always inserts the new virtual image in position 256 of the image catalog. The size of the new virtual image is set to 1,000,000 MB with ALCSTG(*MIN). The previous volume gets moved to an earlier position.

The following table shows an example of what happens when the server adds a new volume during a save to an image catalog where Vol001 and Vol002 existed before starting the save.

Index	Volume Name	Virtual image name	Volume sequence number	Size	Description
1	Vol001	File1	1	1000 MB	My Save 1
2	Vol002	File2	2	1000 MB	My Save 1

Index	Volume Name	Virtual image name	Volume sequence number	Size	Description
256	GEN001	GEN001	3	1,000,000 MB	Created on 12/31/05 15:38:29

Format of virtual tape images

The density (format) parameter controls the optimum block size that the volume will use so the created volume will be compatible for duplication to your physical tape device.

- Volumes with a Density of *VRT256K will use an optimum block size of 256KB.
- Volumes with a Density of *VRT240K will use an optimum block size of 240KB.
- Volumes with a Density of *VRT64K will use an optimum block size of 64KB.
- Volumes with a Density of *VRT32K will not use an optimum block size and will be compatible with all devices.

You want to pick the largest compatible optimum block size to maximize performance. The Initialize Tape (INZTAP) command can be used to change the density of an existing volume.

Note: Initialize tape (INZTAP) removes any existing data on the tape.

Prepare for virtual tape storage

This topic provides information about meeting the requirements for virtual tape storage and preparing to use it.

To prepare to use virtual tape 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 virtual images volumes you need
- The maximum block size supported by the physical tape device that the virtual tape volume will be saved to
- Make sure that the user profiles used to create the virtual tape volumes has its maximum storage allowed attribute set to *NOMAX.

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 you have enough disk space. The smallest allowable size for a tape image file volume is 48 MB. The largest allowable size is 1,000,000 MB.

To determine how much disk space you have, do the following:

1. In iSeries 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** tab.

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

   Note: Disk usage is limited to 95% of capacity. The tape operation will stop with an end of media error when 95% of disk capacity is reached.

   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.

Clean up disk storage space:

Steps to clean up storage space:

1. Remove any unused virtual tape volumes by using RMVIMGCLGE KEEP(*NO).
2. Delete any unused objects.
3. Save objects by specifying STG(*FREE).
4. Save the old log versions of QHST that are not currently used and then delete them.
5. Print or delete spooled files on the system.

The number of volumes of virtual images you need:

Steps to determine how many volumes you need:

1. Determine how much data you plan to store.
2. Determine the size of each virtual image. Determine image size based on what you plan to do with the tape image file. Keep files small if you want to electronically transfer them to another system.

Set up virtual tape storage

This topic provides a high-level overview of the steps used to set up virtual tape storage. This topic also provides links to information that provide specific instructions for setting up virtual tape storage based on what task you want to accomplish.

Here is a high-level overview of how to set up virtual tape storage for the most common tasks. The exact steps you use to set up virtual tape 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 tape storage.

The tasks are as follows:

- "Create virtual devices"
- "Create virtual images in an image catalog"
- "Use virtual images in an image catalog" on page 157
- "Specific tasks" on page 157

Create virtual devices:

If you do not already have a virtual tape device type 63B0, create one and vary it on:

```
CRTDEVTAP DEVD(TAPVRT01) RSRCNAME(*VRT)
VRYCFG CFGOBJ(TAPVRT01) CFGTYPE(*DEV) STATUS(*ON)
```

Note: You can create up to 35 virtual tape devices.

Create virtual images in an image catalog:

1. Create the image catalog:

   ```
   CRTIMGCLG IMGCLG(MYCATALOG) DIR('/MYCATALOGDIRECTORY') TYPE(*TAP)
   ```

2. Add the virtual tape volume from an existing virtual tape file or create a new virtual tape volume.
   - 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.
   - To create new virtual tape volumes:

     ```
     ADDIMGCLG IMGCLG(MYCATAGLOG) FROMFILE(*NEW)
     TOFILE(vo1001) VOLNAME(VOL1001)
     ```

Use virtual images in an image catalog:
Load the image catalog in the virtual device

```
LODIMGCLG IMGCLG(MYCATALOG) DEV(TAPVRT01)
```

Specific tasks:

You can perform save and restore operations with virtual tape storage.

Perform a save operation

To save to virtual tape storage, see Consider using virtual tape storage in the Backup up your server topic.

Perform a restore operation

To restore from virtual tape storage, see Backup and Recovery .

Duplicating virtual tape to physical media

When you plan to duplicate the virtual tape volumes to physical tape devices you will need to make sure that the virtual tape volumes are created using a block size that is compatible with your physical tape device. The density (format) of the virtual tape volumes is used to control the maximum size that is used for the blocks of data on the virtual tape volume. . If you are unsure what block size your tape device supports, you can view the supported block size information by using iSeries Navigator to display the properties of your physical tape device.

Using volumes in dependent image catalogs

A dependent catalog provides a read-only view of the virtual tape volumes that are within a reference image catalog. To create dependent image catalogs use the following command:

```
CRTIMGCLG IMGCLG(JOEDEP) DIR(*REFIMGCLG) TYPE(*TAP) REFIMGCLG(JOE)
```

All of the volumes in the reference image catalog (JOE) are accessible when the dependent image catalog (JOEDEP) is mounted in a separate virtual tape device. The dependent image catalogs are not synchronized with additional changes that are made to the reference image catalog.

Multiple dependent image catalogs can be created all pointing to the same reference catalog. The same virtual tape volume can be mounted in several virtual devices at the same time through the use of dependent image catalogs. This mounting procedure enables the same virtual tape volume to be used for input operations by multiple users at the same time.

Using virtual tape from other partitions

1. Make sure that the virtual tape device description has unload at vary off with parameters specifying *NO.
2. Mount the virtual volume you want to use from the other partition using the image catalog commands.
3. Vary off the virtual tape device.

   Note: The virtual volume is still mounted.

The other partition can now use the previously mounted virtual tape volume through virtual I/O to the virtual tape device.

Using virtual tape volumes in user ASP's

1. CRTUDFS '/dev/qaspXX/aspXX.udfs', where XX is the ASP number
2. MKDIR '/your-path' to make a mount point directory
3. MOUNT *UDFS '/dev/qaspXX/aspXX.udfs' '/mount-point-directory'
4. Now anything you create in '/mountpoint' is created in the UDFS
5. Use the CRTIMGCLG command to create an image catalog with the mount point in the path name

Note: You cannot specify the mount-point directory when specifying a path-name with the CRTIMGCLG command. Only the directory below the mount-point can be specified.

Using virtual tape volumes in independent ASP's
To use a virtual tape volume in an independent ASP specify the ASP device name as the first part of the IFS path name. The independent ASP must be varied on before the virtual tape volumes are usable, so certain restore commands, such as RSTLICPGM can not be used for virtual tape volumes in independent ASPs.

Image files *ALWSAV attributes
When the image catalog is in ready status all of the image catalog's images have a *ALWSAV attribute value of *NO. This does not allow the images to be saved by the Save Object (SAV) command or the QsrSave API. When the image catalog is not in ready status all of the image catalog's images have a *ALWSAV attribute value of *YES. This allows the images to be saved.

Change the write protection for image catalog entries for virtual tape

Use this information to change the write protection for virtual tape media.

All image catalog entries include a write-protect switch, which functions identically to the write-protect switch on actual media. The default setting is that the image catalog entry is not write-protected.

Note: All image catalog entries in dependent catalogs are write protected.

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)
```

Transport virtual images to another server

Use these instructions to move virtual images among different servers.

A benefit of using virtual tape 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 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.

Troubleshoot virtual tape storage

This topic provides general information about troubleshooting common virtual tape problems.

Typically, when an error occurs with virtual tape 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 most common inquiry and escape messages that occur with virtual tape storage are:

Inquiry messages

CPA4262 - Volume &5 on device &4 is write protected (C R).
CPA6745 - Volume on device &4 is write protected (C R).

Escape messages

CPF415B - Device list not correct.
CPF41B0 - Incorrect image catalog name specified.
CPF41B3 - No more volumes to mount from catalog.
CPF41B4 - Virtual tape volume not available.
CPF41B5 - Virtual tape volume not found.
CPF67F5 - Duplicate cartridge or virtual volume name found.
CPF4373 - End of Media on Device. This message is sent when the storage threshold of the ASP containing the virtual tape volume exceeds 95%, or when the maximum storage allowed threshold of the user profile that owns the virtual tape is exceeded and additional storage cannot be allocated to continue the output operation.

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

Virtual optical storage

When you use virtual optical storage, you create virtual CD or DVD images that exist on your server disk units.

You can use virtual optical images to perform the following tasks:

- Install software such as Licensed Internal Code, program temporary fixes (PTFs), i5/OS, 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.

Image catalog entry for virtual optical storage

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 device. The mounted virtual image is the available virtual image that can be seen

by using the Work with Catalog Entries (WRKIMGCLGE) or Work with Optical Volumes (WRKOPTVOL) command. Only 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.

Volume spanning for virtual optical storage

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 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 inserts 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.

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 Integrated xSeries Server for iSeries
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.

Related concepts

Custom fix package

Format of virtual optical images

For virtual optical, images are available in International Standards Organization (ISO) 9660 format and 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.

Prepare for virtual optical storage

This topic provides information about meeting the requirements for virtual tape storage and preparing to use it.

To prepare to use virtual optical storage, you need to consider these items:

- Whether you have the authority to create virtual images
- The amount of disk space available
- The number of volumes of virtual images you need

Related tasks

Clean up disk storage space

Related reference

Work with Disk Status (WRKDSKSTS)

Related information

iSeries Security Reference

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 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, the first volume must be at least 1489 MB because the first volume must be large enough to store the Licensed Internal Code. The remaining volumes can be smaller than 1489 MB.

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.

Set up virtual optical storage

This topic provides a high-level overview of the steps used to set up virtual optical storage. The topic also provides links to information that provide specific instructions for setting up virtual optical storage based on what task you want to accomplish.

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.

The tasks are as follows:

- “Install from an image catalog” on page 164
- “Create virtual optical”
- “Use virtual images in an image catalog” on page 164
- “Specific tasks” on page 165

Related concepts

Consider using virtual optical storage

Related tasks

Preparing to upgrade or replace software using an image catalog

Prepare the central system for virtual images

Distribute software

Install fixes from an image catalog

Backup up your server

Related information

Backup and Recovery

Create virtual optical:

1. Create the image catalog:

```
CRTIMGCLG IMGCLG(MYCATALOG) DIR('/MYCATALOGDIRECTORY')
```

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:

You can perform these tasks 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.

Install from an image catalog:

1. Create the image catalog:

```
CRTIMGCLG IMGCLG(MYCATALOG) DIR('/MYCATALOGDIRECTORY')
```

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.

   ```
   VFYIMGCLG IMGCLG(MYCATALOG) TYPE(*UPGRADE) SORT(*YES)
   ```

   The following are required for the verify operation:
   a. Licensed Internal Code for i5/OS
   b. Operating System/iSeries
   c. i5/OS - Library QGPL
   d. i5/OS - Library QUSRSYS
6. Start the installation:

   ```
   PWRDWNSYS OPTION(*IMMED) RESTART(*YES) IPLSRC(*IMGCLG) IMGCLG(AL)
   ```

   Refer to Preparing to upgrade or replace software using an image catalog for more information.

Specific tasks:

You can perform save and restore operations with virtual optical storage.

Image files *ALWSAV attributes

When the image catalog is in ready status all of the image catalog's images have a *ALWSAV attribute value of *NO. This does not allow the images to be saved by the Save Object (SAV) command or the QsrSave API. When the image catalog is not in ready status all of the image catalog's images have a *ALWSAV attribute value of *YES. This allows the images to be saved.

Note: By using the code examples, you agree to the terms of the "Code license and disclaimer information" on page 170.

Change the write protection for image catalog entries for virtual optical

Use this information to change the access-mode for virtual optical media.

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 are 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 a write-protected image catalog entry's write-protection status to 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)
```

Note: By using the code examples, you agree to the terms of the "Code license and disclaimer information" on page 170.

Create actual media from a virtual image

Use these instructions to copy a virtual image to an optical disk.

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.

Related tasks

Transfer files with FTP

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.

Create actual media using a PC:

To create an actual media using a PC, you must use a method such as File Transfer Protocol (FTP) or iSeries 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)
```

Note: By using the code examples, you agree to the terms of the "Code license and disclaimer information" on page 170.

Transport virtual images to another server

Use these instructions to move virtual images among different servers.

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. For instructions on moving a file with FTP see Transfer files with FTP.

iSeries 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 instructions on moving a file with Management Central, see Packaging and sending objects with Management Central.

QFilesvr.400

The i5/OS File Server file system (QFileSvr.400) 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 i5/OS File Server file system (QFileSvr.400).

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

Related concepts

FTP

Management Central

i5/OS File Server file system (QFileSvr.400)

Related tasks

Transfer files with FTP

Packaging and sending objects with Management Central

Troubleshoot virtual optical storage

This topic provides general information about troubleshooting common virtual optical problems.

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

This topic describes what storage area networks (SANs) are and how they can be used to provide centralized storage. It discusses advantages and disadvantages and links you to more detailed information.

SANs are a newer development in the disk and tape attachment business. They consolidate the storage of multiple, storage devices 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 case 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 SAN data movement capability enables data to be moved without server intervention, thereby freeing 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 server.

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.

Related information

Introduction to Storage Area Networks

iSeries in Storage Area Networks A Guide to Implementing FC Disk and Tape with iSeries

Related information for storage solutions

Following are the iSeries manuals (PDFs) and IBM Redbooks™ (PDFs), Web sites, and information center topics 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)

IBM Redbooks

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

Web sites

- Backup, Recovery and Media Services
- Hierarchical Storage Management
- iSeries Storage Solutions
- IBM TotalStorage

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