AS/400e

Optical Support

Version 4

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> **Take Note!**
>
> Before using this information and the product it supports, be sure to read the general information under "Notices" on page 183.

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About Optical Support (SC41-5310)

This book serves as a user's guide and reference for IBM optical support on the OS/400 operating system. This book explains the functions that are unique to optical support, and the information contained in this book can help you use and understand:

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

Unless otherwise stated, this book refers to the operational and functional characteristics of directly attached optical devices. Many of these characteristics are the same for LAN-attached optical media library devices, but are not guaranteed unless stated.

For information about other OS/400 publications, see the bibliography.

For a list of related publications, see the Bibliography.

Who Should Use This Book

The information in this book is intended for the following audiences:

System operators

AS/400 system operators can use this book as their primary reference for CD-ROM, DVD, and optical media library operation.

Service representatives

Service representatives can use this book to perform activities as directed by the *IBM 3995 AS/400 Optical Library Dataserver: Maintenance Information* book.

Application programmers

Programmers can use this book to assist in the development of applications that use the hierarchical file system and integrated file system application programming interfaces to optical support.

End users

End users can use this book as their primary reference for information on operating and using CD-ROM, DVD, and optical media libraries.

All audiences should be familiar with the AS/400 system.

Conventions and terminology used in this book

This book includes examples and displays that specify dates. The date format used is MM/DD/YY where MM represents the month, DD represents the day, and YY represents the year. A different date format may be used by your system.

AS/400 Operations Navigator

AS/400 Operations Navigator is a powerful graphical interface for Windows clients. With AS/400 Operations Navigator, you can manage and administer your AS/400 systems from your Windows desktop.

You can use Operations Navigator to manage communications, printing, database, security, and other system operations. Operations Navigator includes Management Central for managing multiple AS/400 systems centrally.

Figure 1 shows an example of the Operations Navigator display:
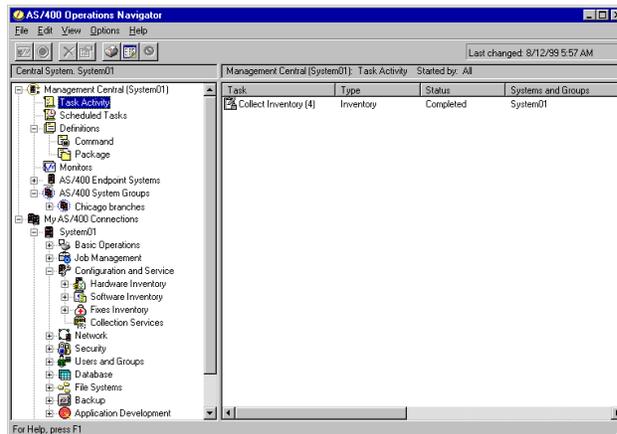
Figure 1. AS/400 Operations Navigator Display

This new interface has been designed to make you more productive and is the only user interface to new, advanced features of OS/400. Therefore, IBM recommends that you use AS/400 Operations Navigator, which has online help to guide you. While this interface is being developed, you may still need to use an emulator such as PC5250 to do some of your tasks.

Installing Operations Navigator

To use AS/400 Operations Navigator, you must have Client Access installed on your Windows PC. For help in connecting your Windows PC to your AS/400 system, consult *Client Access Express for Windows - Setup*, SC41-5507-01.

AS/400 Operations Navigator is a separately installable component of Client Access that contains many subcomponents. If you are installing for the first time and you use the **Typical** installation option, the following options are installed by default:

- Operations Navigator base support
- Basic operations (messages, printer output, and printers)

To select the subcomponents that you want to install, select the **Custom** installation option. (After Operations Navigator has been installed, you can add subcomponents by using Client Access Selective Setup.)

After you install Client Access, double-click the **AS400 Operations Navigator** icon on your desktop to access Operations Navigator and create an AS/400 connection.

Prerequisite and related information

Use the AS/400 Information Center as your starting point for looking up AS/400 technical information. You can access the Information Center from the AS/400e Information Center CD-ROM (English version: *SK3T-2027*) or from one of these Web sites:

```
http://www.as400.ibm.com/infocenter
http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm
```

The AS/400 Information Center contains advisors and important topics such as CL commands, system application programming interfaces (APIs), logical partitioning, clustering, Java, TCP/IP, Web serving, and secured networks. It also contains Internet links to Web sites such as the AS/400 Online Library, AS/400 redbooks, and the AS/400 Technical Studio.

For a list of related publications, see the "Bibliography" on page 181.

How to send your comments

Your feedback is important in helping to provide the most accurate and high-quality information. If you have any comments about this book or any other AS/400 documentation, fill out the readers' comment form at the back of this book.

- If you prefer to send comments by mail, use the readers' comment form with the address that is printed on the back. If you are mailing a readers' comment form from a country other than the United States, you can give the form to the local IBM branch office or IBM representative for postage-paid mailing.
- If you prefer to send comments by FAX, use either of the following numbers:
  - United States, Canada, and Puerto Rico: 1-800-937-3430
  - Other countries: 1-507-253-5192
- If you prefer to send comments electronically, use one of these e-mail addresses:
  - Comments on books:

    RCHCLERK@us.ibm.com

    IBMMAIL, to IBMMAIL(USIB56RZ)
  - Comments on the AS/400 Information Center:

    RCHINFOC@us.ibm.com

Be sure to include the following:
- The name of the book.
- The publication number of the book.
- The page number or topic to which your comment applies.

Summary of Changes

The following items are revised with this release of this guide:

- Changed the number of drives for models 3995-C24, 3995-C26, 3995-C28, 3995-C46, and 3995-C48. Refer to Table 1 in ″Supported Hardware for Optical Storage″.
- Added information pertaining to DVD devices.
- Added chapter 10 which describes the different optical media formats.
- Added information related to 8x media capacity.
- Added information related to using optical in a thread-safe environment.
- Added information related to enhanced save/restore support.
- Command changes to WRKOPTVOL, INZOPT, and ADDOPTCTG.
- Added information related to allocating and deallocating an optical drive.

A vertical line (|) to the left of the text indicates a change or addition.

Chapter 1. Optical Support—Introduction

Optical storage on the AS/400 system 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 storage devices, such as tape and microfilm, with faster access times and a hierarchical-type file organization. AS/400 optical storage uses files that are stored in directories and files that are stored in subdirectories similar to UNIX** or PC-based file systems. Compact disk read-only memory (CD-ROM) drives are standard equipment on AS/400 Advanced Series systems that use PowerPC® technology. They provide an economical means for wide-scale distribution of programs and data. DVD-RAM drives are available as an orderable feature on many AS/400e™ systems that are running at least Version 4 Release 5 level of OS/400. You can use the DVD-RAM for many day-to-day save and restore operations. In addition, you can use file system interfaces such as the integrated file system and hierarchical file system to store and retrieve data files on DVD-RAM media.

The capacity, price, and performance of optical storage continually improve, and IBM® remains committed to providing its customers with these improvements over time. Optical media libraries are now available with data capacities larger than many tape systems. Even with this rapid rate of change in optical hardware, the basic methods of accessing optical information remain consistent. DVD-RAM and 8x density WORM and erasable media are the newest members to the AS/400 Optical Storage family. These new storage types have been added under the current file system interfaces that optical storage programs have used for years.

Optical Media Types

Five categories of optical media are available to meet most storage requirements: CD-ROM, DVD-ROM, DVD-RAM, WORM (write-once read-many) 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 AS/400 system. 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 2-sided writable optical media that provides a pre-formatted capacity of 4.7 GB per side. You can only access DVD-RAM media in a DVD-RAM drive.

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), and 8x (5.2 GB) capacities.

An erasable cartridge offers the most flexibility, with the same capabilities as magnetic storage but with much higher capacities and lower cost. Erasable media is available in 1x (650 MB), 2x (1.3 GB), 4x (2.6 GB), and 8x (5.2 or 4.8 GB) capacities.

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. CCW (continuous composite write-once) WORM and erasable media can either be 1024 or 2048 bytes per sector.

Optical System Configurations

All AS/400 Advanced Series systems include a rack-mounted CD-ROM drive that is ideal for program and data distribution. The CD-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 CD-ROM at a time.

A DVD-RAM drive is available to replace the existing CD-ROM 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.

An **optical media library** is a device that contains at least one optical disk drive and may contain many optical cartridges. These cartridges are automatically inserted into the drive. Optical media libraries can automatically manage large numbers of optical cartridges and users. "Supported Hardware for Optical Storage" on page 4 contains a list of all currently available optical media libraries that are supported by AS/400. These libraries support multiple numbers of users who access multiple numbers of optical cartridges simultaneously.

You can connect optical media libraries to your AS/400 system in two ways: Directly-attached and LAN-attached.

Directly-Attached Libraries

One method of connecting optical media libraries is to directly connect the optical media library to your AS/400 system. A multi-wire cable connects the library to an I/O processor (IOP) card within the AS/400 system.

Directly-attached libraries support all of the following functions:
- All Hierarchical File System application programming interfaces.
- Most integrated file system commands.
- Many AS/400® save and restore commands.
- Accessible by other LAN-connected AS/400 systems by using the integrated file system (as shown in Figure 2 on page 3).

AS/400   AS/400

Directly
Attached
Optical
Library

Work Station

Token Ring or
Ethernet LAN

Work Station   Work Station

PC   PC
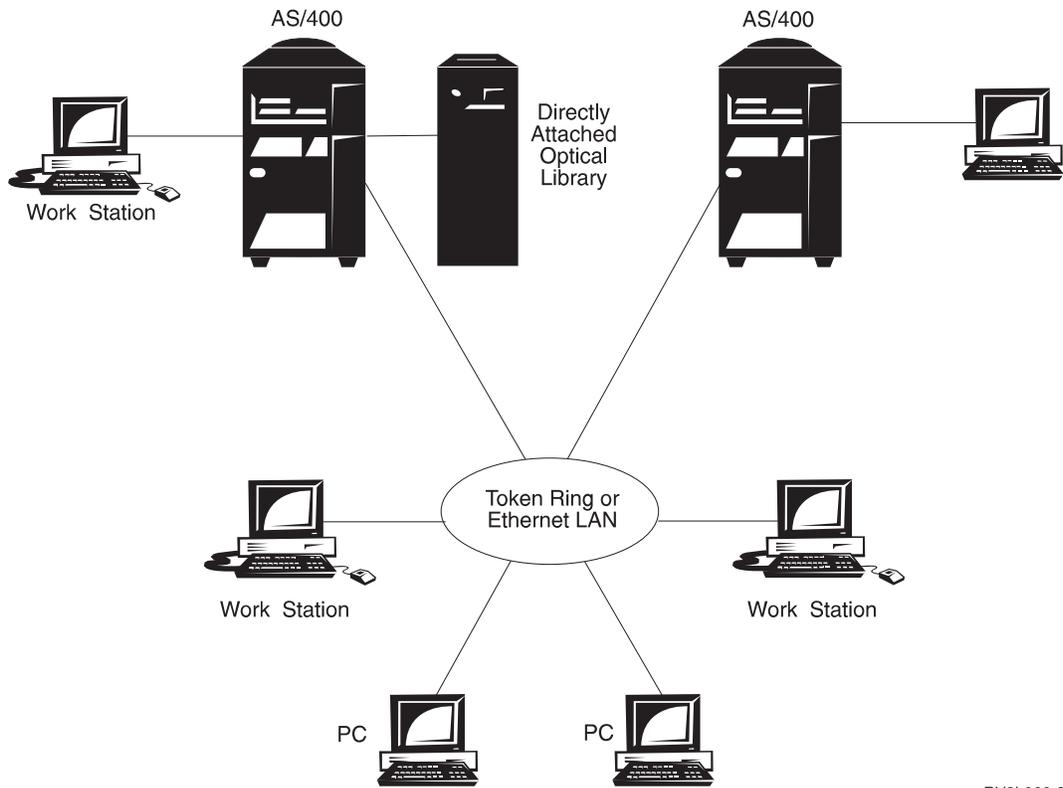
RV3L066-2

Figure 2. Example of Using an AS/400 Directly-Attached Library through a Local Area Network

LAN-Attached Libraries

The second method of connecting optical media libraries to your AS/400 system is through a local-area network (LAN), as shown in Figure 3 on page 4.
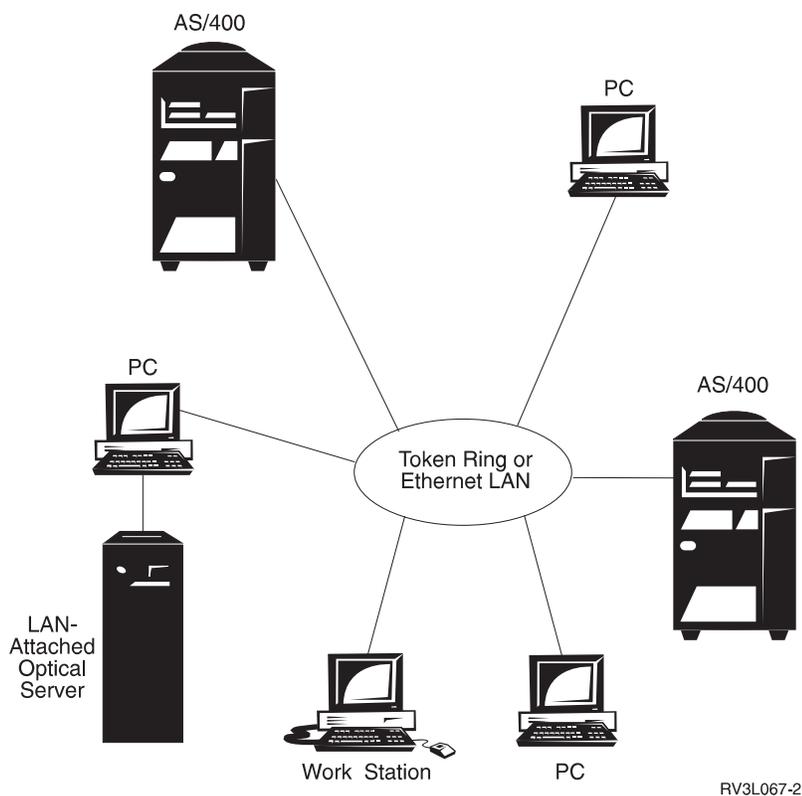
Figure 3. Example of Using AS/400's with a LAN-Attached Optical Library

LAN-connected optical media libraries can be used only through the HFS interface. The libraries can be accessed simultaneously either by several AS/400 systems or any other devices on the LAN. LAN-connected optical media libraries have a controlling PC and do not require an AS/400 system that acts as a controller. LAN-attached optical media libraries are often referred to as **optical servers**.

Supported Hardware for Optical Storage

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 258 optical cartridges and four disk drives. Optical media libraries may be directly connected to the AS/400 system for best functionality and performance, or may be connected through a LAN to allow independent access by PCs or other AS/400 systems. Table 1 provides a list of supported optical devices:

Table 1. 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
3995-023	Multi-Function	LAN	32	2
3995-122	WORM	LAN	144	4

Table 1. Currently Supported Optical Storage Devices (continued)

Model	Drive Type	Connection	Cartridge Capacity	Number of Drives
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-A43	Multi-Function	Direct	16	1
3995-042	WORM	Direct	32	2
3995-043	Multi-Function	Direct	32	2
3995-142	WORM	Direct	144	4
3995-143	Multi-Function	Direct	144	4
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

Additional Software Requirements for Optical LAN Support

If you supply your own PC for the optical LAN server, the following software must be loaded on the PC:

- OS/2® V2.1 or later
- OS/2 Communication Manager/2 V1.01 or later
- IBM High-Performance Optical File System (HPOFS) PC software
- HFS PC-Server Program (HFSSRV.EXE) V4.6 or later

If the PC for the optical LAN server is provided with the 3995 LAN library all required hardware and software is shipped with the unit.

On the AS/400, the extended base support option is also required before using an optical LAN library.

Optical Storage Organization

Optical storage is organized in three hierarchical units: volumes, directories, and files.

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. DVD-RAM, WORM, and erasable optical cartridges, are two sided and contain two volumes per cartridge (one per side).

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 their 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 volumes on a AS/400 system by using the Work with Optical Volumes (WRKOPTVOL) command. The hierarchical and integrated file systems 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
```

In the example:
- `/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

Information on an optical volume is organized into units called **directories**. 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.

Optical Files

The basic element of optical storage is the optical **file**. 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 features:
- 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.

Using and Managing Optical Storage

You can display the primary menu for optical support by entering GO OPTICAL on the AS/400 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 any optical volume within a particular optical media library, CD-ROM drive, DVD-RAM drive, or show all optical volumes in all optical servers.

- 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 a volume that is contained in a directly-attached optical media library.
- 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-ROM drives, and DVD-RAM drives.
- Add, remove, or check the status of any LAN-attached optical server.
- Display active LAN-attached server conversations.

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.

Chapter 2. CD-ROM and DVD on AS/400

This chapter provides information on configuring your CD-ROM or DVD device as well as tips for loading and unloading media.

AS/400 systems have a rack-mounted CD-ROM drive. In Version 4 Release 5, you can order an internally attached DVD-RAM drive as a feature. The DVD-RAM drive can either replace a CD-ROM drive or be attached in addition to it. Both CD-ROM and DVD-RAM drives are multi-user devices where multiple users on the AS/400 system can access data concurrently. The following interfaces are available to access the data on the CD-ROM and DVD media:

- Save and restore interface
- The hierarchical file system application programming interface (HFS API)
- The integrated file system interfaces
- Optical commands and utility displays

Note: The CD-ROM drives on the AS/400 system are not enabled for the digital audio disk format.

Supported Media Formats

OS/400 supports the reading of all CD-ROM media that is created in ISO9660 media format that use the primary volume descriptor (PVD). OS/400 does not support CD-ROMs that are created using *CD-ROM Extensions* through the secondary volume descriptor (SVD).

OS/400 supports DVD-ROM media with either ISO9660 or Universal Disk Format (UDF) media formats. UDF is the Optical Storage Technology Association (OSTA) supported subset of ISO/IEC 13346. (It also addresses ECMA-167 which is equivalent to ISO 13346.) Like CD-ROM, OS/400 supports all DVD-ROM media in ISO9660 that uses the PVD. OS/400 supports only DVD-RAM media that is created with the UDF media format. See "Chapter 10. Optical Media Formats" on page 113 for more information about the different media formats.

Note: Although not accessible through OS/400, CD-ROM and DVD media that are created using the secondary volume descriptor of ISO9660 may be accessible in an AS/400. You can access them through an Integrated Netfinity® Server for OS/400® server by running an operating system other than OS/400.

Configuring Your CD-ROM or DVD Drive

Depending on the model of AS/400, 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.

Working with 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 AS/400, 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. For more information about application programming interfaces, refer to "Chapter 7. Using Application Programming Interfaces for Optical Support" on page 59.

Loading and Unloading CD-ROM and DVD Media

Loading a CD-ROM or DVD media into a drive causes reading of 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. Once the volume identifier is in the optical index, you can access the media through save and restore, 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. A CD-ROM or DVD can be loaded into a varied-off device. However, the optical index does not update until the device description gets varied on.
- When the user varies on a CD-ROM or DVD device description with media in it.

There is additional processing that 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 completes.

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 sucessfully 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. Listed below are the most likely causes for an unsuccessful load.

- 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.

Duplicate Volume Identifiers

With the availability of multiple CD-ROM and DVD drives on a single AS/400 comes the possibility of volume identifier collisions. Optical media, whether it is a CD-ROM, DVD, erasable, or WORM, are stamped or formatted with a volume identifier. The optical file system requires that all volume identifiers in an AS/400 be unique, due to the hierarchical directory structure of the QOPT file system. If a volume identifier collision occurs, the media containing the duplicate volume identifier becomes rejected with the following message that is signalled to QSYSOPR message queue.

```
Optical volume VOLID01 already exists.
```

In addition, the CD-ROM or DVD tray will eject the media.

Allocating the Device Description

The process of loading the CD-ROM or DVD media requires *SHRUPD use of the device description. Therefore, 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.

Mastering Your Own CD-ROM

CD-ROM mastering software is available through IBM business partners. See your IBM account representative for more information.

Chapter 3. Directly-Attached Optical Media Libraries

This chapter provides information on configuring optical media libraries, powering optical media libraries on and off, labeling optical cartridges, and setting write protection on and off. This chapter also includes scenarios for working with optical media libraries.

Directly-attached optical media libraries are optical media libraries that are attached to the AS/400 system through the SCSI** interface. On AS/400, multiple users can access data on directly-attached libraries concurrently. The following interfaces are available to access the data on these devices:

- Save and restore interface
- The hierarchical file system application programming interface (HFS/API)
- The integrated file system interfaces
- Optical commands and utility displays

Configuring 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 library device 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.

Powering Optical Media Libraries On and Off

The following topics describe how to power optical media libraries on and off.

IBM 3995 Compact Optical Library Dataserver, Model A43

To power on the IBM 3995 Compact Optical Library Dataserver, Model A43, push the power switch in and release it.

The front Operator's panel should indicate *ready* after 3 minutes. Wait until the *ready* indicator is lit before you operate the dataserver.

To power off the dataserver, push the power switch in and release it.

IBM 3995 Compact Optical Library Dataserver, Model 04x

To power on the IBM 3995 Compact Optical Library Dataserver, Model 04x, push the power switch in and release it. See Figure 4.
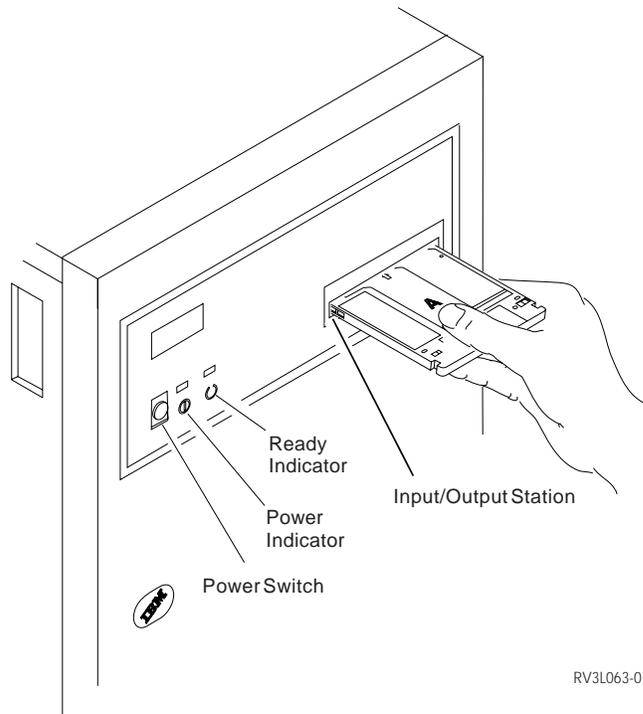
Figure 4. Model 042 Front Panel

The *ready* indicator should glow after 3 minutes. Wait until both the power and ready indicators are on before operating the dataserver.

To power off the dataserver, push the power switch in and release it.

IBM 3995 Optical Library Dataserver, Model 14x

To power on the IBM 3995 Optical Library Dataserver, Model 14x, set the power switch to the *On* position (1).

Wait approximately 3 minutes before you operate the dataserver.

To power off, set the power switch to the *Off* position (0).

IBM 3995 Optical Library Dataserver, Model Cxx

To power on the IBM 3995 Optical Library Dataserver, Model Cxx, set the Power Switch on the back panel of the library to the On (1) position.
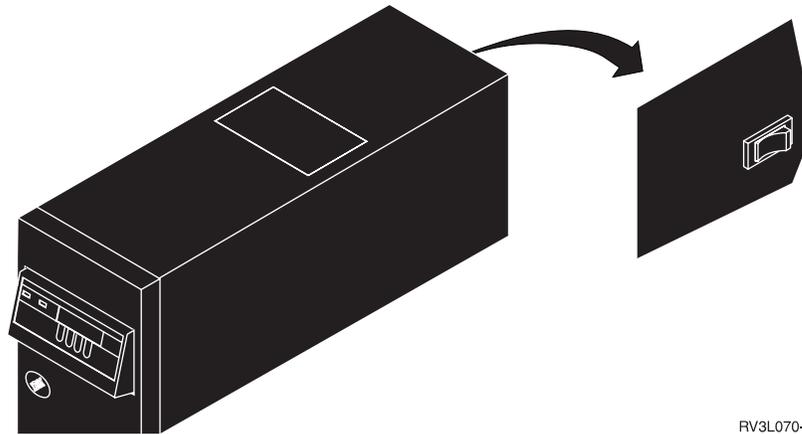
RV3L070-0

Figure 5. Model Cxx Back Panel

The power and active indicators will go on. Wait until the active indicator is off before operating the IBM 3995 Optical Library Dataserver, Model Cxx.

To power off, set the power switch to the *Off* position (0).

Labeling Optical Cartridges (WORM or Erasable)

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.

Labeling a New Optical Cartridge with Uninitialized Volumes

To label a cartridge that is new (both volumes are uninitialized), follow these steps. 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. Add the optical cartridge by choosing option 1 (Add).

   After the cartridge is added, the volume names appear on the Work with Optical Volumes display (see Figure 6 on page 16) as system-generated IDs that consist of the system date and time.

```
                      Work with Optical Volumes
                                                  System:   XXXXXXXX
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 ...

                               Volume       Media      Authorization
Opt  Volume        Device      Type         Type          List
 _
 _   941215111729  OPTMLB01    *UNFORMATTED  *ERASE      QOPTSEC
 _   941215111730  OPTMLB01    *UNFORMATTED  *ERASE      QOPTSEC




                                                              Bottom
Parameters or command
===> _____
F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve   F11=View 2
F12=Cancel   F14=Show extended information          F24=More keys ...
```

Figure 6. Work with Optical Volumes Display

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.

Labeling 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 choosing 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. See "Setting Write Protection" on page 17 for more details on setting write protection.

3. Add the cartridge to an optical media library by choosing 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 choosing option 4 (Remove) next to the volume ID.

7. Label the write-protected side of the cartridge to the volume ID you previously recorded.

Setting 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.

Allocate/Deallocate Optical Drive

Optical media libraries range from a model that has a single drive to a model that has six 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.

```
                    Work with Media Library Status
                                           System:    xxxxx

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

       Device/                                              Job
  Opt  Resource     Status           Allocation          name
  __   OPTMLB01         ACTIVE
  6_    OPT03          OPERATIONAL        ALLOCATED
  __    OPT02          OPERATIONAL        ALLOCATED




                                                    Bottom

  Parameters or command
  ===> _____
  F3=Exit   F4=Prompt   F5=Refresh   F9=Retrieve   F12=Cancel   F17=Position to
  F23=More options
  (C) COPYRIGHT IBM CORP. 1980, 1999.
```

Figure 7. Work with Media Library Status

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.

```
                        Work with Media Library Status
                                                System:   xxxxx

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


         Device/                                               Job
   Opt   Resource     Status           Allocation           name
   __    OPTMLB01        ACTIVE
   __      OPT03         OPERATIONAL        DEALLOCATED
   __      OPT02         OPERATIONAL        ALLOCATED




                                                  Bottom

   Parameters or command
   ===> _____
   F3=Exit    F4=Prompt   F5=Refresh   F9=Retrieve   F12=Cancel   F17=Position to
   F23=More options
   (C) COPYRIGHT IBM CORP. 1980, 1999.
```

Figure 8. Work with Media Library Status

The device allocation status of DEALLOCATED will remain until the drive is allocated again or the AS/400 is IPLed.

Getting 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 in this chapter assume that you have a new optical disk cartridge available to use and your optical media library is empty.

Adding Optical Cartridges to an Optical Media Library—Example

To add an optical cartridge to the optical media library you have attached to your AS/400 system, 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.

Note: It is not a requirement to have side A up to add an optical cartridge. To correctly label a new optical cartridge, however, it is important to know which side is up when you add the cartridge to an optical media library.

If the cartridge is new, you may want to label it before adding it for the first time. See "Labeling Optical Cartridges (WORM or Erasable)" on page 15 for more information.

Enter 1 (Add) in the options field and press the Enter key. The Add Optical Cartridge display appears. Complete the fields on the Add Optical Cartridge display as follows:
- Optical media library: 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).
- Authorization List: Specify QOPTSEC to secure the volumes with the default authorization list.
- Rebuild Directory Index: Specify *YES for this parameter. This indicates that the system created an optical directory index for both volumes.

When all parameters are entered, press the Enter key. You receive a confirmation screen to continue with adding an optical cartridge. Press the Enter key again.

Initializing Optical Volumes—Example

If the cartridge you added was a new cartridge, you will see something similar to the display shown in Figure 9 on page 20. This indicates that the optical cartridge has two uninitialized volumes on it.

```
                     Work with Optical Volumes
                                                  System:    XXXXXXXX
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 ...

                              Volume         Media      Authorization
Opt  Volume        Device     Type           Type          List

_    _____
_    941215111729  OPTMLB01   *UNFORMATTED   *ERASE      QOPTSEC
_    941215111730  OPTMLB01   *UNFORMATTED   *ERASE      QOPTSEC




                                                                 Bottom
Parameters or command
===> _____
F3=Exit    F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve   F11=View 2
F12=Cancel   F14=Show extended information          F24=More keys ...
```

Figure 9. Work with Optical Volumes Display

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
indicates 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 options field beside that volume. Press the Enter key.

Attention: Initializing a previously initialized volume makes all existing data on
that volume inaccessible. If you have entered 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 fields on the Initialize Optical Volume display as follows:

- 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. After the volume is initialized, the Work with Optical Volumes display reappears as shown in Figure 10.

Note: Initializing an erasable optical volume can take up to 10 minutes.

```
                        Work with Optical Volumes
                                                  System:   XXXXXXXX
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 ...

                               Volume       Media     Authorization
Opt  Volume         Device     Type         Type         List

 _   _____
 _   VOL001         OPTMLB01   *PRIMARY     *ERASE     QOPTSEC
 _   941215111730   OPTMLB01   *UNFORMATTED *ERASE     QOPTSEC




                                                                 Bottom
Parameters or command
===> _____
F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve   F11=View 2
F12=Cancel   F14=Show extended information          F24=More keys ...
```

Figure 10. Work with Optical Volumes Display

The previously uninitialized volume is initialized and the type has changed from *UNFORMATTED to *PRIMARY. The volume is now available for reading and writing files and directories.

From this display, you can perform the following functions:
- Add an optical cartridge by selecting option 1 (ADD).
- Change the volume attributes by selecting option 2 (Change).
- Copy a volume by selecting option 3 (Copy).
- Remove an optical cartridge by selecting option 4 (Remove Cartridge).

- Display volume information by selecting option 5 (Display).
- Print volume information by selecting option 6 (Print).
- Rename a volume by selecting option 7 (Rename).
- Work with directories on the volume by selecting option 8 (Work with Directories).
- Delete volume information for a previously removed volume by selecting option 9 (Delete).
- Initialize or reinitialize a volume by selecting option 10 (Initialize).
- Work with directories and files on the volume by selecting option 11 (Work with object links).
- Duplicate a volume to another optical media by selecting option 12 (Duplicate).

Removing an Optical Disk Cartridge—Example

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, as shown in the example that follows in Figure 11, specifying option 4 (Remove) on either VOL001 or 941215111730 produces the same result.

```
                    Work with Optical Volumes
                                                System:   XXXXXXXX
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 ...

                           Volume        Media     Authorization
Opt   Volume       Device  Type          Type      List
_     _____
_     VOL001       OPTMLB01  *PRIMARY      *ERASE    QOPTSEC
_     941215111730 OPTMLB01  *UNFORMATTED  *ERASE    QOPTSEC




                                                              Bottom
Parameters or command
===> _____
F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve   F11=View 2
F12=Cancel   F14=Show extended information          F24=More keys ...
```

Figure 11. Work with Optical Volumes Display

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.

Enter 4 (Remove) in the Opt field next to the cartridge you wish 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.

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.

Press F3 (Exit) to return to the optical support main menu. The screen that displays shows that the optical disk cartridge is no longer available.

Press F3 again to return to the AS/400 command line.

Chapter 4. LAN-Attached Optical Media Libraries

This chapter describes aspects of optical LAN support, including:

- Configuration of optical LAN support.
- Volume security.
- Description of LAN-specific commands.
- Differences between directly-attached and LAN-attached devices.
- Getting started with optical LAN support

Optical LAN support allows one or more AS/400 systems access to optical devices or libraries over either a token-ring or Ethernet LAN connection. Figure 12 shows an example optical configuration where three LAN-attached optical media libraries are shared by two AS/400 systems and a workstation.
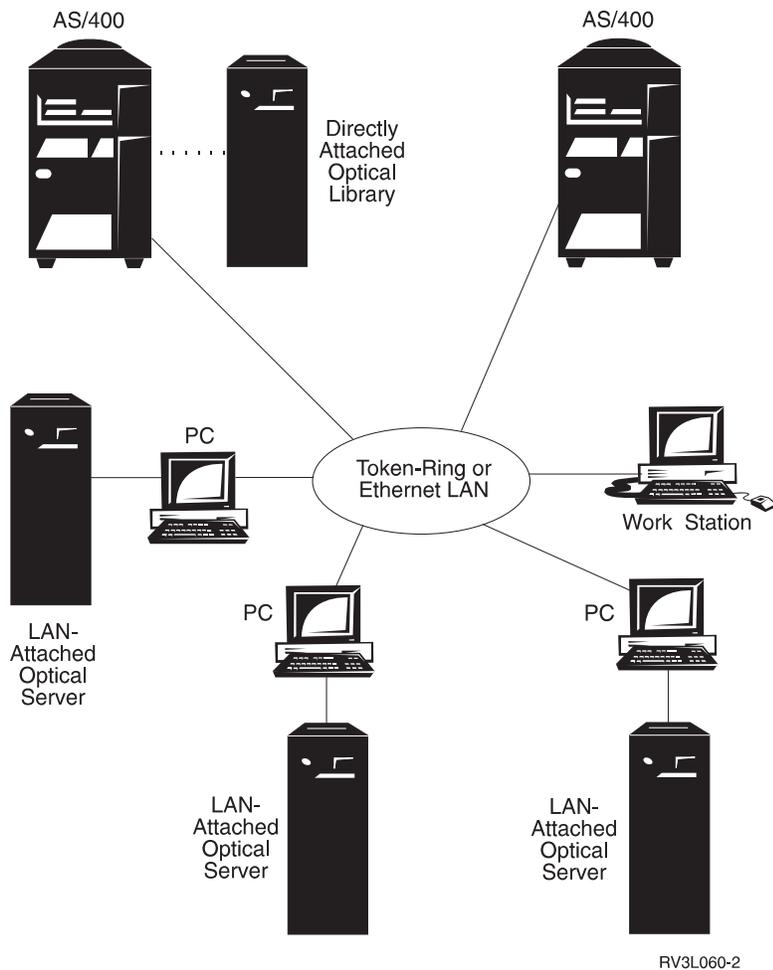
Figure 12. Typical Optical LAN Configuration

The following interfaces are available to access data on optical LAN devices:

- Hierarchical file system application program interfaces (HFS APIs)
- Optical commands and utility panels

Accessing data on a LAN device works the same way as accessing data on a directly-attached device. To access or store information, you need to know the path name. The path name consists of the file system name, volume, directory, and file to use. Optical support determines where to store the volume, and whether the device is directly-attached or LAN-attached. The HFS request gets routed to the appropriate server.

An application that uses HFS APIs to access optical volumes in directly-attached devices can also access volumes in remotely-attached optical LAN devices. Volume names must be unique across all optical devices, whether the volumes exist in a directly-attached device or a LAN device. Most HFS APIs that are supported by directly-attached devices are also supported by LAN devices with minor differences. For a complete list of what is supported, unsupported, and changed, refer to Table 3 on page 60.

Three commands are dedicated to LAN support. They are used for adding, removing, and displaying optical LAN devices.

- Add Optical Server (ADDOPTSVR) command
- Display Optical Server (DSPOPTSVR) command
- Remove Optical Server (RMVOPTSVR) command

There are other optical commands and utility panels that support optical LAN devices and volumes in those devices. For a complete list of these commands, see Table 2 on page 37.

Configuring Optical LAN Support

To start using optical LAN support, all of the hardware and software items must be in place and active. Figure 13 on page 27 shows the layers of software used in optical LAN support. For more details on hardware, refer to "Supported Hardware for Optical Storage" on page 4. The software that is needed for LAN support is described in "Additional Software Requirements for Optical LAN Support" on page 5.
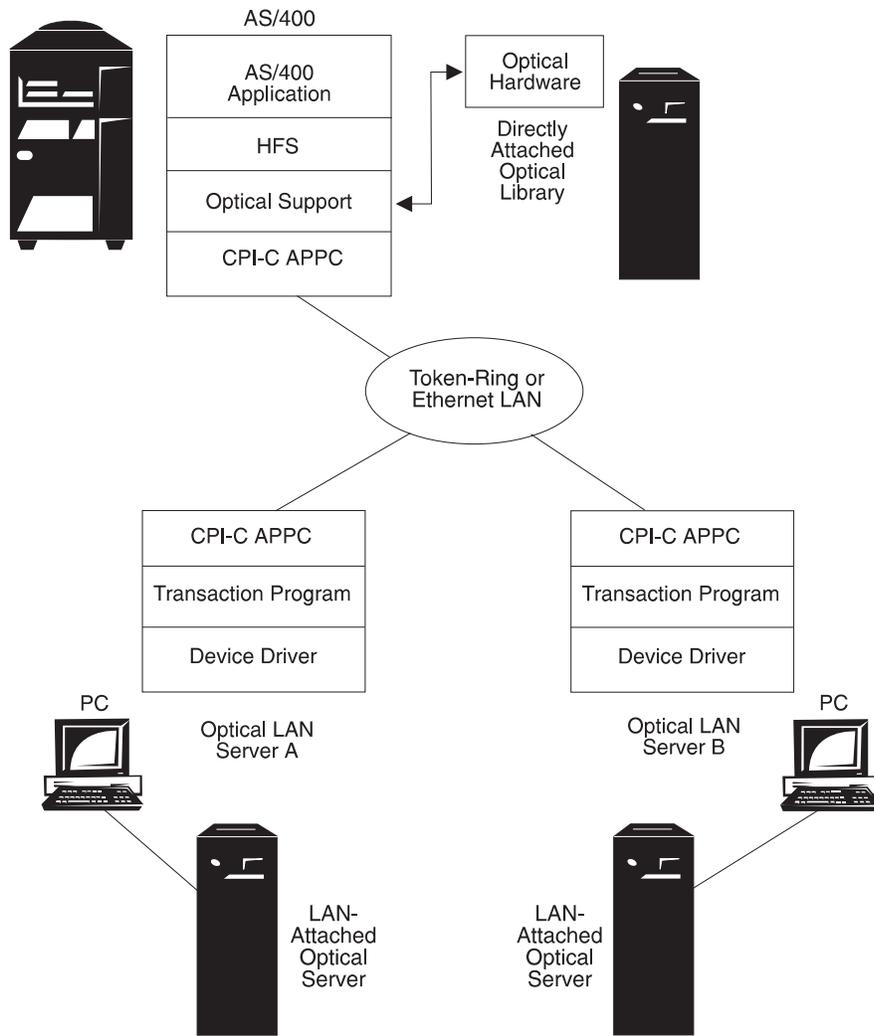
Figure 13. Optical LAN Software Interfaces

You can use advanced program-to-program communications (APPC) to communicate between AS/400 and the optical LAN device. On AS/400, the LAN device is configured as an APPC controller and device which is on either a token-ring or Ethernet connection. You must have OS/400 Extended Base Support installed on AS/400 (use GO LICPGM to determine if it is installed). A sample configuration to use when configuring a LAN device is given in "AS/400 Communications Control Setup—Example" on page 28. Figure 14 on page 28 shows the relationship between the AS/400 communications control setup and the LAN device controller setup.
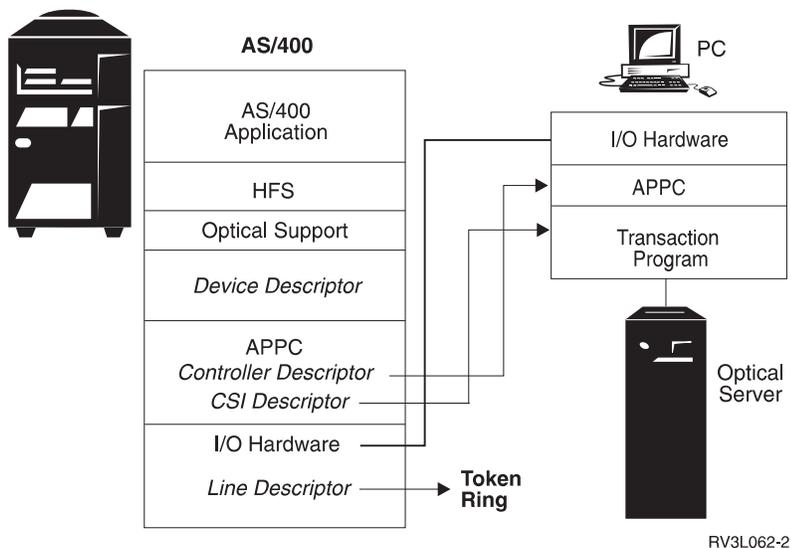
Figure 14. Optical LAN Configuration

AS/400 Communications Control Setup—Example

The following example shows you how to set up optical LAN support on an AS/400 system. If you need more information on commands or parameters, see the *Communications Configuration*, SC41-5401-00 book.

1. Use the Create Line Description Token Ring (CRTLINTRN) command to define the token ring that is used to access the optical LAN device. Use the DSPHDWRSC TYPE(*CMN) command to find the resource name (LIN031 in this example) and a token-ring port. If you plan on using an existing line, you do not need to create a line description.

   ```
   CRTLINTRN LIND(TRLANOPT)
   RSRCNAME(LIN031)
   LINESPEED(16M)
   MAXFRAME(16393)
   LINKSPEED(16M)
   AUTOCRTCTL(*NO)
   TEXT('Token Ring Line for Optical LAN device')
   ```

2. Use the Create Controller Description APPC (CRTCTLAPPC) command to create the controller description for the logical definition for the PC. The values of ADPTADR and RMTCPNAME are dependent on the PC configuration. Refer to the *IBM 3995 LAN Optical Library Dataserver: Reference* for more details.

   ```
   CRTCTLAPPC CTLD(OPTSRV2)
   LINKTYPE(*LAN)
   APPN(*NO)
   SWTLINLST(TRLANOPT)
   RMTCPNAME(LU3995X)
   ADPTADR(10005AE8B454)
   TEXT('Controller for Optical LAN device')
   ```

3. Use the Create Device Description APPC (CRTDEVAPPC) command to create the device description for the logical definition for the optical LAN device.

   ```
   CRTDEVAPPC DEVD(OPTSRV2)
   RMTLOCNAME(LU3995X)
   CTL(OPTSRV2)
   APPN(*NO)
   TEXT('Device Descriptor for Optical LAN device')
   ```

4. Use the Create Communications Side Information (CRTCSI) command to define the communications side information (CSI) object that logically defines the optical LAN device. The name of the CSI is referred to as the optical LAN servers destination name. The CSI also defines the name of the transaction program which is started at the LAN device. The value for `TNSPGM` is dependent on the configuration of the PC. Refer to the *IBM 3995 LAN Optical Library Dataserver Reference* for details. The library which contains the CSI definitions must be in the library list of any user who will use the optical LAN device. You also need *USE authority to the *CSI object before you can use the optical LAN device which it defines.

```
CRTCSI CSI(<user lib>/OPTSRV2)
RMTLOCNAME(LU3995X)
TNSPGM(HFSSRV)
DEV(OPTSRV2)
LCLLOCNAME(*LOC)
TEXT('CSI description of Optical LAN device')
```

5. After all the create commands have completed successfully, use the Work with Configuration Status (WRKCFGSTS) command to make sure that the line, controller, and device descriptions are varied on.

6. Use the Add Optical Server (ADDOPTSVR) command to enable LAN support for a maximum of 16 CPI Communications destinations.

```
ADDOPTSVR CSI(OPTSRV2)
```

LAN Controller Setup

The LAN controller, usually a PC, must be configured to allow AS/400 requests to communicate with the controller as an optical LAN device. For details on LAN controller configuration, see the *IBM 3995 LAN Optical Library Dataserver Reference*

Volume Security

You can use authorization lists to secure volumes within a LAN device in the same way that you secure volumes in a directly-attached optical device. "Chapter 6. Optical Security and Auditing" on page 53 describes this further. If multiple AS/400 systems use an optical LAN device, you must define volume security on each AS/400. Volume security for the first AS/400 can be exactly the same, slightly different, or totally different from the security that is defined on the second AS/400. It is up to the security administrator of each AS/400 system to define their security requirement for the optical volumes.

When an optical LAN device is initially added to the system using the Add Optical Server (ADDOPTSVR) command, all volumes in that device are secured by the default authorization list `QOPTSEC`. The default authorization list for a volume can be changed by using the Change Optical Volume (CHGOPTVOL) command.

Before removing an optical LAN device from the AS/400 using the Remove Optical Server (RMVOPTSVR) command, you should determine whether or not you want to retain the list of volumes along with their authorization lists in the optical index database. The `VOLOPT` parameter allows you to either keep or remove the volume entries for a LAN device from the optical index database. If you choose to have the entries removed, you need to redefine the authorization list for any volume not defined by the default authorization list the next time the server is added for use.

Description of LAN-Specific Commands

Three CL commands are dedicated to optical LAN support:
- Add Optical Server (ADDOPTSVR)
- Remove Optical Server (RMVOPTSVR)
- Display Optical Server (DSPOPTSVR)

Add Optical Server

The Add Optical Server (ADDOPTSVR) command enables optical support to access an optical LAN device. Before you issue the ADDOPTSVR command, make sure that the communications controller and device that represent the optical LAN device are varied on and are active. Typically, the command should be run during the following scenarios:
- After initial installation
- After an IPL
- To restart optical LAN support for a server that has been removed by using the RMVOPTSVR command

The ADDOPTSVR command performs the following functions:
- Verifies that the CPI Communications destinations that define optical LAN devices are correct. Currently, the limit on the number of optical LAN devices is 16.
- Sets up the index for the names of all the volumes in all optical LAN devices.
- This command verifies that all optical volume names are unique for both LAN-attached and directly-attached optical devices. The system issues diagnostic error messages for any duplicate volume names that are found. If there are any duplicate volume names, only the first volume with the duplicate name is accessible.

After the ADDOPTSVR command has completed successfully, optical LAN support knows all the added optical LAN devices. Dynamic checking of any processed HFS request determines if the request is for a volume in a LAN server or a directly-attached device.

Remove Optical Server

The Remove Optical Server (RMVOPTSVR) command disables access to optical volumes that are in a specific LAN device, a list of LAN devices, or all LAN devices. Access to volumes in directly-attached devices is not affected. The RMVOPTSVR command performs the following functions:
- This command ends any active conversations that belong to the current job that issues the command.
- This command verifies that there are no other allocated LAN conversations before attempting to end.
- When the last server has been removed, this command indicates that LAN support is no longer active.

Display Optical Server

The Display Optical Server (DSPOPTSVR) command can be used to determine if LAN support is active and to display information about the optical LAN configuration. The DSPOPTSVR command has two different options:

- *DEST (destinations). This option displays all the CPI Communications destinations that were added with the Add Optical Server (ADDOPTSVR) commands and their current status.
- *CONV (conversations). This option displays all active conversations, the destination of each conversation, the jobs using the conversations, and the path of any open files.

Differences between Directly-Attached and LAN-Attached Devices

There are some functional differences between optical LAN devices and directly-attached optical devices of which you should be aware. If you have both types of devices, please be sure to review the following list.

- You must install the OS/400 Extended Base Support before you can add an optical LAN device.
- LAN devices allow fewer HFS commands than directly-attached devices. Additionally, there are some differences between the level of support that the two attachments (directly-attached or LAN-attached) provide for the commands. Please be sure to review Table 3 on page 60, which identifies these differences.
- LAN optical volumes do not support integrated file system APIs and commands.
- LAN optical volumes do not support save interfaces and restore interfaces.
- The term *path* refers to a file-system name, volume name, directory name, and file name. For directly-attached devices, the path cannot contain more than 294 characters. For optical LAN devices, the path cannot contain more than 256 characters.
- The valid character set for path names is slightly different between LAN and direct. For the character set that LAN supports, see the *IBM 3995 LAN Optical Library Dataserver: Reference*. For the character set that directly-attached libraries support see "Path Names" on page 88.
- Depending on the initialization of a LAN volume, path and file names may or may not be case-sensitive. Path and file names that are created on a volume in a directly-attached device are not case-sensitive. The path

  /directory1/directory2/file1

  or

  /DIRECTORY1/DIRECTORY2/FILE1

  refers to the same file when that file was created on a direct device. The path may or may not refer to the same file when that file was created on a volume that is located in a LAN device.
- A single AS/400 job using an optical LAN device may have a maximum of 249 open files for each optical LAN device.
- LAN does not support extended attributes for files, and directly-attached devices do.
- LAN support does not allow file attribute information on the open stream file request.

- LAN does not support all of the optical commands. For a list of supported optical commands and differences, refer to Table 2 on page 37.
- LAN does not support the expanding buffer I/O, the attribute that is named QOPT.IOMETH, on the open stream file request. Any specifying of the attribute remains ignored.
- The available volume space returns differently for LAN-attached devices than for directly attached devices. LAN support returns a 44-byte output buffer whose format is defined in "Retrieve Volume Information Function" on page 69.
- Support exists for using the HFS API Copy Stream File (QHFCPYSF) to copy between two optical LAN devices. Copying files between two directly-attached optical devices is supported. No support exists for copying files between a LAN device and a directly-attached device. To do this, you need one additional step. As an example, you could first copy the files from either the LAN device or directly-attached device to a folder file on the AS/400 system. "Appendix G. Programming Examples" on page 165 has an example tool for copying between file systems. You would then copy this folder from the AS/400 system to the other optical device.
- Unlike direct support, HFS LAN does not receive information when a cartridge imports or exports from a dataserver. The LAN is unaware of an imported cartridge that occurred since the last time the Add Optical Server (ADDOPTSVR) command was issued. This remains true only until the LAN receives a request for a volume on the cartridge. At that time, LAN automatically performs a query of all active optical LAN devices in order to find the volume. The LAN support receives no information when cartridge removal occurs from a LAN device. If a request for a volume on the cartridge occurs, the LAN device returns an error condition of `Volume not found`. If this is a problem, update the LAN support each time a cartridge is removed. Do this by either performing an Update LAN request UPD/LAN request through the QHFCTLFS program, or by issuing the Add Optical Server (ADDOPTSVR) command.

Getting Started with Installing an Optical LAN Device

The following topics illustrate some of the basic functions you may attempt when initially adding an optical LAN device to your system. The example illustrates the following:
- Adding an optical LAN device
- Working with volumes in a LAN device
- Working with directories
- Working with files
- Removing an optical LAN device

It is assumed that the configuration of the AS/400 system and the optical controller device has been previously done and that the communications line, controller, and device are in an active state. It is also assumed that the communications side information (CSI) object is defined and you have been informed of its name.

Adding an Optical LAN Device

Figure 15 on page 33 shows an attempt to add optical server OPTSVR2 to a configuration using the Add Optical Server (ADDOPTSVR) command. The ADDOPTSVR command attempts to contact the communications device defined in the CSI object named OPTSVR2. If the command does not appear to complete

successfully, start your problem analysis by checking for messages in the message queue for QSYSOPR. Also check for messages indicating that you have optical volumes with the same name. If duplicate volumes are found, only the first volume found can be accessed.

```
                        Add Optical Server (ADDOPTSVR)

 Type choices, press Enter.

 Side information . . . . . . . .   optsvr2_       Name
   Library  . . . . . . . . . . .    *LIBL_____   Name, *LIBL, *CURLIB
             + for more values        _____
                                      *LIBL_____






                                                                     Bottom
 F1=Add   F2=Change   F3=Copy   F4=Remove   F5=Display   F8=Work with directories
 F10=Initialize       F11=Work with object links        F12=Duplicate ...
```
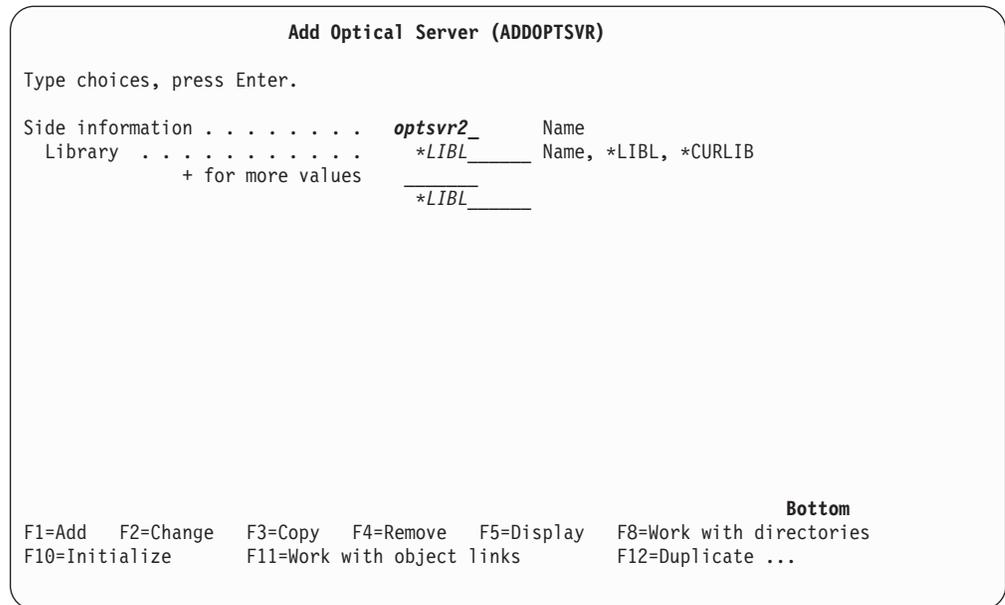
Figure 15. Add Optical Server

Working with Volumes in a LAN Device

Wait for the ADDOPTSVR command to complete successfully. Then use the Work with Optical Volumes (WRKOPTVOL) command to view a list of volumes that is found in the optical device that is defined by the OPTSVR2 CSI object. To see a list of volumes in all directly-attached devices and all LAN-attached devices, issue the following command:

WRKOPTVOL DEV(*ALL) CSI(*ALL)

A display similar to the one shown in Figure 16 on page 34 is shown.

```
                     Work with Optical Volumes
                                                      System:    XXXXXXXX
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 ...

                              Volume       Media     Authorization
Opt  Volume       Device      Type         Type         List
 _   _____
 _   VOLL01       OPTSVR3     *SVRVOL                 QOPTSEC
 _   VOLL02       OPTSVR2     *SVRVOL                 QOPTSEC
 _   VOLL03       OPTSVR2     *SVRVOL                 QOPTSEC
 _   VOLL04       OPTSVR2     *SVRVOL                 QOPTSEC
 _   VOLL05       OPTSVR2     *SVRVOL                 QOPTSEC
 _   VOLL06       OPTSVR2     *SVRVOL                 QOPTSEC
 _   VOLUMEXXXX > OPTSVR2     *SVRVOL                 QOPTSEC
                                                               More...
Parameters or command
===>   _____
F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve   F11=View 2
F12=Cancel   F14=Show extended information        F24=More keys
```

Figure 16. Work with Optical Volumes Display

In the figure, one of the volume names ends with a greater than sign (>). This
signifies that the name of the volume is longer than what can be shown on the
display. To see the full name of the volume, place the cursor on the name and
press function key 22 (F22). A pop-up window is displayed that shows the entire
volume name.

The Work with Optical Volume display shows options that are for both
directly-attached and LAN-attached devices and volumes. If you attempt an option
that is not supported by a LAN device, you receive message OPT1346. This
indicates that the operation is not allowed to a volume that is located in a remote
optical device.

Media Interchange Between LAN and Direct Attach Libraries

WORM (Write Once Read Many) volumes are interchangable between LAN and
direct attach libraries. Rewritable optical volumes that are initalized on a direct
attached library are also interchangable between both libraries.

Rewritable optical volumes formatted on a LAN library as WORM are
interchangeable between LAN and direct attached libraries.

However, rewritable optical volumes initalized on a LAN library as rewritable
media are not interchangable between LAN and direct attach libraries. Rewritable
optical volumes that are initalized as rewritable in a LAN attached library are
written in a format that is not recognized by direct attach libraries.

LAN libraries also allow for file and directory names to be in mixed uppercase and
lowercase characters. This mixed case support is not provided on direct attached
libraries.

Removing an Optical LAN Device

If you no longer need access to a LAN-attached device and the volumes that the device contains, you can use the Remove Optical Server (RMVOPTSVR) command. You can use this command for a single CSI, a list of CSIs, or all CSIs. Additionally, you can keep or remove the record of all volumes that are found in devices that are represented by the CSIs from the AS/400 system. Choosing to remove the volume entries from the AS/400 system also removes any special security for those volumes. You must redefine the special security for the volumes when those volumes are again accessible by the AS/400 system.

Chapter 5. Working with Optical Volumes

This chapter describes the ″Work with Optical Volumes″ options on the AS/400 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 AS/400 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. As an example, option 1 (Add cartridge) on the Work with Optical Volumes display applies only to a directly-attached optical media library. It does not apply to CD-ROM, DVD, or LAN-attached optical media library devices.

This chapter contains information describing which optical commands are supported to which devices and media formats. The different optical devices are:

- CD-ROM.
- DVD-RAM.
- Directly attached optical media library.
- LAN-attached optical media library.

The different optical media formats supported are:

- ISO 9660.
- Universal Disk Format (subset of ISO 13346).
- High performance optical file system (HPOFS).

See "Chapter 10. Optical Media Formats" on page 113 for more information.

Command and Device Dependency

Some optical commands have no meaning when used with certain optical devices. No support exists for other commands with certain optical devices. Table 2 lists all of the device related optical commands and the device types to which they apply.

Table 2. Optical Commands and Device Dependencies

Command	CD-ROM or DVD Device	Directly Attached Library Device	LAN-Attached Library Device
ADDOPTCTG	Not supported	Supported	Not supported
ADDOPTSVR	Not applicable	Not applicable	Supported
CHGDEVMLB	Not applicable	Supported	Not applicable
CHGDEVOPT	Supported	Not applicable	Not applicable
CHGOPTA[1]	Supported	Supported	Not supported
CRTDEVMLB	Not applicable	Supported	Not applicable
CRTDEVOPT	Supported	Not applicable	Not applicable
DSPOPTSVR	Not applicable	Not applicable	Supported
RCLOPT	Supported	Supported	Not supported
RMVOPTCTG	Not supported	Supported	Not supported
RMVOPTSVR	Not applicable	Not applicable	Supported

Table 2. Optical Commands and Device Dependencies (continued)

Command	CD-ROM or DVD Device	Directly Attached Library Device	LAN-Attached Library Device
VFYOPT	Supported	Supported	Not supported

Notes:
1. CHGOPTA is not a device or volume specific command.

Working with Optical Volumes Option

The primary menu for working with optical volumes is the Work with Optical Volumes display (shown in Figure 17). There are several variations of this display to accommodate alternate formats and extended attribute information.

```
                    Work with Optical Volumes
                                              System:   XXXXXXXX
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 ...

                          Volume      Media      Authorization
Opt   Volume       Device      Type        Type         List

 _    _____
 _    VOL2047      OPTMLB01    *PRIMARY    *ERASE     QOPTSEC
 _    VOL2048      OPTMLB01    *PRIMARY    *ERASE     QOPTSEC




                                                             Bottom
Parameters or command
===> _____
F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve   F11=View 2
F12=Cancel   F14=Show extended information         F24=More keys ...
```

Figure 17. Work with Optical Volumes Display

You can select the Work with Optical Volumes display by choosing option 1 (Work with optical volumes) on the AS/400 Optical Support Utilities menu. You can also run the Work with Optical Volumes (WRKOPTVOL) command on the command line.

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

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

Displaying 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, 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 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 display 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 (shown in Figure 18).

```
                        Work with Optical Volumes
                                               System:   XXXXXXXX
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...
                        Write
Opt  Volume         Protected  Threshold  Text
  _   _____
  _   VOL2047          *NO         99
  _   VOL2048          *NO         99




                                                             Bottom
 Parameters or command
 ===> _____
 F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve   F11=View 2
 F12=Cancel   F14=Show extended information          F24=More keys ...
```

Figure 18. Work with Optical Volumes Display, View 2

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 Figure 19 on page 40.

```
                         Work with Optical Volumes
                                               System:    XXXXXXXX
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...
                                            Last         Volume
Opt    Volume     Location    % Used    Referenced    Accessible
  _    _____
  _    VOL2047    SLOT004      38.4      01/17/95        *NO
  _    VOL2048    SLOT004      54.8      06/17/94        *NO




                                                           Bottom
Parameters or command
===>  _____
F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve   F12=Cancel
F14=Exclude extended information   F16=Repeat position to   F24=More keys
```

Figure 19. Work with Optical Volumes Display, Extended Information

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.

Initializing 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. Figure 20 on page 41 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 UDF (Universal Disk Format) and
HPOFS (High Performance Optical Fils System). See "Chapter 10. Optical Media
Formats" on page 113 for more details about these media formats and what
formats are allowed on which media types.

```
                        Initialize Optical (INZOPT)

 Type choices, press Enter.

 Volume identifier  . . . . . . . >  981215101506_____
 New volume identifier  . . . . .    VOL001_____
 Volume full threshold  . . . . .    095__          1-100
 Check for an active volume . . .    *YES           *NO, *YES
 Clear  . . . . . . . . . . . . .    *NO_           *NO, *YES
 Text 'description' . . . . . . .    Volume 1_____
 _____

                         Additional Parameters

 Volume type  . . . . . . . . . .    *PRIMARY       *PRIMARY, *BACKUP
 Coded character set ID . . . . .    *CALC          *CALC, 500, 850
 Media format . . . . . . . . . .    *MEDTYPE       *MEDTYPE, *HPOFS, *UDF




                                                               Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 20. Initialize Optical (INZOPT) Display

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

Note: The Initialize Optical (INZOPT) Command applies to the following volumes:
- Volumes in directly-attached optical media libraries.
- Volumes on writable media in DVD devices.

Renaming Optical Volumes

You can rename an optical volume without losing the information on the volume. The system merely updates the optical volume with the new name. 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 defaults to the current volume name.

Note: The Rename option applies to the following volumes:
- Volumes in directly-attached optical media libraries.
- Volumes on writeable media in DVD devices.

Adding Optical Disk Cartridges

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 (Option) column next to the blank volume name. You are prompted by the Add Optical Cartridge display, shown in Figure 21.

```
                       Add Optical Cartridge (ADDOPTCTG)

 Type choices, press Enter.

 Optical media library  . . . . .   OPT02____   Name
 Authorization list . . . . . . .   *PRV_____   Name, *PRV, QOPTSEC, *NONE
 Rebuild directory index  . . . .   *YES        *YES, *NO




                                                                      Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 21. Add Optical Cartridge (ADDOPTCTG) Display

2. Enter information for the following:
   - Optical media library (required).
   - Authorization list.
   - Rebuild directory index.

     Note: Specifying *NO for Rebuild Directory Index can improve the performance of ADDOPTCTG by deferring the rebuilding of the optical directory index until a later time. In Version 4 Release 4 of OS/400, DIR(*NO) will avoid the rebuild for all optical volumes. Prior to this release, DIR(*NO) only applied to volumes that were marked as *REMOVED.

   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.

3. After you complete the information on the Add Optical Cartridge display, you are prompted to insert a cartridge into the input station of the optical media library.

   Place the optical disk cartridge into the input/output station of your optical media library. Each cartridge has two volumes, one on each side of the cartridge; these volumes are treated separately. Neither of the volumes needs to be initialized immediately, but they must be initialized before data can be written on them.

4. Press Enter.

A message is displayed when the cartridge is accepted by the system. The Work with Optical Volumes display is then updated to include the new volume.

The Add Cartridge (ADDOPTCTG) command applies to:

- Directly-attached optical media libraries.

Copying Optical Volume Data

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 (Option) 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 Figure 22 on page 44) appears and prompts you for more information.

```
                        Copy Optical (CPYOPT)

Type choices, press Enter.
From volume identifier:
  Volume . . . . . . . . . . . .   VOL001_____
  Volume type  . . . . . . . . .   *PRIMARY      *PRIMARY, *BACKUP
From path  . . . . . . . . . . .   /_____
  _____
  _____
  _____
To volume identifier:
  Volume . . . . . . . . . . . .   VOL004_____
  Volume type  . . . . . . . . .   *PRIMARY      *PRIMARY, *BACKUP
To path  . . . . . . . . . . . .   *FROMPATH_____
  _____
  _____
  _____
Select files to copy . . . . . .   *CHANGED      *CHANGED, *NEW, *ALL
Copy subdirectories  . . . . . .   *NO           *NO, *YES
                                                              More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

```
                        Copy Optical (CPYOPT)

Type choices, press Enter.


Additional Parameters

Create directory . . . . . . . .   *NO           *NO, *YES
Allow copy to opposite side  . .   *NO           *NO, *YES
Copy option  . . . . . . . . . .   *IOP__        *IOP, *SYSTEM
Starting date and time:
  Starting date  . . . . . . . .   *BEGIN__      Date, *BEGIN
  Starting time  . . . . . . . .   *AVAIL__      Time, *AVAIL




                                                              Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
Parameter FROMVOL required.
```

Figure 22. Copy Optical (CPYOPT) Display

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

You cannot use this command for UDF formatted volumes. To copy files to and from UDF volumes, use Copy Object (CPY).

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 do additional copies, you must delete files from the target volume that have been deleted from the source volume.

When the copy request completes, 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 directory copied 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 files are copied if they do not exist on the To volume identifier field or, if they already exist, if the creation or modification date on the From volume identifier field is later than the creation or modification date on the To volume identifier field. 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.

If you copy your primary volume every week, this parameter could be used to request only files that were created or changed since the beginning of the week. For example, consider a directory that contains 100 files. Suppose that during the week five existing files get changed and five files are added. At the end of the week, an additional copy of the directory is required.

Processing time could be saved by using both the file option parameter and the starting date and time parameter. When only SLTFILE(*CHANGED) is used, the copy request has to process 105 files (100 existing plus 5 new) and only ten files (5 changed plus 5 new) are copied to the target directory. If the copy request was made with SLTFILE(*CHANGED) and FROMTIME(beginning of week) values specified, only 10 files (5 new plus 5 changed) would be processed and copied.

Copying Optical Volume Data—Example

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

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

Note: The Copy Optical (CPYOPT) command applies to:
- Volumes in directly-attached optical media libraries.

• CD-ROM volumes in either CD-ROM or DVD 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 Figure 23) appears and prompts you to type your changes for the volume you selected.

```
                    Change Optical Volume (CHGOPTVOL)

 Type choices, press Enter.

 Volume identifier  . . . . . . . >  'VOL001'        Character value
 Volume full threshold  . . . . .    099___          1-100, *SAME
 Authorization list . . . . . . .    QOPTSEC___       Name, *SAME, *NONE
 Text 'description' . . . . . . .    'Volume 1_____
 _____




                                                                    Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```
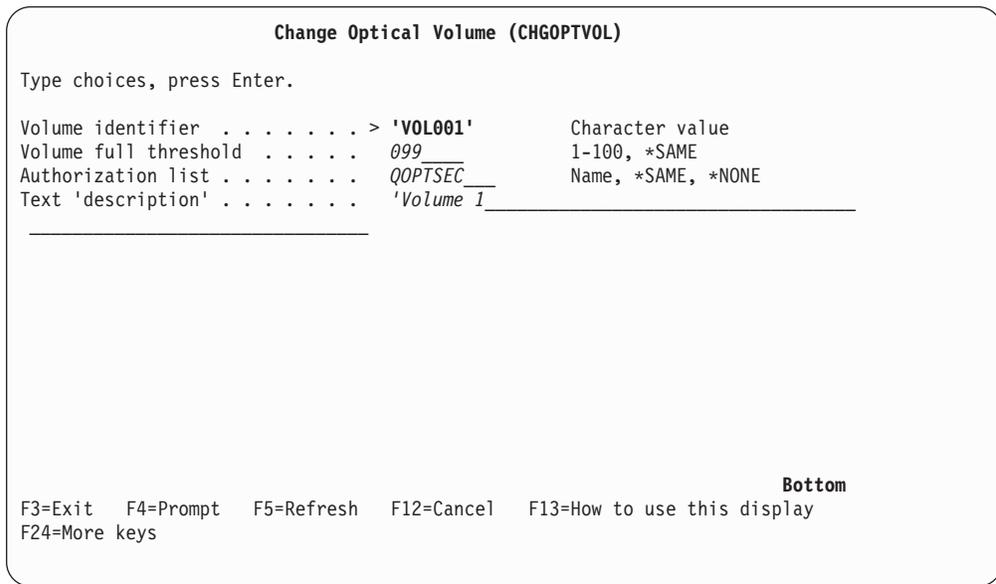
Figure 23. Change Optical Volume (CHGOPTVOL) Display

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 library device, you can only maintain the authorization list when removing the media by specifying VOLOPT(*KEEP) on the Remove Optical Cartridge (RMVOPTCTG) CL command.
• Volume description of the volume for DVD-RAM volumes and volumes in directly-attached media libraries.

Displaying and Printing Optical Volume Attributes

Displaying Optical Volume Attributes

To view the attributes of a volume, select option 5 (Display) in the Opt (Option) column next to the volume you want to view on the Work with Optical Volumes display. The first Display Optical Volume Attributes display appears (Figure 24 on page 47

page 47

page 47). This display shows the attributes of the volume you selected. All fields may not contain a value depending on the type of volume and where the volume is located.

```
                  Display Optical Volume Attributes

  Volume . . . . . . . . . . . . . . :    VOL001
  Device . . . . . . . . . . . . . . :    OPT02
  Authorization list . . . . . . . . :    QOPTSEC

Volume Header Information:
  Internal Volume ID . . . . . . . . :    VOL001
  Serial Number  . . . . . . . . . . :    1077952576
  Volume type  . . . . . . . . . . . :    *PRIMARY
  Media type . . . . . . . . . . . . :    *ERASE
  Media format . . . . . . . . . . . :    *HPOFS
  Coded character set ID  . . . . . . :    500
  Volume-full threshold  . . . . . . :    99
  Volume sequence number . . . . . . :    0
  Create date  . . . . . . . . . . . :    12/28/94
  Create time  . . . . . . . . . . . :    15:43:46
  Text . . . . . . . . . . . . . . . :    Annual sales volume by state


                                                            More...

Press Enter to continue.

F3=Exit   F12=Cancel    F14=Additional volume attributes
```

Figure 24. Display Optical Volume Attributes Display, First Display

Press the Page Down key to view the second display (Figure 25). The second Display Optical Volume Attributes display appears.

```
                  Display Optical Volume Attributes

Usage Information:
  Last reference date  . . . . . . . :    01/24/95
  Volume on opposite side  . . . . . :    VOL002
  Block size . . . . . . . . . . . . :    1024
  Volume capacity (bytes)  . . . . . :    305135616
  Space available on volume (bytes)  . :  188000000
  Percentage used  . . . . . . . . . :    38.38

Status Information:
  Volume location  . . . . . . . . . :
  Volume access  . . . . . . . . . . :    Writeable
  Double volume  . . . . . . . . . . :    No
  Double sided . . . . . . . . . . . :    No
  IPL Capable  . . . . . . . . . . . :    No



                                                            Bottom
Press Enter to continue.

F3=Exit   F12=Cancel    F14=Additional volume attributes
```

Figure 25. Display Optical Volume Attributes Display, Second Display

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 (option) 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.

Note: 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 optical LAN-attached devices.

Duplicating Optical Volumes

The most 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 which is identical to the source except for the volume identifier and creation date and time.

Refer to "Chapter 8. Optical Volume Backup" on page 91 for more information about using the Duplicate Optical command.

```
                      Duplicate Optical (DUPOPT)

 Type choices, press Enter.

 From volume identifier  . . . . .   VOL001_____
 To volume identifier  . . . . . .   980428072748_____
 New volume identifier  . . . . .    VOL001-BACKUP_____
 Clear  . . . . . . . . . . . . .    *NO_            *NO, *YES
 From device  . . . . . . . . . .    _____        Name,
 To device  . . . . . . . . . . .    _____        Name,

                       Additional Parameters

 From end of media option . . . .    *LEAVE_         *LEAVE, *UNLOAD
 To end of media option . . . . .    *LEAVE_         *LEAVE, *UNLOAD




                                                          Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 26. DUPOPT Panel

Enter the information for the following fields:
- From volume identifier.

- To volume identifier.
- New volume indentifier.
- Clear.

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

Working with Directories and Files

There are two methods to view directory and file information through the optical support panels and commands.

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. The system denotes directories as type DDIR and files as type DSTMF.

```
                      Work with Object Links

 Directory  . . . . :   /QOPT/VOL001

 Type options, press Enter.
   2=Edit   3=Copy   4=Remove   5=Display   7=Rename   8=Display attributes
   11=Change current directory ...

 Opt   Object link          Type     Attribute    Text
  _     DIRECTORY.1          DDIR
  _     DIRECTORY.2          DDIR
  _     DIRECTORY.3          DDIR
  _     FILE.1               DSTMF
  _     FILE.2               DSTMF
  _     FILE.3               DSTMF



                                                              Bottom
 Parameters or command
 ===> _____
 F3=Exit   F4=Prompt   F5=Refresh   F9=Retrieve   F12=Cancel   F17=Position to
 F22=Display entire field          F23=More options
```

Figure 27. WRKLNK Panel

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.

Work with Optical Directories and Files

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 during Add Optical Cartridge. The Work with Optical Files (WRKOPTF) command works with optical files.

The Work with Optical Directories (WRKOPTDIR) command and Work with Optical Files (WRKOPTF) command apply to the following conditions:

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

Note: Volumes that are created in Universal Disk Format do not support the WRKOPTDIR and WRKOPTF commands.

```
                    Work with Optical Directories
                                              System:    XXXXX
Directory . . . . .     *ALL_____
Volume  . . . . . .     VOL001_____
Date  . . . . . . .     *AVAIL__

Type options, press Enter.
  1=Create   3=Copy   4=Delete   5=Display   6=Print   8=Work with files

Opt  Directory                               Volume      Created
  _  _____     _____
  _  /DIRECTORY.1/SUB1/SUB2                   VOL001      04/05/99
  -  /DIRECTORY.1/SUB1                        VOL001      04/05/99
  _  /DIRECTORY.2                             VOL001      04/05/99
  _  /DIRECTORY.1                             VOL001      04/05/99
  -  /                                        VOL001      04/05/99


                                                           Bottom
Parameters or command
===> _____
F3=Exit   F4=Prompt     F5=Refresh   F6=Print list   F9=Retrieve
F11=Sort by directory   F12=Cancel   F16=Repeat position to   F24=More keys
```

Figure 28. WRKOPTDIR Panel

Removing 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 (Figure 29 on page 51) appears and prompts you for additional information.

```
                   Remove Optical Cartridge (RMVOPTCTG)

Type choices, press Enter.

Volume identifier  . . . . . . . > 'VOL001'      Character value, *IOSTATION
Volume description option  . . .   *REMOVE       *REMOVE, *KEEP




                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```
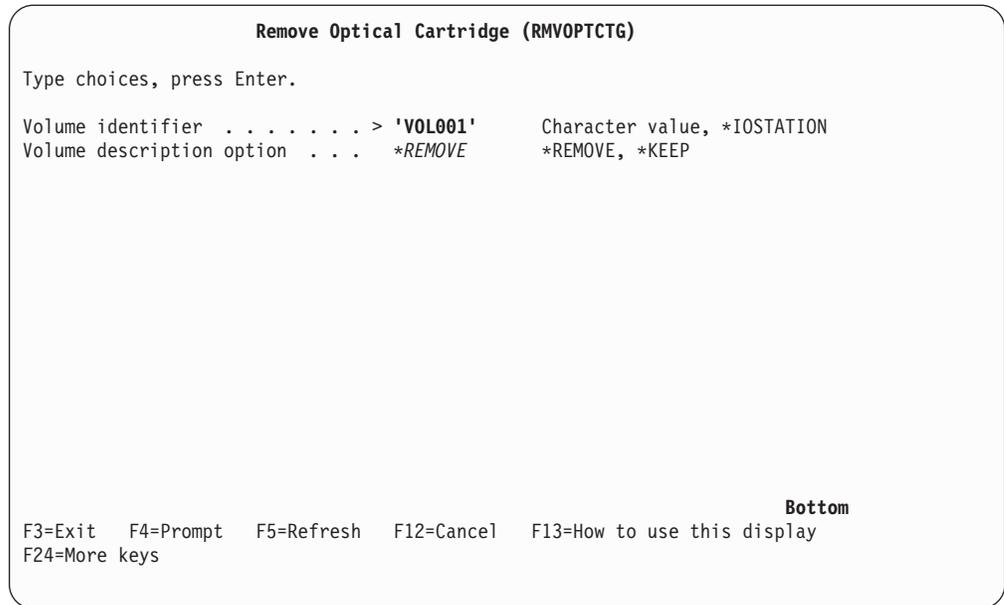
Figure 29. Remove Optical Cartridge (RMVOPTCTG) Display

Enter the information for the following fields:

- Volume identifier
- Volume description option
- Removed cartridge location (if *KEEP was specified as the volume description option).

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.

Deleting *REMOVED Volumes from the Optical Index Database

If you 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 a 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.

Chapter 6. Optical Security and Auditing

You can secure information on optical media by using AS/400 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, and directly-attached optical devices. Optical volumes formatted in Universal Disk Format (UDF) provide directory 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

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

Authorization List Security

You can use an authorization list to secure all optical volumes. The authorization list contains the definition for each user's access to the volume. The system assigns an authorization list to the volume when the volume is added to the system. You can change the authorization list to the volume by using the Change Optical Volume (CHGOPTVOL) CL command. IBM ships the default authorization list that is named QOPTSEC with the AS/400 system. This authorization list secures volumes unless you specifically secure the volume by another authorization list. You can change this, but if you eject and add the media, the system resets the authorization list to QOPTSEC. To add volumes to directly-attached media library devices, specify an authorization list on the Add Optical Cartridge command.

You can change the list of users in the default authorization list or the public authority to a volume. You can do this by using the authorization list management commands of OS/400. You must have authorization list management (*AUTLMGT) authority to change the users in an authorization list. For a complete description of authorization list management rules see the *Security - Reference*, SC41-5302-04.

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Authorities Required for Optical Functions

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

- Open file for read
- Open directory
- Retrieve file or directory attributes
- Read sector
- List paths or 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 following optical functions:

- Move file

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 existing authorization list)

Specifying an Authorization List on the Add Optical Cartridge (ADDOPTCTG) Command

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 removed with the VOLOPT(*KEEP) option.

This 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 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.

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) 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.

Changing 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 a directly or LAN-attached optical media library 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.

Retaining the Authorization List when Removing Optical Volumes

The tie between an optical volume and an authorization list is maintained in the optical index database. This tie 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 which secured the optical volume before it was removed with the *KEEP option is used to secure the volume when it is re-added. The tie between a CD-ROM volume and the authorization list securing it is lost when the CD-ROM is removed from the drive.

Mapping an 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.

Directory 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.

For detailed information on the directory and file authorities that are required for specific interfaces, refer to "Chapter 7. Using Application Programming Interfaces for Optical Support" on page 59. Also refer to "Chapter 10. Optical Media Formats" on page 113 for an overview of the media format that provides directory and file level security.

Optical Auditing

To enable optical auditing, the system value QAUDCTL must be set to *AUDLVL and *OPTICAL must be specified in the QAUDLVL system value. You use the *SEC value on the SYSVAL parameter of the Work with System Values (WRKSYSVAL) command to change these system values. Changing these values requires *AUDIT special authority.

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

The format of the optical audit journal entries can be found in the *Security - Reference* book.

Object Authority

All programs are shipped with PUBLIC(*EXCLUDE) authority, and most of the commands are shipped with PUBLIC(*USE) authority. The following commands are shipped PUBLIC(*EXCLUDE).

- Add Optical Cartridge (ADDOPTCTG)
- Remove Optical Cartridge (RMVOPTCTG)
- Add Optical Server (ADDOPTSVR)
- Remove Optical Server (RMVOPTSVR)
- Reclaim Optical (RCLOPT)

Refer to the *Security - Reference* for information on controlling access to commands.

Chapter 7. Using Application Programming Interfaces for Optical Support

This chapter describes the interfaces an application programmer may use to access optical volumes on the AS/400. The proper name for these interfaces is application programming interfaces, or APIs. You can use these APIs to interface with a variety of different file systems, of which the optical file system is one. This chapter is not a complete description of these APIs. It only describes the aspects of API usage that are unique to the optical file system.

Programmers can utilize the available APIs to create, access, change, or maintain optical files and directories. The APIs may be used to customize usage of optical support for specific business applications.

Categories of APIs for Optical Support

Two categories of APIs may be used to manipulate optical files and directories:
- Hierarchical file system (HFS) APIs
- Integrated file system support, which consists of UNIX-type APIs and the generic command interface

You can use both categories of APIs concurrently. For example, an optical file that is opened by one application by using the HFS Open Stream File API can be opened by another application by utilizing the Open UNIX-type API. IBM provides online information about using the HFS or UNIX-type APIs on the generic commands. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Since different file systems are supported, some means must be provided for HFS or the integrated file system to differentiate which file system a call is targeted for. This is accomplished by requiring that the first name in the path name parameter be the name of the file system to be called, preceded by a leading slash. For the optical file system to be identified as the receiver of a request submitted to HFS or the integrated file system, the first portion of the path name parameter must be /QOPT.

The following topics describe the aspects of HFS or integrated file system API usage that are unique to the optical file system.

Using the HFS API Interface to Optical Support

A hierarchical file system (HFS) is a part of the operating system that includes the application programming interface (API) and the underlying file system (optical or otherwise) support. The HFS API makes it possible for an application that is written in a high-level language to create, store, retrieve, and manipulate data on a storage device. IBM provides online information that describes the HFS API. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

The HFS API support for optical support consists of two parts:

- An application programming call interface to the hierarchical file system to manipulate objects known as files and directories.
- An optical or other registered file system that manages the storage devices where the files and directories are stored.

HFS API optical functions include the following:

- Creating or deleting a directory
- Opening, reading, or closing a directory
- Opening, reading, writing, or closing a file
- Locking or unlocking bytes in a file
- Getting or setting the size of a file
- Renaming, copying, deleting, or removing a file
- Retrieving or changing directory entry attributes

Applications use HFS APIs to manage byte stream files on an AS/400 system. These byte stream files are also called objects to identify them as data elements that do not have a conventional record structure. The object is treated as a named byte stream of known length, whose size can vary from a few bytes to megabytes.

HFS APIs allow applications to create and manage file objects on storage devices and to perform input/output operations to those file objects. HFS APIs allow applications to create and manage directory objects, which can be thought of as a logical grouping of similar file objects. These directory objects contain information about the file objects belonging to that directory. Directories can be contained within directories resulting in the hierarchical structure.

Optical File System Implementation of HFS APIs

This topic describes how the HFS API usage is different for the optical file system as compared to the specifications in the **Information Center**. Although the APIs that HFS supports are common to all file systems, each file system has different interpretations or restrictions regarding those APIs. Table 3 summarizes the optical interpretation of each HFS API. LAN-attached optical devices and directly-attached optical devices have different restrictions for several of the APIs.

Table 3. Optical HFS API Restrictions

HFS APIs	Directly Attached Restrictions	LAN-Attached Restrictions
Change File Pointer (QHFCHGFP)	None	None
Close Stream File (QHFCLOSF)	None	None

Table 3. Optical HFS API Restrictions (continued)

HFS APIs	Directly Attached Restrictions	LAN-Attached Restrictions
Control File System (QHFCTLFS)	Supports the following requests: • SAV saves a held optical file. • RLS releases a held optical file. • SRD/VOL returns a sector read from an optical volume. • SRD/DEV returns a sector read from an optical device. • RTV/VOL returns volume specific information. • GET reads file data directly from the media with minimal data caching. For UDF formatted volumes, GET requires *X authority to parent directory and *R authority to the file.	Supports the following requests: • UPD/LAN performs a dynamic index refresh of the list of LAN volumes • UPD/VOL returns volume specific information • RTV/VOL returns volume specific information • RTV/DIR returns subdirectory and file entries for a specified directory
Copy Stream File (QHFCPYSF)	If the source file is in the QOPT file system, *USE authority is required to the source optical volume. If the target file is in the QOPT file system, *CHANGE authority is required to the target optical volume. Copy information parameter, Byte 1, Option 2 is not supported (Copy Append). If specified, CPF1F62 will be returned. When the operation is complete, QCRTDTTM, QACCDTTM, and QWRTDTTM are set to the current date. When copying between the QOPT and QDLS file systems, file attributes are optionally copied depending on global optical attribute CPYATR. This attribute can be displayed or changed utilizing the CHGOPTA command. If the source file is on a UDF formatted volume, *X authority is required to the parent directory and *R authority is required to the file. If the target file is on a UDF formatted volume, *WX authority is required to the parent directory.	If the source file is in the QOPT file system, *USE authority is required to the source optical volume. If the target file is in the QOPT file system, *CHANGE authority is required to the target optical volume. Copy information parameter, Byte 1, Option 2 is not supported (Copy Append). Copying from a volume in a directly attached library to a volume in a LAN-attached optical device is not supported.

Table 3. Optical HFS API Restrictions (continued)

HFS APIs	Directly Attached Restrictions	LAN-Attached Restrictions
Create Directory (QHFCRTDR)	When the operation is complete, QCRTDTTM, QACCDTTM, QWRTDTTM are set to the current date. When the operation is complete, QFILSIZE and QALCSIZE are set to 0. Requires *CHANGE authority to the optical volume. Creating the optical root directory is not supported. Creating the volume portion of the directory is not supported. Attributes passed in the attribute information table are not supported, and will result in a CPF1F71 error message. The length of the attribute information table parameter must be 0. Optical attribute OPT.CHGATDTTM, which indicates the last time that the directory attributes were changed, is created. This date is set to the current date. If a user specifies an attribute, it is ignored. For UDF formatted volumes, *WX authority is required to the parent directory.	When the operation is complete, QCRTDTTM, QACCDTTM, QWRTDTTM are set to the current date. When the operation is complete, QFILSIZE and QALCSIZE are set to 0. Requires *CHANGE authority to the optical volume. Creating the optical root directory is not supported. Creating a volume portion of a directory is not supported. All standard attributes are ignored. Length of attribute information table parameter must be set to 0.
Delete Directory (QHFDLTDR)	Deleting the optical root directory is not supported. Deleting the volume portion of a path is not supported. Requires *CHANGE authority to the optical volume. For UDF formatted volumes, *WX authority is required to the parent directory and *W is required to the directory being deleted.	Deleting the optical root directory is not supported. Deleting the volume portion of a path is not supported. Requires *CHANGE authority to the optical volume.
Delete Stream File (QHFDLTSF)	Requires *CHANGE authority to the optical volume. For UDF formatted volumes, *WX authority is required to the parent directory and *W is required to the file being deleted.	Requires *CHANGE authority to the optical volume.
Get File Size (QHFGETSZ)	None	None
Set File Size (QHFSETSZ)	None	Not Supported

Table 3. Optical HFS API Restrictions (continued)

HFS APIs	Directly Attached Restrictions	LAN-Attached Restrictions
Open Stream File (QHFOPNSF)	Parameter open information: • Opening with an access mode (Byte 6) of write only or read/write requires *CHANGE authority to the volume. • Opening with an access mode (Byte 6) of read only requires *USE authority to the volume. • Lock Modes (Byte 5) are enforced across different open instances. If the same job opens a file multiple times, these open locks can conflict. • If the media format is UDF, the write-through flag (Byte 3) must be asynchronous. If QALCSIZE was specified on an open request for the write operation, optical media will be checked to see if enough space is available. If not, error message CPF1F62 is returned. All standard attributes except QALCSIZE are ignored. If a file is being created, QCRTDTTM, QACCDTTM, and QWRTDTTM are set to the current date. If a file is being updated, QWRTDTTM is set to the current date. If a file is being read, no time stamps are changed. QACCDTTM is never changed after a file is created. It will always equal QCRTDTTM. The following authorization rules apply only for UDF formatted volumes. • If opening a file for READ, *X authority is required to the parent directory and *R authority is required to the file. • If opening an existing file for WRITE, *X authority is required to the parent directory and *W authority is required to the file. • If opening an existing file for READ/WRITE, *X authority is required to the parent directory and *RW authority is required to the file. • If creating the file, *WX authority is required to the parent directory.	Parameter Open information: • Byte 3 (write-through flag), is not supported. • Byte 7 (type of open operation to perform), is not supported. • Opening with an access mode (Byte 6) of read only requires *USE authority to the volume. Unless the file open attempt is for read only access, attributes are not tolerated and result in a CPF1F71 error message. The length of the attribute information table parameter must be 0. If a file open attempt is for read only access, attributes are tolerated but ignored.
Read Stream File (QHFRDSF)	None	None

Table 3. Optical HFS API Restrictions (continued)

HFS APIs	Directly Attached Restrictions	LAN-Attached Restrictions
Retrieve Directory Entry Attributes (QHFRTVAT)	Requires *USE authority to an optical volume. For UDF formatted volumes, *X authority is required to the parent directory, and *R authority is required to the file or directory being read.	User can retrieve only LAN-standard attributes: QFILSIZE, QCRTDTTM, and QWRTDTTM. Requires *USE authority to an optical volume. Length of attribute information table parameter must be set to 0.
Write Stream File (QHFWRTSF)	None	None
Change Directory Entry Attributes (QHFCHGAT)	QFILATTR is the only standard attribute that can be changed. All others that are specified are ignored. Read only flag, byte 1 of the QFILATTR attribute, can only be set for a file, not a directory. If specified for a directory, it is ignored. Changed Flag, byte 5 of the QFILATTR attribute, can only be set off(0). It is automatically set on(1) whenever a file is created or written to. If OPT.CHGATDTTM is specified, it is ignored. Requires *CHANGE authority to an optical volume. For UDF formatted volumes, *X authority is required to the parent directory and *W authority is required to the file.	API not supported.
Close Directory (QHFCLODR)	None	API not supported.
Force Buffered Data (QHFFRCSF)	Buffered data is forced to DASD, not to optical disk. A file opened for "read only" has no effect.	API not supported.
Lock and Unlock Range in Stream File (QHFLULSF)	None	API not supported.

Table 3. Optical HFS API Restrictions (continued)

HFS APIs	Directly Attached Restrictions	LAN-Attached Restrictions
Move Stream File (QHFMOVSF)	If the source file is in the QOPT file system, *CHANGE authority is required to the optical source volume. If the target file is in the QOPT file system, *CHANGE authority is required to the optical target volume. When moving between the QOPT and QDLS file systems, file attributes are optionally copied depending on the global optical attribute CPYATR. This attribute can be displayed or changed using the CHGOPTA command. If the source file is on a UDF formatted volume, *WX authority is required to the parent directory and *RW authority is required to the file. If the target file is on a UDF formatted volume, *WX authority is required to the parent directory.	API not supported.
Open Directory (QHFOPNDR)	Opening file system root (/QOPT) will allow both directly attached and LAN attached volumes to be returned on Read Directory Entries. Lock mode is ignored when opening the file system root. Lock mode of no lock is not supported. If requested, a lock mode of deny none is substituted. Requires *USE authority to the optical volume. For UDF formatted volumes, *X authority is required to the parent directory and *R authority is required to the directory being opened.	API not supported.
Read Directory Entries (QHFRDDR)	QNAME is returned without the QOPT file system name. QNAME is the only field which is set for a LAN attached volume. QWRTDTTM will always equal QCRTDTTM. For files and directories, QACCDTTM will always equal QCRTDTTM. For volumes, QACCDTTM will equal the last volume reference date.	API not supported.

Table 3. Optical HFS API Restrictions (continued)

HFS APIs	Directly Attached Restrictions	LAN-Attached Restrictions
Rename Stream File (QHFRNMSF)	Requires *CHANGE authority to the optical volume. For UDF formatted volumes, *WX authority is required to the parent directory and *W authority is required to the file being renamed.	API not supported.
Rename Directory (QHFRNMDR)	API not supported.	API not supported.

Control File System Functions to Optical Support

Optical support provides Control File System (QHFCTLFS) functions to perform unique operations for the optical file system. These are optical specific functions that are not otherwise available through the HFS APIs. Different functions are available for directly-attached and LAN-attached optical devices.

The following control file system functions are available for directly-attached media libraries:
- SAV - saves a held optical file.
- RLS - releases a held optical file.
- SRD/VOL - performs a sector read to an optical volume.
- SRD/DEV - performs a sector read to an optical device.
- RTV/VOL - returns volume-specific information.
- GET - reads file data directly from the media with minimal caching.

Control File System Functions for Directly-Attached Optical

The following functions are available for directly-attached optical devices.

Save Held Optical File Function: Use the Control File System program to save a held optical file. A process must be allowed read access to a held optical file to save it.

The following is the syntax for the input buffer for the QHFCTLFS program:

```
'SAV' + '/' + held-file-path + '//' + destination-file-path
```

For example:
- Input Data Buffer: SAV/VOLUME1/DIRECTORY1/FILE1//VOLUME2/DIRECTORY2/FILE2
- Input Data Buffer Length: 54

This function is also available using an option on the Work with Held Optical File (WRKHLDOPTF) display. However, unlike the save option on the Work with Held Optical File (WRKHLDOPTF) display, 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 held optical file request is needed afterwards. For an explanation of held optical files, see "Held Optical Files" on page 85.

Release Held Optical File Function: Use the Control File System program to clear the held status of a file and release the optical file system from its obligation to

write to the optical disk. A process must be allowed read and write access to a held file in order to release it; this means that no locks may currently be imposed on the file by other active jobs.

The following is the syntax for the input buffer for the QHFCTLFS program:

```
'RLS' + '/' + held-file-path
```

For example:
- Input Data Buffer: RLS/VOLUME1/DIRECTORY1/FILE1
- Input Data Buffer Length: 28

This function is also available using an option on the Work Held Optical File (WRKHLDOPTF) display. For an explanation of held optical files, see "Held Optical Files" on page 85.

Sector Read Function: The Control File System program can be used to do a sector reading of optical media. The sector read function is useful if the application knows precisely where data is stored on optical media. Sector read functions can be accomplished without opening and closing files, and independently of all HFS APIs. Multiple sectors may be read at one time.

There are two variations of the input buffer for issuing the Control File System sector read function:

```
SRD/VOL/volume_name/starting sector/number of sectors
SRD/DEV/device_name/starting sector/number of sectors
```

Both return the range of sectors requested by the user. Sectors can be requested from an optical volume or optical device. For example, if an application wanted to read five sectors of optical volume VOL01 beginning at sector 1000, the following is requested:

```
SRD/VOL/VOL01/1000/5
```

Note: DEV is only valued for CD-ROM devices.

Retrieve Volume Information Function: Use the Control File System program to retrieve information about a particular volume.

The following is the input buffer format for the QHFCTLFS program:

```
RTV/VOL/volume_name
```

The format of the information returned in the output buffer is identical to the output file structure for volume attributes (QAMODVA) as shown in "Appendix E. Output File Support Structures" on page 153. The length of the output buffer must be large enough to contain the QAMODVA structure.

Get File Data: The get file data function is available as part of the base operating system in V4R1. This function is also available in V3R6 and V3R7 via PTFs. Contact your next level of support for PTF information.

You can use the Control File System (QHFCTLFS) HFS API to read a block of data from a file directly into your output buffer. This function improves performance when reading an entire file sequentially or when reading large blocks of data. The optical file system will not copy or cache the data as it does through normal Open, Read, and Close Stream File HFS APIs. When doing random reads to a file, the Open, Read, and Close Steam File option may still provide the best performance.

The following restrictions apply when using this API:
- Align output buffer on a 512 byte boundary.
- File offset must be 0 or a multiple of 4096.
- Maximum-read size is 16,000 sectors (16,384,000 bytes).
- The HFS API requires Shared No Update (*SHRNUP) access to the file.
- Calling program must be in User (not System) state.
- The HFS API requires *use authority to the volume.

Here is the syntax for the input buffer for the QHFCTLFS program:

```
'GET' + '/' + entire path + '//' + bytes to read + '/' + file offset
```

The following example will read 15MB from FILE.XXX. Starting at the beginning of the file with (offset=0):
- Input Data Buffer: GET/VOL1/DIR1/SUBDIR1/FILE.XXX//15728640/0
- Input Data Buffer Length: 42

The number of bytes read is returned in the "Length of Data Returned" parameter. In the above example if FILE.XXX is only 50KB in size, 51200 will be returned in the field. Therefore, it is not necessary to know the file size prior to issuing this request. Likewise, if 15728640 is returned in the "Length of Data Returned" parameter, the file is at least 15MB in size. More reads may be necessary to retrieve all the data.

It is not required that the number of bytes to read is a multiple of 4096. Although if it is not, data may be read into the output buffer beyond the number of bytes requested. This is because the device does I/O in blocks of 4096 bytes. Therefore, reading data in multiples of 4096 bytes is advise to avoid this problem.

Errors from Control File System (GET): The table below shows some common application errors that may occur using this API.

Table 4. Common errors for GET API

Message	Error
OPT1812 with 6030 as unexpected return code	File offset is beyond the end of file.
OPT1812 with A950 as unexpected return code	Output buffer is not 512 byte aligned.
OPT1860	Bytes to read is greater than the buffer size.
OPT1812 with C060 as unexpected return code	Attempted to read more than 16,384,000 bytes.
OPT1812 with C061 as unexpected return code	File offset is not a 4096 multiple.
CPF1F48	Input buffer is invalid. Verify the syntax.

Control File System Functions for LAN-Attached Optical Devices

The following control file system functions are available for LAN-attached media libraries.
- UPD/LAN - performs a dynamic refresh of the LAN volume lists.
- UPD/VOL - returns volume-specific information.
- RTV/VOL - returns volume-specific information.
- RTV/DIR - returns subdirectory and file entries for a specified directory.

Update Volume Information: Use the Control File System program to retrieve information about a particular volume or to update the internal list of available volumes on a LAN.

The following is the input buffer format for the QHFCTLFS program:

```
UPD/VOL/volume_name
```

It performs the following:
- UPD/VOL/volume-name: Using this input buffer format returns the amount of free space on a volume, total user space, media type, and flip-side volume ID. The format is shown here:
  - Bytes (1-32): Opposite-side volume ID.
  - Bytes (33): Reserved.
  - Bytes (34-37): User free space on the volume. This is a four-byte binary field.
  - Bytes (38-41): Total free space on the volume. This consists of the user free space on the volume plus the reserved space on the volume. The reserved space on the volume is determined when setting the volume-full threshold for the volume. This is a four-byte binary field.
  - Bytes (42): Media type. This is a one-byte binary field that can have the following values.
    - 0 = Non-valid Media or 3431 Standalone Drive
    - 1 = Write Once Read Many (WORM) media
    - 2 = Rewriteable media
  - Bytes (43): Magnitude of free space on the volume. This is a one-byte binary field that can have the following values:
    - 0 = Space field is in number of bytes.
    - 1 = Space field is in number of kilobytes (1024).
    - 2 = Space field is in number of megabytes (1048576).
  - Bytes (44): Magnitude of Total Space on the Volume. This is a one-byte binary field that can have the following values:
    - 0 = Space field is in number of bytes.
    - 1 = Space field is in number of kilobytes (1024).
    - 2 = Space field is in number of megabytes (1048576).
- UPD/LAN: Using this input buffer format updates an internal list of available volumes on all activated servers. You can perform this function after adding or removing cartridges from dataservers.

Retrieve Volume Information Function: Use the Control File System program to retrieve information about a particular volume.

The following is the input buffer format for the QHFCTLFS program:

```
RTV/VOL/volume_name
```

The format of the information returned in the output buffer is identical to the output file structure for volume attributes (QAMODVA) as shown in "Appendix E. Output File Support Structures" on page 153. The length of the output buffer must be large enough to contain the QAMODVA structure.

The system uses format QAMODVA for volumes in all optical device types. While the format is the same, not all fields contain a value for LAN volumes. Check the "Output File Structure for Volume Attributes" on page 153 for the differences between the device types.

Retrieve Directory Information Function: Use the Control File System program to retrieve a list of files and subdirectories for a particular directory.

The following is the input buffer for the QHFCTLFS program:

```
RTV/DIR/volume_name/directory_name
```

The directory information is returned in the output buffer in the following format:
- CBdirectoryBCBdirectoryBCBfilenameBCBfilenameBB, whereas the following are:
  - C
    - D = Directory Entry
    - F = File Name Entry
  - B = EBCDIC Blank
  - BB = Double EBCDIC Blanks to indicate end of string

The output buffer must be at least 31KB long.

Standard Attribute Definition and Restrictions—Directly-Attached

Directory entries for files and directories have information that is associated with them called **attributes**. Each attribute consists of a name and a value. Some attributes generate automatically when creating the directory or file. These attributes are called **standard attributes**. Standard attributes start with the letter Q for ease of identification. All file systems use standard attributes. Several receive unique interpretation by the optical file system. LAN-attached optical devices have a different interpretation of standard attributes than directly-attached optical devices. For specific information that regards standard attribute differences for LAN and directly-attached optical devices, see "Optical File System Implementation of HFS APIs" on page 60. Also, you can find the meaning of these attributes for each HFS API in "Optical File System Implementation of HFS APIs" on page 60. The following is a basic definition of the standard attributes and their meaning with respect to optical support.

QALCSIZE Attribute

When the QALCSIZE attribute is specified on Open Stream File during a write request, the media is checked to see if there is enough space available to allocate the amount specified. If there is not enough space available on the optical volume, message CPF1F61, `No free space available on media`, is issued. For more information on using this attribute, see "Media Capacity and Volume Threshold" on page 81

QACCDTTM Attribute

This attribute is not supported by the optical file system. It is always the same as the file creation date and time (QCRTDTTM).

QCRTDTTM Attribute

This attribute indicates the creation date of a file or directory.

QWRTDTTM Attribute

This attribute indicates the last date and time that data was written to an optical file. It does not reflect the date and time that the file attributes were last written.

QFILATTR Attribute

Support of this attribute is only by directly-attached optical support devices. The optical interpretation of the file flags is as follows:

- Read-only file: OS/400 provides full support of this attribute through the optical file system. When setting this attribute to ON (1), you cannot delete or overwrite the file.
- Hidden file: OS/400 maintains this attribute for the user application to manage, but does not fully support it by the optical file system. When setting this attribute to ON (1), the optical file system does not recognize the file as hidden. User applications require no special access to files with this attribute on.
- System file: OS/400 maintains this attribute for the user application to manage; but does not fully support it by the optical file system. When setting this attribute to ON (1), the optical file system does not recognize the file as a system file. User applications require no special access to files with this attribute on.
- Changed file: OS/400 supports this attribute by the optical file system. It is automatically set on(1) when a file is created or written to. You can only set it off(0) by using the Change Directory Entry Attributes (QHFCHGAT) API.

Special Attributes Unique to Optical File System

Attributes for files and directories that are not standard and therefore not recognized by HFS are referred to by HFS as **extended attributes**. They are usually defined by a business application, but some are recognized by the optical file system as having special meaning.

OPT.CHGATDTTM Attribute

This optical attribute reflects the last date and time that the file attributes were written. It is returned to the user application as an extended attribute through the Retrieve Directory Entry Attributes (QHFRTVAT) command.

QOPT.IOMETH Attribute

This is a special extended attribute to the optical file system. Provided supported is only by directly-attached optical support devices; it is ignored by LAN support. The system also ignores this attribute when the media format is Universal Disk Format.

When an extended attribute of this name is passed by the application as the attribute name field in the Attribute Information Table (AIT) during an open stream file request, the optical file system knows that a special method of I/O is being requested. The optical file system retrieves the special method of I/O from the attribute value field in the AIT.

Currently, there is only one special method of I/O supported by the optical file system: **expanding buffer I/O**. You can request this method of I/O when the

attribute value field for the QOPT.IOMETH attribute contains the value (EXPNBUFF). The optical software recognizes this special extended attribute as a requested I/O method, and not as a normal extended attribute. It is not hereafter associated with the file in any way, and does not appear when attributes for the file are retrieved. All read operations for the process use expanding buffer I/O until the file is closed. Methodology and restrictions for using expanding buffer I/O are listed here. In order to determine if expanding buffer I/O should be used, see "Expanding Buffer I/O through HFS—Tailoring Read Requests for Performance" on page 84.

An HFS attribute in an attribute information table consists of several fields. These fields and the values you specify when opening a file for expanding buffer I/O are summarized in Table 5.

Table 5. Expanding Buffer Attribute Definition

Field	Data Type (see note)	Value for EBIO
Attribute Name	CHAR(*)	QOPT.IOMETH
Attribute Value	CHAR(*)	EXPNBUFF
Length Attribute Name	BIN(4)	0000000B
Length Attribute Value	BIN(4)	00000008
Note:		
• CHAR(*) indicates a variable number of bytes of character information.		
• BIN(4) indicates 4 bytes of binary information.		
• All character fields should be set in uppercase.		

In addition to the values for attribute fields in Table 5, two additional fields are required to build an attribute information table:
- The number of attributes defined in the table.
- The table offset to each attribute, in bytes.

The Open Stream File (QHFOPNSF) API requires 10 bytes of open information as input. When you attempt to open a file for expanding buffer I/O, the open information is subject to the following restrictions:
- The action to take if a file exists must be to open the file.
- The action to take if a file does not exist must be to return an error.
- The lock mode for the file must be Deny Write or Deny Read/Write (exclusive).
- The access mode for the file must be Read Only.

If there is an expanded buffer I/O attribute in the attribute information table and any of these restrictions are not observed, an OPT1133 message is issued, indicating which of the fields in the open information was passed in error.

IBM provides online information on the format of attributes, the Attribute Information Table, or the Open Stream File API. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Expanding Buffer I/O HFS API Restrictions: In addition to the restrictions that were detailed when opening a file for expanded buffer I/O, you cannot use the following APIs after a file is opened for expanding buffer I/O:
- Write Stream File

- Set Stream File Size
- Lock or Unlock Range in Stream File

Copying File Attributes Using HFS

When you copy files, using the hierarchical file system, between QOPT and QDLS file systems, the target file is assigned either default file attributes or the file attributes of the source file. This depends on the value you specify for the copy attributes (CPYATR) global value on the Change Optical Attributes (CHGOPTA) command.

When the CPYATR global value is specified as *NO on the CHGOPTA command, default file attributes are created for files that are copied between the QOPT and QDLS file systems.

When the CPYATR global value is specified as *YES on the CHGOPTA command, file attributes from the source file are copied to the target file for copies between the QOPT and QDLS file system.

Copying Attributes from QDLS to QOPT

In copies or moves from QDLS to QOPT, the following default attributes are assigned to the target file:
- Standard file attributes:
  - Creation date and time is set to the current date and time
  - Modification date and time is set to the current date and time
  - Access date and time is set to the current date and time
  - The QFILATTR standard attribute is set to '00000': the file is not read-only; the file is not hidden; the file is not a system file; the file is not a directory; and the file has not changed since it was last archived or created.
- No DIA document attributes are copied.
- No user-defined extended attributes are copied.

The file name (QNAME) and file size (QFILSIZE) are maintained.

Copying Attributes from QOPT to QDLS

In copies or moves from QOPT to QDLS, the following default attributes are created:
- Standard file attributes:
  - Creation date and time is set to the current date and time
  - Modification date and time is set to the current date and time
  - Access date and time is set to the current date and time
  - The QFILATTR standard attribute is set to '00000': the file is not read-only; the file is not hidden; the file is not a system file; the file is not a directory; and the file has not changed since it was last archived or created.
- DIA document attributes:
-
  - DIA.CA04C700 (text description) is set to the file name.
  - DIA.CA04C701 (profile GCID) is set to code page 697 and character set 500.
  - DIA.CA04C706 (file type) is set to X'000E' (PC file).

- DIA.CA04C720 (library assigned document name) is assigned to represent this file.
- DIA.CA04C708 (last changed date and time) is set to the current date and time.
- DIA.CA04C707 (creation date and time) is set to the current date and time.
- DIA.CA04C710 (NLS information) is set to the language ID and country ID of the job.
- DIA.CA04C740 (file date and time) is set to the current date and time.
- No user-defined extended attributes are copied.

The file name (QNAME) and file size (QFILSIZE) are maintained.

Using the Integrated File System Support Interface to Optical Support

The integrated file system support provides a UNIX-type interface that you can use to maintain optical files and directories. LAN-attached optical devices do not support this interface .

The integrated file system support for optical support consists of:
- **UNIX-type APIs:** These APIs are C language functions that can be used in ILE C for OS/400 programs.
- **Generic commands:** These are system CL commands that allow interface to optical support.
- **TCP/IP File Server Support for OS/400:** This licensed program offering allows PC users to access the files and directories of optical systems or other file systems. For more information, see the *OS/400 Server Concepts and Administration* book.

IBM provides online information about using the HFS or UNIX-type APIs, and on the generic commands. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Optical File System Implementation of Integrated File System Support

Like all file systems, the optical file system has unique rules and restrictions for applications that access optical functions through the integrated file system. Several of the UNIX-type APIs and generic commands are not supported. Others are only partially supported, or restricted. Table 6 on page 75 and Table 7 on page 79 summarize these differences for the optical file system.

Table 6. Optical Implementation of UNIX-type APIs

UNIX-type API	Supported	Comments and Restrictions
access (Determine File Accessibility)	Yes	Requires *X authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes the following authorization rules apply: • Requires *X authority to each directory in the path preceding the object tested. • Requires *R authority when R_OK is specified. • Requires *W authority when W_OK is specified. • Requires *X authority when X_OK is specified. • Requires *RX authority when R_OK|X_OK is specified. • Requires *WX authority when W_OK|X_OK is specified. • Requires *RX authority when R_OK|W_OK is specified. • Requires no authority when F_OK is specified.
chdir (Change Current Directory)	Yes	Requires *X authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes, *X authority is required to each directory in the path
chmod (Change File Authorizations)	Yes	Only supported for UDF formatted optical volumes. Requires *CHANGE authority to the parent optical volume. Requires *X authority to each directory in the path preceding the object. To perform this operation you must be the owner of the file or have *ALLOBJ special authority.
chown (Change Owner and Group of File)	Yes	Only supported for UDF formatted optical volumes. Requires *CHANGE authority to the parent optical volume. Requires *X authority to each directory in the path preceding the object. To perform this operation, you must be the owner of the file, or have *ALLOBJ special authority. Files and directories on non-UDF formatted volumes are owned by QDFTOWN user profile.
close (Close File Descriptor)	Yes	
closedir (Close Directory)	Yes	

Table 6. Optical Implementation of UNIX-type APIs (continued)

UNIX-type API	Supported	Comments and Restrictions
creat (Create or Rewrite File)	Yes	Requires *CHANGE authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes, *X authority is required to each directory in the path and *WX authority to the parent directory. The change and modification time stamps for the parent directory are not updated.
dup (Duplicate Open File Descriptor)	Yes	
dup2 (Duplicate Open File Descriptor to Another Descriptor)	Yes	
fchmod (Change File Authorizations by Descriptor)	Yes	Only supported for UDF formatted optical volumes. To perform this operation you must be the owner of the file or have *ALLOBJ special authority.
fchown (Change Owner and Group of File by Descriptor)	Yes	Only supported for UDF formatted optical volumes. To perform this operation you must be the owner of the file or have *ALLOBJ special authority. Files and directories on non-UDF formatted volumes are owned by QDFTOWN user profile.
fcntl (Perform File Control Command)	No	
fpathconf (Get Configurable Path Name Variables by Descriptor)	Yes	
fstat (Get File Information by Descriptor)	Yes	Owner, group, and other mode bits are always on, regardless of the user's authority to the file. File access time stamp is not changed.
fsync (Synchronize Changes to File)	Yes	For UDF formatted volumes, data is forced to optical disk. For non-UDF formatted volumes, data is forced to DASD recoverable through held optical files.
ftruncate (Truncate File)	Yes	
getcwd (Get Current Directory)	Yes	Requires *X authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes, *RX authority is required to each directory in the path name preceding the object.
getegid	Yes	
geteuid	Yes	
getgid	Yes	
getgrid	Yes	
getgrnam	Yes	
getgroups	Yes	

Table 6. Optical Implementation of UNIX-type APIs (continued)

UNIX-type API	Supported	Comments and Restrictions
getpwnam	Yes	
getpwuid	Yes	
getuid	Yes	
ioctl (Perform File I/O Control Request)	No	
link (Create Link to File)	No	QOPT does not support links.
lseek (Get File Read/Write Offset)	Yes	
lstat (Get File or Link Information)	Yes	File access time stamp is not changed. Requires *X authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes, *X authority is required to each directory in the path preceding the object and *R authority to the object.
mkdir (Make Directory)	Yes	Requires *CHANGE authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes, *X authority is required to each directory in the path and *WX authority to the parent directory. The change and modification time stamps for the parent directory are not updated. Owner ID and group ID are not set.
open (Open File)	Yes	If opening file for write, *CHANGE authority is required to parent optical volume. If opening a file for read, *USE authority is required to the parent optical volume. For UDF formatted volumes, the following additional authorization rules apply: • Requires *R authority when object is being opened O_RDONLY. • Requires *W authority when object is being opened O_WRONLY. • Requires *RW authority when object is being opened O_RDWR. • Requires *WX to the parent directory when object does not exist and O_CREAT is specified.
opendir (Open Directory)	Yes	Requires *USE authority to the parent optical volume. For UDF formatted volumes, *X authority is required to each directory in the path preceding the object, and *R authority to the object being opened.

Table 6. Optical Implementation of UNIX-type APIs (continued)

UNIX-type API	Supported	Comments and Restrictions
pathconf (Get Configuration Path Name Variables)	Yes	
Qp0lGetPathFromFileId	Yes	
Qp0lRenameKeep	Partial	QOPT does not support renaming a directory. Object must be a file. Requires *CHANGE authority to the parent optical volume. For non-UDF volumes, no other authority is required. UDF formatted volumes require *X authority is required to each directory in the path, and *WX authority to the parent directory, and *W authority to the file. If renaming the volume, *RWX is required to the root (/) directory of the volume. New and old files must exist in the same directory.
Qp0lRenameUnLink	Partial	QOPT does not support renaming a directory. Object must be a file. Requires *CHANGE authority to the parent optical volume. For non-UDF volumes, no other authority is required. UDF formatted volumes require *X authority is required to each directory in the path, *WX authority to the parent directory, and *W authority to the file. If renaming the volume, *RWX is required to the root (/) directory of the volume. Object that is identified by a new path cannot exist.
read (Read from File)	Yes	The file access time is not updated.
readdir (Read Directory Entry)	Yes	The directory access time is not updated.
readlink (Read Value of Symbolic Link)	No	QOPT does not have symbolic links.
rename (Rename File or Directory)	Partial	QOPT does not support renaming a directory. Object must be a file or a volume. Requires *CHANGE authority to the parent optical volume. For non-UDF volumes, no other authority is required. UDF formatted volumes require *X authority is required to each directory in the path, *WX authority to the parent directory, and *W authority to the file. If renaming the volume, *RWX is required to the root (/) directory of the volume. Object that is identified by a new path cannot exist.
rewinddir	Yes	

Table 6. Optical Implementation of UNIX-type APIs (continued)

UNIX-type API	Supported	Comments and Restrictions
rmdir (Remove Directory)	Yes	Requires *CHANGE authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes, *X authority is required to each directory in the path and *WX authority to the parent directory. Change and modification time stamps for the parent directory are not updated. Operation will not be allowed if the directory is busy.
stat (Get File Information)	Yes	File access time stamp is not changed. Requires *X authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes, *X authority is required to each directory in the path preceding the object and *R authority to the object.
symlink (Make Symbolic Link)	No	QOPT does not support symbolic links.
sysconf (Get System Configuration Variables)	Yes	
unmask (Set Authorization Mask for Job)	Yes	
unlink (Remove Link to File)	Yes	Requires *CHANGE authority to the parent optical volume. For non-UDF volumes, no other authority is required. For UDF formatted volumes, *X authority is required to each directory in the path and *RX authority to the parent directory. Change and modification time stamps for parent directory are not updated. Link to a file cannot be removed when a job has the file opened.
utime (Set File Access and Modification Times)	No	QOPT does not support setting the file access or modification time.
write (Write to File)	Yes	Change and modification time stamps for the file are updated when the file is closed.

Refer to *Security - Reference*, SC41-5302-04 for authorities that are required to issue generic commands.

Table 7. Optical Implementation of Generic Commands

Generic Command	Supported	Comments and Restrictions
ADDLNK	No	
CHGAUD	No	
CHGAUT	Yes	
CHGCURDIR	Yes	

Table 7. Optical Implementation of Generic Commands (continued)

Generic Command	Supported	Comments and Restrictions
CHGOWN	Yes	Only supported for UDF formatted optical volumes.
CHGPGP	Yes	Only supported for UDF formatted optical volumes.
CHKIN	No	
CHKOUT	No	
CPY	Yes	
CRTDIR	Yes	Command will fail if attempt is to create /QOPT or next level directory, which represents a volume.
DSPAUT	Yes	
DSPCURDIR	Yes	
DSPLNK	Yes	
MOV	Partial	QOPT does not support moving a directory, if it contains files or subdirectories. QOPT does not support moving a volume.
RMVDIR	Partial	QOPT does not support RMVLNK(*YES).
RMVLNK	Yes	
RNM	Partial	QOPT does not support renaming a directory.
RST	No	
RTVCURDIR	Yes	
SAV	No	
WRKAUT	Yes	
WRKLNK	Yes	

Thread Safety

In Version 4 Release 4 of OS/400, the optical file system (QOPT) is thread-safe through the integrated file system application program interfaces. You can spawn multiple threads in the same process that is reading and writing files in QOPT. This holds true for all optical volumes that are accessed using the integrated file system APIs. This includes all optical volumes except those in LAN-attached optical media library devices.

Tips and Techniques for the Application Programmer

This topic describes how the optical file system manages file data so application programmers can optimize their applications. Since applications have different requirements, this topic does not suggest the best way to write an optical application. It does, however, provide explanations that all application programmers could find useful.

You should use this topic to determine the best way to handle optical file management, either through the HFS or UNIX-type APIs. You should use this topic only for applications to directly-attached optical support. **Concepts in this topic do not apply to optical LAN support.**

IBM provides online information on the HFS or UNIX-type API functions. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Media Capacity and Volume Threshold

One thing to consider when writing to optical media is the possibility of reaching the media capacity or threshold. The optical file system provides a logical threshold capability to help applications protect themselves from reaching the absolute volume capacity. Definition of the logical threshold occurs when the volume initializes, and is unique for each volume. You can change this threshold by using the Change Optical Volume command.

Note: The logical volume threshold is only applicable for high performance optical file system (HPOFS) media format. For UDF media format, the logical volume threshold is always 100% and cannot be changed.

You should devise a strategy to deal with the situation when the media becomes full. This is especially true when writing to WORM media. You might consider the following questions:

- How should I use the volume threshold?
- What should I do when the volume is full?
- How can I prepare for a volume-full condition?

The volume threshold is provided to allow applications to prepare for an actual volume-full condition. When WORM media becomes full, there can be no further write operations. Depending on the requirements of the application, the threshold can be used in various ways to prepare for the media becoming physically full.

For example, an application might write groups of spooled files to optical disk. After each group is written, an additional file might be written that contains an index to the spooled files just written. Without the index, the spooled files could be useless. Unless the application can manage the media capacity, the volume might run out of space before the index file can be written. One way around this is to set the volume threshold to 99%. When a `No space available` message is issued, the application can then increase the threshold to 100% and write any necessary additional files.

Managing Media Capacity on a Per-File Basis

An application might also need to manage the media capacity on a per-file basis. Following are a few methods you can use to decide if a file will fit on the media:

1. Handle error on a close operation

   Assume an optical volume is initialized to a 95% threshold and an application writes files until the volume threshold is reached. When the threshold is reached, the application will receive message CPF1F61, `No free space available on media.`. At this point, the volume threshold can be increased to 97% (or anything else up to 100%) by using the CHGOPTVOL command. You can then attempt to close the file.

2. Specify QALCSIZE on the Open Stream File HFS API

   Another method to determine if a file will fit on a volume is by specifying an allocation size (QALCSIZE) on an open stream file. On an open stream file, the system can pass a value in attribute QALCSIZE. This attribute is valid when

the open operation is for create or replace; otherwise, it is ignored. Specifying a value for QALCSIZE results in comparing the specified value against the space available on the volume. If the space available is less than QALCSIZE, then the system issues message CPF1F61. Having the space available exceed the QALCSIZE allows the open operation. Only on the first open instance of a file honors this attribute. If specified by more than one opening of a file, the system ignores the additional attributes.

Note: This does not actually allocate space on the optical volume at the time of the open operation. It simply checks the volume to see if the number of bytes that are requested are available.

There are drawbacks to using this method:
   a. You need to know at the time the open request is made the size of the file you are creating.
   b. If multiple jobs are writing to the same media, there is no guarantee that by the time the data is written, the space will still be available.

If the size of the file is known prior to the time the open request is made, and there will not be other jobs writing to that volume during the time your file is open, this is an excellent method to check media capacity before creating a file.

3. Retrieve space available on a volume

Another method is to have the application retrieve the space available on the volume. You can do this by using the the Display Optical (DSPOPT) command through output file support. The output file can then be read to retrieve the number of bytes assumed to be available on the media.

Data Buffering (Virtual Optical File)

File data is buffered into a **virtual optical file** in AS/400 main storage by the optical file system. Data is buffered during both read and write processing for the following reasons:
- To simulate read and write access to optical files
- To lock or share files
- To lock or share bytes
- To perform random processing of optical file data
- To write variable-length data buffers to the optical file
- To reduce input or output to the optical disk
- To provide proper alignment of data
- To recover data

Writing Files

When an application writes a file to optical media, it issues calls to the open, write, and close the file. Other requests are possible, but open, write, and close are the primary functions to write a file. Following is a breakdown of the major functions performed by the optical file system for each type of request.

Open (Write) Function
- The volume is checked to see if the file exists. This is done to satisfy the open information on the request. The volume is mounted in a drive if that has not already been done.

- A virtual optical file is created on the AS/400 system to store the data on future write requests.
- The virtual file is locked as specified on the request. The directory and volume are locked implicitly to prevent another process from using them exclusively.

Write Function
- If the file already exists and was opened for updating, the entire contents of the file are read from optical disk into the virtual file created during the open function. When updating an existing file, the entire file is written to optical disk as a completely new copy of the file. For this to happen, the existing data must be read from the media into the virtual file.
- The data being written is moved into the virtual file. No data is put on the optical disk at this time.

Close Function
- If the user issuing the close request is the last user to have the file opened, the data is moved from the virtual file to the optical disk. If this operation fails, the file is marked as a held optical file (see "Held Optical Files" on page 85).
- If the virtual file was successfully written to the optical disk, the file, directory, and volume are unlocked and the virtual file is destroyed.

Note: No data is written to the optical disk until the application closes the file. Therefore, all data written to a file reside in the AS/400 main storage until the file is closed by the last user who has opened it. This is an important consideration when processing large files.

Reading Files

When an application reads a file from optical disk, it issues calls to open, read, and close the file. Other requests are possible, but open, read, and close are the primary functions to reading a file.

A breakdown of the major functions performed by the optical file system for each type of request follows:

Open (Read) Function
- The volume is checked to see if the file exists. The volume is mounted in a drive if that has not already been done.
- A virtual optical file is created on the AS/400 system to store the data on future read requests.
- The virtual file is locked as specified on the request. The directory and volume are locked implicitly to prevent another process from using them exclusively.

Read Function

The virtual optical file is logically separated into pages of 256KB. Data is read from optical disk to the virtual file 256KB at a time corresponding to each logical page. When a Read requests data from a page that has not yet been read from optical disk, the entire page is read into the AS/400 storage. Only the amount of data requested on the read request is returned to the application. Any future read requests for data within that logical page returns the data directly from the AS/400 storage because the data is already paged in. For files that are less than 256KB, the first read request reads all data from the optical disk into the virtual file.

Close Function

- The file, directory, and volume are unlocked.
- The virtual optical file is destroyed.

Expanding Buffer I/O through HFS—Tailoring Read Requests for Performance

An alternative method of opening a stream file through HFS can improve performance for applications that typically read portions, but not all, of the data in large optical files. This alternate method of input/output is referred to as **expanding buffer I/O**. Expanding buffer I/O is available only to HFS API applications when accessing HPOFS or ISO9660 formatted media. This attribute is ignored when the media format is UDF.

Note: Using the HFS APIs, optical file data is buffered into a virtual optical file in AS/400 main storage. If expanding buffer I/O is not selected as an option, the size of this buffer is equal to the size of the actual optical file. For example, a 100MB file on optical media has a 100MB buffer when the file is opened through the HFS API, Open Stream File. The performance cost for overhead operations involving the optical buffer is proportional to the buffer size. The time it would take to read one byte of a 100MB file is substantially greater than reading one byte of a 50KB file.

When an optical file is opened for expanding buffer I/O, the size of the buffer begins at zero and expands as data is read into the buffer as requested by the application. The minimum amount of the size expansion is 256KB. The buffer expands only if the requested data is contained within a logical 256KB page that is not yet contained in the buffer. For these reasons, the amount of time it would take to read one byte of a 100MB file opened for expanding buffer I/O should be roughly identical to the time to read one byte of a 50KB file opened in the same manner.

Situations in Which Expanding Buffer I/O is Especially Useful

Expanding buffer I/O should be considered as an option for improving the performance of reads if any of the following is true.

- The typical size of an optical file to be read is greater than 256KB.
- The amount of data read from the optical file between the open and close stream file is a fraction of the total file data. The exact fraction would be impossible to specify, but the performance improvements that are achieved will be greater the smaller the fraction. For example, an application that used expanding buffer I/O to read 25KB of a 50MB file would experience much greater performance improvements than an application that read 45MB of the same file. An application that reads the entire 50MB example file 40KB at a time through multiple reads probably would not experience any performance improvement using expanding buffer I/O.
- The application will not issue the Set Stream File Size, Lock-Unlock Byte Range, or Write Stream file APIs while the file is open for expanding buffer I/O. For further expanding buffer restrictions, see "Expanding Buffer I/O HFS API Restrictions" on page 72.

For specific details on how to implement expanding buffer I/O, see "Special Attributes Unique to Optical File System" on page 71.

How Data Buffering Works With Files That Have Multiple Users

When you use data buffering with a file that has multiple users, you should consider the following rules of optical buffering:

- On read requests, data is always returned to the application directly from AS/400 main storage.
- On write requests, data is always written directly to AS/400 main storage.

When you are performing a read request, if the requested data does not exist in the virtual file in main storage, it must be retrieved from optical media before you return it to the application. However, the data is still returned to the application from AS/400 storage.

When multiple users have the same file opened, there is only one virtual file created on the AS/400 system which is "shared" by all of its users. Separate users or processes can access different offsets or records within the file at the same time. The only restriction is that their access cannot conflict with another opening of the file. For example, user A may request that FILEX be opened with an HFS access mode of Read Only and an HFS lock mode of Deny Write. If user B attempts to open FILEX with an access mode of Write Only, the open request will fail because this conflicts with the lock mode of Deny Write specified by user A. However, user B can open FILEX with an access mode of Read Only because this does not conflict with other openings. All other users can all open this same file as long as their access modes and lock modes do not conflict with other open requests.

Two users can even have a file opened for Write Only access as long as their lock modes do not have Deny Write. Multiple openings for write access can be a valid operation if each were updating separate records within the file. Byte locking through the Lock and Unlock Range in the Stream File API can be used to manage multiple users updating a file at the same time. This file will get written to optical disk when the last user closes the file by using the Close Stream File API.

There is always only one virtual file for each opened optical file regardless of the number of users that have opened that file. As long as there is at least one open request for an optical file, a virtual file exists in main storage for that file. When the file is closed, the virtual file is deleted unless the file is a held file (see "Held Optical Files").

Force Buffered Data or fsync() APIs

Optical data can be synchronously written to nonvolatile storage by using either the HFS API Force Buffered Data or the fsync() UNIX-type API. When performing either function to an optical file on a non-UDF formatted volume, all previously written data to that file is AS/400 DASD ensured. When performing either function to an optical file on a UDF formatted volume, all previously written data to that file is written to optical disk.

Held Optical Files

Held optical files are virtual files that were never successfully written to optical media. A virtual file becomes *held* if an error occurs during the close operation of a file on a non-UDF formatted volume. You can manage these virtual files by using

application interfaces and optical utilities. No creation of held files occurs for files that fail to archive on UDF formatted volumes.

Using the example cited in "Media Capacity and Volume Threshold" on page 81, assume an application reaches the volume threshold when writing to a file. This time, however, the absolute volume capacity is reached. The file is too large to fit on the volume. Because increasing the volume threshold will not help, another solution is needed. When the close request fails, the virtual file becomes held. Using the Work With Held Optical Files command, this virtual file can be saved to another volume. If desired, the file can be saved under a different name. The save request can also be performed using a control file system function. For more information on the optical control file system support, see "Control File System Functions to Optical Support" on page 66.

Volume, Directory, and File Considerations

The following topics discuss considerations for working with optical volumes, directories, and files.

Working with Volumes

Consider the following terms when referring to volumes:

Online
> The volume is mounted in a drive under the read/write heads.

Near Online
> The volume is in the optical media library, but not online. The volume may be in a storage slot or the opposite side of an online volume.

Removed
> The volume is not physically in an optical media library, but volume information for the volume was kept when the volume was removed.

Offline
> The volume is in an optical device, but the device is either powered off, varied off, or no longer connected.

Consider the following characteristics of optical volumes:
- An optical volume is one side of an optical cartridge.
- An optical cartridge contains two volumes.
- All volume names must be unique.
- Depending on the optical media density and type, the capacity of a volume can range from 300MB to 4.7GB.
- Normally, a near online volume takes 8-15 seconds to become an online volume. This requires the volume to be mounted into a drive.
- The number of drives in the optical media library determines how many volumes can be online at any time. Only one volume can be mounted in a drive (online) at one time. The remaining volumes in the library are near online.
- Volumes are generally independent of each other, with one exception. The two volumes on the same cartridge can never be completely independent. Both volumes on a cartridge can never be online at the same time. Copying between two volumes on the same cartridge can be done, but it requires the cartridge to be "flipped" several times to copy all of the requested files.
- There is no limit to the number of removed volumes that can exist.

How an application manages volumes depends almost entirely on the requirements of the application. Data should be written to volumes strategically, depending on the desired retrieval time in the future. If it is not desirable to wait for a near online volume to become online, the application might need to be set up so the most likely volumes to be accessed are online.

Working with Directories

The only limit to the number of directories that can be created on a volume is the capacity of the media. This restriction also applies to the number of files that can exist in an optical directory. Directories are not required to exist for files to be stored on a volume. If desired, all files can be stored in the root directory of a volume. The root directory is the ″/″ directory that is created when a volume is initialized. This root is not considered a directory in the traditional sense since it cannot be created or deleted like other directories. The root directory will always exist on initialized optical volumes.

Directories can be used to categorize optical files into more manageable subsets. Directories can contain files from a particular time period, subject, characteristic, or any combination of these. For example, there may be a directory SPOOLFILES with subdirectories YEAR_1994 and YEAR_1995. Taking this one step further, there could be subdirectories within these subdirectories named MONTH_MARCH and MONTH_APRIL. This structure could be represented as follows:

```
/SPOOLFILES
/YEAR_1994
/MONTH_MARCH
/MONTH_APRIL
/YEAR_1995
/MONTH_MARCH
/MONTH_APRIL
```

Fully qualified directory names for this example look like this:

```
/SPOOLFILES
/SPOOLFILES/YEAR_1994
/SPOOLFILES/YEAR_1994/MONTH_MARCH
/SPOOLFILES/YEAR_1994/MONTH_APRIL
/SPOOLFILES/YEAR_1995
/SPOOLFILES/YEAR_1995/MONTH_MARCH
/SPOOLFILES/YEAR_1995/MONTH_APRIL
```

Directories can be useful when categorizing files, but they are not necessary. Like volume names, directory names must be unique within the same volume. For example, volume VOL001 cannot have two directories named DIR001. Volume VOL001 can, however, have a DIR001 directory and a DIR000/DIR001 directory. Also, a DIR001 directory can exist on volume VOL001 and volume VOL002. For information on directory naming conventions, see "Path Names" on page 88.

Working with Files

Choosing the size of optical files depends almost entirely on the requirements of the application and the users of those files. The size of an optical file can range from 0 bytes to 2.6GB, depending on the capacity of a volume.

Note: Application files cannot span volumes; however, save or restore files can span volumes.

When selecting optimal file sizes for your application, pay special attention to the following considerations:

- The amount of system disk unit or main storage on the AS/400 system
- How the data will be read (sequentially or randomly)
- Whether the entire file will usually be retrieved, or just a small portion
- Whether files will be updated once they are written to the volume

Generally, the larger the file, the better the performance and media use. When larger files are used, less media space is taken up by file directory information and more is used for actual data. Also, the performance related to file size is not a linear comparison. It does not take twice as long to write 20KB of data as it does to write 10KB of data. Performance (KB/second) improves as the amount of data being read or written increases.

Consider the following example:
- A 50KB file requires X seconds to write
- A 100KB file requires Y seconds to write, where $Y < 2X$
- A 200KB file requires Z seconds to write, where $Z < 2Y < 4X$

This example holds true in most cases. From this example it is easy to see that it takes longer to write two files, each 50KB, than it does to write one 100KB file. Also, it takes longer to write two files, each 100KB, than it does to write one 200KB file. This is true when files are being read as well.

Although large files yield better performance and better media use, files that are too large may use more AS/400 storage (during file input/output) than desired. This depends on the system configuration and requirements of the application. Generally, file sizes of less than 10KB or greater than 3MB might be undesirable. However, if an AS/400 system has the storage to handle it, files can be 20MB, 30MB, 40MB, or larger. Also, files less than 10KB might be acceptable for specific applications. In this case, keep in mind that more space on the media is being occupied by file directory information than if larger files were used.

Remember, you can back up a full volume containing 50KB files to another optical volume much faster (by using the CPYOPT command) than a full volume containing 4KB files.

It is difficult to generalize acceptable optical file sizes. Probably the most important factor to help determine file sizes is to realize that all file data is buffered in AS/400 storage during file input/output. See "Data Buffering (Virtual Optical File)" on page 82 for an explanation of how and why this is done. For information on file naming conventions, see "Path Names".

Path Names

The term **path** refers to a file-system name, volume name, directory name, and file name.

Path Names for Volumes in Directly-Attached Devices

The following example illustrates the format for a path name on a directly-attached device. The forward slash (/) is used as a separator character. The path name must begin with a forward slash and contain no more than 294 characters.

```
/QOPT/VOL_NAME/DIRECTORY_NAME/SUB_DIR1/.../SUB_DIRn/FILE_NAME
```

QOPT refers to the optical file system. You must use it to qualify the optical file system when issuing calls to optical support through the HFS API or the Unix-type APIs. The portion of the path following the file system name cannot contain more than 289 characters. Following are rules for using path names:

- A path name can consist of any EBCDIC characters, except the characters that are listed below:
  - X'00' through X'3F'.
  - X'FF'.
  - The quotation mark (").
  - The asterisk (*).
  - The less than (<) and greater than (>) signs.
  - The question mark (?).
  - The hyphen (-).
  - The back slash (\).

  When accessing UDF formatted volumes through the integrated file system APIs, the only characters not valid are X'00' through X'3F', X'FF', and back slash.

- The volume identifier can be a maximum of 32 characters for HPOFS media format, and a maximum of 30 characters for UDF media format. The identifier 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 blanks.

- You can include one or more directories in the path name, but it is not required. The total number of characters in all of the subdirectories together cannot exceed 256

- The file name is the last element in the path. The directory length in the path limits the file name length. The directory name and file name combined cannot exceed 256 characters. The preceding forward slash of the directory name is considered part of this 256 characters.

Path Names for Volumes in LAN-Attached Devices

The following example illustrates the format for a path name on an optical volume in a LAN-attached optical device. The forward slash (/) is used as a separator character. The path name must begin with a forward slash and contain no more than 261 characters.

```
/QOPT/VOL_NAME/DIRECTORY_NAME/SUB_DIR1/.../SUB_DIRn/FILE_NAME
```

QOPT refers to the optical file system, and must be used to qualify the optical file system when issuing calls to optical support through the HFS or integrated file system APIs. The portion of the path following the file system name cannot contain more than 256 characters. Following are rules for using path names on LAN-attached devices:

- See the *IBM 3995 LAN Optical Library Dataserver* book for the allowed characters for path names.

- The volume name is required and can contain a maximum of 32 characters.

- One or more directories can be included in the path name, but it is not required. The total number of characters in all of the subdirectories together cannot exceed 254.

- The file name is the last element in the path. The file name length is limited by the volume and directory length in the path. The volume name, directory name,

and file name combined cannot exceed 256 characters. The preceding forward slashes of the volume and directory name are considered part of the 256 characters.

Chapter 8. Optical Volume Backup

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

Defining Your 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 strategy:

- 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?
- What backup options are available for the different media formats?
  - If the media format is *UDF, your options are either Duplicate Optical (DUPOPT) CL command or the Copy Object (CPY) CL command.
  - If the media format is *HPOFS, your options are: Duplicate Optical (DUPOPT) CL command, Copy Optical (CPYOPT) CL command, or the Copy Object (CPY) CL command.
- 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.

Your Backup Options

There are four options which are available to support backing up your optical data, and they are:

- Duplicate Optical (DUPOPT) CL command
- Copy Optical (CPYOPT) CL command to volume type *PRIMARY
- Copy Optical (CPYOPT) CL command to volume type *BACKUP
- Copy Object (CPY) CL command

The DUPOPT and CPYOPT CL commands were developed especially for the QOPT file system, whereas the CPY CL command is a general-purpose integrated file system command. IBM provides online information about the CPY CL command. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Although there are four different backup options, the preferred and suggested method for backing up optical media is the Duplicate Optical (DUPOPT) method. Why is DUPOPT now the suggested backup method? DUPOPT in almost all cases, will be significantly faster than any of the copy options. There also has been several enhancements that were made since the introduction of DUPOPT method in version 3.6, and they include:

- DUPOPT no longer requires the source and target volume to be in the same optical library.
- 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.

In general, the performance order of your four options in order of fastest to slowest is: DUPOPT, CPYOPT to type *PRIMARY, CPYOPT to type *BACKUP and CPY. This is because the duplicate takes place at a lower level of code than any of the copy methods. There is much more processing that is required for any of the copy methods. This is because the copy takes place at the file system level of code as opposed to duplicate takes place at the media level of code. This will greatly increase the time that is required to complete a full volume copy. Two factors cause this condition:

- The rapid increase in media capacities.
- The associated increase in files per volume in the overhead that is required to process large numbers of files by the file system.

As an example suppose that you wish to backup a volume which contained 150,000 files. If you use CPYOPT to backup the volume, the following processing has to take place for each file: Locate source file, open source file, open target file, read source file, write target file, close source file, and close target file. If this process took one half-second per file, the copy operation will take approximately 21 hours to copy all 150,000 files. Using DUPOPT in V4R5 to backup the same media would take under 2 hours if the media type is *ERASE. The process could take longer if the media type is *WORM.

It is not as easy to provide time estimates when the media type is *WORM. How the data was written to *WORM media has an effect on the time required to

duplicate the volume. In general the time required to duplicate a piece of *WORM media will be equal to or greater than *ERASE media of the same density. In some instances the time required could be up to 3 times longer than duplicating an *ERASE media that contains the same information.

If your media type is *ERASE, consider only using DUPOPT to make backup copies of your volumes. If your media type is *WORM, you could consider using DUPOPT or CPYOPT to make backup copies of your volumes. Remember that CPYOPT could be significantly slower than DUPOPT. You can use CPYOPT to make incremental backups of your source volume by specifying a starting time for only files that have changed. Please refer to the section titled CPYOPT.

Using the Duplicate Optical Command to Back Up a Volume

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. However, as stated previously, DUPOPT cannot be used for incremental backups.

The DUPOPT command has the following requirements:
- Two optical drives.
- 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. 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.
- 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 on the drives until the command completes.

The DUPOPT command can be used 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: Determine how often you wish to backup your source and how many backup copies you wish to keep. Use DUPOPT to duplicate your source media to a target media which has a media type of *ERASE. This will give you an exact copy of the source media. Continue making duplicates of your source volume as often as you wish until you source volume becomes full. 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. If you 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.

Attention: If the DUPOPT command does not complete successfully or it ends for any reason while processing, the backup is unsuccessful. This potentially makes the target media no longer usable. If the target media type is *WORM media, you can write to it only one time.

V4R5 Enhancements

The V4R5 release provided the following enhancements to DUPOPT:
- The addition of the cross device support (that is library to library, stand-alone to stand-alone).
- The addition of the unload support for stand-alone devices

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

Note: The system only supports "unload" for stand-alone devices.
```
> DUPOPT FROMVOL(*MOUNTED) TOVOL(*MOUNTED) NEWVOL(MYBACKUP)
FROMDEV(OPT01) TODEV(OPT02) FROMENDOPT(*LEAVE) TOENDOPT(*UNLOAD)
```

CPYOPT

This section 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:
- All files and directories for an entire volume.
- All files and subdirectories for a directory.
- All files for a directory.
- A single file.

Note: CPYOPT does not support *UDF formatted media.

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. Later, this chapter discusses the *BACKUP volume type in more detail. You can use CPYOPT to copy files between the following volume types:

FROM Volume	TO Volume
*PRIMARY	*PRIMARY
*PRIMARY	*BACKUP
*BACKUP	*PRIMARY

Key parameters

There are several parameters which you can specify in order to help you select the files that you want copied, and they 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. Please 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 choice which files you want to copy. Your options are:

- ***CHANGED** this 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** this is the default options. It indicates that only files in the specified **From path** are eligible to be copied.
- ***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

Use the **Starting date and time** (FROMTIME) parameter to specify the starting date and time. The system will use this parameter to determine if a file is eligible

for copying. 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 and possibly best option would be to use one of the SLTFILE options in combination with specifying a starting date and time. This would be the most efficient method for additional copy.

```
> 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:

- 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 the extra space on the backup volume to store control information. The amount that is used is approximately 2KB per directory copied. Therefore, if the system copies five directories from a primary volume to a backup volume, the backup volume uses an additional 10KB of space. This example uses 5KB on the backup volume 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

What is a **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: 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

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. You can specify a starting date and time on the CPYOPT command. 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

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 is read and stored in AS/400 temporary storage.
- The source volume is removed, and the system mounts the target volume by turning over the optical cartridge.
- Files are read from AS/400 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 AS/400 system 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.

Chapter 9. Optical Media Library Performance

This chapter describes performance considerations for users of optical media libraries (both directly attached and LAN-attached).

General Performance Considerations for Optical Support

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 is one of the most important factors affecting 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:

- Having only one drive available for use by applications libraries.
- Having many optical processes 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. For more information on the effects file size have on performance, see "Working with Files" on page 87.

Performance Considerations—Directly-Attached Optical Libraries

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

Effects of File Attributes on Performance

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.

HFS API Expanding Buffer I/O

Users of the HFS APIs can improve performance by taking advantage of the expanding buffer I/O option. Expanding buffer I/O 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. For information on using expanding buffer I/O, see "Expanding Buffer I/O through HFS—Tailoring Read Requests for Performance" on page 84.

CPYOPT and DUPOPT Performance Considerations

Performance of the CPYOPT and DUPOPT functions 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, you should read "Chapter 8. Optical Volume Backup" on page 91 to better understand how to achieve the optimum performance using the CPYOPT and DUPOPT commands.

Volume Mounting and Dismounting Schedule Timers

This topic provides information on how the AS/400 system manages work requests to the directly-attached IBM 3995 Compact Optical Library Dataserver. 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 AS/400 system for directly-attached optical media libraries.

There are two timer values that 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 the 3995 can have 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 completes.
- 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 pre-empted 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 completes.
- 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 cancelled. 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 30 minutes, the job fails due to a time-out.

Changing Job Priority on Active Jobs

Due to the work management method used by AS/400 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.

Add Optical Cartridge Performance

Prior to Version 4 Release 4 of OS/400, DIR(*NO) only applied to volumes marked *REMOVED. Specifying *NO for Rebuild Directory Index can improve the performance of ADDOPTCTG by deferring the build of the optical directory index until a later time. In Version 4 Release 4 of OS/400, IBM made a change to improve overall performance of the Add Optical Cartridge (ADDOPTCTG) CL command.

Performance Considerations—LAN-Attached Optical Libraries

This topic describes the ways you can control the performance of applications using an optical LAN server.

Controlling the Block Size for an Optical LAN Server

Optical LAN support is optimized to receive and send the largest possible block of data across the network. Currently, optical LAN support communicates with servers using data frames containing a maximum of 31KB bytes of information. This does not directly affect the HFS user, but to minimize communications time, applications using large files should avoid read and write operations of less than 31KB. Read or write operations larger than 31KB are not a problem because they are automatically broken up into the optimum size.

Controlling Block Size for Optical LAN Server—Examples

Consider an example application that has 64KB bytes of information to be written to an optical volume. The application could be designed to write blocks of 1KB, 31KB, or the entire file. If 1KB blocks were written, the application would make 64 write requests. These 64 write requests would result in 64 communications requests.

If 31KB blocks were written, the application would make 3 write requests (2(31KB) + 1(2KB)). These 3 write requests would result in 3 communications requests.

Finally, if the application requested that the entire file be written, there would be 1 write request. The file would automatically be broken up into 3 communications requests (2(31KB) + 1(2KB)).

All three approaches work, but the best performing one is the single write request of the entire file.

While a single write request may be appropriate for some applications a single read request may not. To correctly optimize a read application, you first need to determine what portion of the file is required. Assume that the the same 64KB file in the example above is a read application, but that you will most likely need only 1KB of information. If the application requests that the entire file be read, this would result in three communications requests (2(31KB) + 1(2KB)). If the application requested a 31KB read request, this would result in a single communication request. A 1K application read request would also result in a single communications request. Even though the 31K and 1K read request have the same results, you might be better off with the 31K read request if you anticipate more information will be needed by the application.

Conversation Allocation for Optical LAN Server

You have performance control over how files are opened and closed, and how requests to optical volumes are issued from the application. Either of these can result in excessive communications overhead.

But, before addressing that, it is important to understand how conversations are allocated and de-allocated between AS/400 and the optical LAN server. AS/400 and the optical LAN server can support a limited number of conversations between them. The mode status of the AS/400 system determines how many conversations can be started and owned by the system.

The optical LAN server has its own mode status that determines how many conversations it can own and have active. A limit is negotiated between the system and the optical LAN server when communications are initially started. To view what that limit is, use the Display Mode Status (DSPMODSTS) command for the device that defines the optical LAN server. From the displayed list of modes, display the details for the mode that is used by the device. Locate the negotiated session limits. This number is the maximum number of concurrent applications that can use the LAN server. Different servers can have different limits.

This negotiated limit can be viewed as a pool of conversations. To stay within this conversation pool limit, optical LAN support was designed to use and return conversations as needed. It is also designed to keep a conversation as long as the application has at least one open file.

Conversation Allocation for Optical LAN Server—Example

Following is an example application and information on how you could change it to optimize conversation allocation. This sample application performs the following actions:

1. Find the available space on a volume
2. Create a directory
3. Open file 1
4. Write to file 1
5. Close file 1
6. Open file 2
7. Read from file 2
8. Close file 2

Running the example application would result in 4 different conversations. The first conversation is allocated for the volume space request. When the request completes, the conversation would be returned to the pool. The second conversation is used and returned when the directory is created. The third conversation is used when file 1 is opened and returned when it is closed. The fourth conversation is used when file 2 is opened and returned when it is closed.

Now suppose that the application is changed in the following manner:

1. Open file 2.
2. Read from file 2.
3. Find the available space on a volume.
4. Create a directory
5. Open file 1.
6. Write to file 1.
7. Close file 2.
8. Close file 1.

These changes have an impact on the use of conversations.

A conversation is allocated when file 2 is opened, and continues to be used as long as there is at least one open file. This application uses only one conversation while the other requires four.

A disadvantage to this approach is that the conversation is not being shared. Assume additional processing is taking place between each of the listed steps. There would be periods of time where the conversation could be returned to the pool but is not because a file is open. If you had a large number of applications using a small pool of conversations, you may quickly run out of conversations. Jobs needing a conversation would go into a wait state until conversations become available.

Minimizing Volume Mounts for Optical LAN Server

Other factors that can greatly affect performance for both optical LAN servers and directly-attached libraries are volume mounting and drive contention. In order to remove and mount a new volume, the following sequence of events takes between 8 to 15 seconds.

- Remove a volume from the optical drive.
- Store the volume in an open library slot.
- Select the new volume to mount from a library slot.
- Move the volume into the optical drive.

Applications should be designed to minimize volume mounting. The optical LAN server also has its own set of performance parameters that can be changed to optimize optical drive usage. Please refer to the *IBM 3995 LAN Optical Library Dataserver Reference* book for more information about the performance parameters available for LAN-attached optical media libraries.

Chapter 10. Optical Media Formats

OS/400 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. The AS/400 supports the following optical media formats.

- ISO 9660

  This industry-standard media format specifies the volume and file structures of compact read only optical disks (CD-ROM).

- HPOFS (High Performance Optical File System)

  This IBM developed architecture is the media format that is used for WORM and erasable media that are supported in 3995 optical media library devices. The OS/400 implementation of HPOFS is the WORM (write-once-read-many) based version of this architecture. Everywhere in this chapter where the term **HPOFS** is used, the WORM version of HPOFS is implied.

- UDF (Universal Disk Format)

  This industry-standard subset of ISO 13346 is the media format that is created on DVD-RAM media through OS/400. It is also available to use on erasable media in 3995 optical media library devices.

Writable optical media (WORM, erasable, DVD-RAM) is initialized on OS/400 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 HPOFS or UDF depending on the requirements of the user. You can specify the format by using the MEDFMT keyword on the INZOPT command.

This chapter provides information about the different media formats. This chapter also provides a comparison of the media formats so users of erasable media can select the media format that best meets their requirements.

ISO 9660

Overview

This industry-standard media format specifies the volume and file structures of compact read only optical disks (CD-ROM). This is a read-only media format. OS/400 supports ISO 9660 media that is created using the primary volume descriptor (PVD). CD-ROMs created using the **CD-ROM Extensions** through the secondary volume descriptor (SVD) are not supported.

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 (_).

File name searches are case-insensitive meaning that you can use either uppercase or lowercase characters to access existing files.

Programming Interfaces

The system can read files on ISO 9660 media by using either the HFS (Hierarchical File System) programming interface or the integrated file system programming interface.

Command Interfaces

You can use AS/400 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 to ISO 9660 media. Refer to Table 8 on page 120 later in this chapter for more information about which commands the system supports for each media format.

Directory and File Security

There is no directory and file level security for ISO 9660 media. Volume level security is available through authorization lists. See "Chapter 6. Optical Security and Auditing" on page 53 for more information.

High Performance Optical File System

Overview

HPOFS (High Performance Optical File System) is an IBM developed media format architecture available to use when initializing 3995 optical media on the AS/400. OS/400 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 comsumption continues to grow as you update and even delete files.

This section contains detailed information on the OS/400 implementation of HPOFS for direct-attached (C4x) 3995 optical media libraries. This section does not address HPOFS characteristics for LAN-attached (C2x) 3995 optical media libraries.

Volume, Directory, and File Names

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 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 x00-x3F, xFF, ″, *, <, >, ?, and \.

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.

Space Reclaim

You can update or delete files even though HPOFS is a WORM media format. When a file gets changed or deleted, a new version of the file gets 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 media.

Programming Interfaces

You can create or read files on HPOFS media by using either the HFS (Hierarchical File System) programming interface or the integrated file system programming interface. There are things specific to the AS/400 implementation of the HPOFS media format that application writers 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 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 affects if an application used the two API sets interchangably 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 (eg. 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 AS/400 DASD 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 all writes to be synchronous. When specified, writes will be synchronous to AS/400 DASD, 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 AS/400 DASD, 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 honors file 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.

Command Interfaces

AS/400 save and restore commands can be used to save and restore data on HPOFS optical media. Refer to "Appendix C. Optical Save and Restore" on page 139 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. Refer to Table 8 on page 120 later in this chapter for more information about which commands the system supports for each media format.

Directory and File Security

There is no directory and file level security for HPOFS media. Volume level security is available through authorization lists. See "Chapter 6. Optical Security and Auditing" on page 53 for more information.

Media Interchange

You can access HPOFS optical media created on the AS/400 in any C4x or C2x 3995 optical media library. Conversely, you can use a C4x 3995 to access HPOFS media that is created in a C2x LAN-based 3995. However, the volume requires formatting in "WORM Format" that does not support the mixed uppercase and lowercase structure.

Directory Structure and Performance

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 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 affect 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.

Universal Disk Format

Overview

UDF (Universal Disk Format) is the OSTA (Optical Storage Technology Association) supported subset of ISO/IEC 13346. It 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 OS/400 implementation of UDF for direct-attached (C4x) 3995 optical media libraries as well as a DVD-RAM device.

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 OS/400 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.

Programming Interfaces

You can create files or read files on UDF media by using either the HFS (Hierarchical File System) programming interface or the integrated file system programming interface. There are things specific to the OS/400 implementation of the UDF media format that application writers 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 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 affects 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 (eg. 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). Once 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() prior to the close. These APIs will force the writing of the data to the optical disk.

- Synchronous writes

  You cannot open files on UDF volumes through HFS by specifying all writes to be synchronous. On the Open Stream File API, if the write-through-flag specifies "synchronous", the system returns an error to the application.

  File data can be forced to optical disk synchronously using the HFS Force Buffered Data API and the integrated file system fsync() API. For UDF files, these APIs will force the data to optical disk rather than to AS/400 DASD. In the event of a power failure prior to close, using these APIs will ensure that the data in on the optical media.

- File sharing

  Multiple jobs or thread can share files for read, but writers are always exclusive. Remember: 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 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.

Command Interfaces

AS/400 save and restore commands can be used to save and restore data on UDF optical media. Refer to "Appendix C. Optical Save and Restore" on page 139 for more information about save and restore to UDF volumes.

There is some restrictions on which optical commands are supported to UDF volumes. For example, the system does not support Copy Optical (CPYOPT), Work with Optical Directories (WRKOPTDIR), and Work with Optical Files (WRKOPTF). Display Optical (DSPOPT) has some restrictions when used for UDF volumes. You should use the integrated file system commands Copy Object (CPY), Work with Object Links (WRKLNK), and Display Object Links (DSPLNK) instead of the optical commands. Refer to Table 8 on page 120 later in this chapter for more information about which commands the system supports for each media format.

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; they are: owner, group, and public. Volume level security is also available through authorization lists. See "Chapter 6. Optical Security and Auditing" on page 53 for more information.

Media Interchange

UDF media created on OS/400 is UDF Version 2.0. This media will interchange to other operating system platforms that support this version of UDF.

UDF compliant media that is created or updated on another operating system platform will be accessible by OS/400 as "read only". The system accepts the media as read only the next time it is accessed by OS/400. This is true even if another operating system updated the media after an OS/400 created (initialized) it.

In addition, OS/400 creates and only supports file names in "8-bit OSTA Compressed UNICODE" format.

Directory Structure and Performance

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 will, 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 will be better for UDF if you evenly distribute files across several directories and subdirectories.

Command and Media Format Dependencies

Some optical commands have no meaning when used with certain optical media formats. No support exists for other commands with certain optical media formats. Table 8 lists all of the volume related optical commands and the media formats to which they apply.

Table 8. Optical Commands and Media Format Dependencies

Command	ISO 9660	Universal Disk Format	HPOFS in Directly-Attached Device	HPOFS in LAN-Attached Device
CHGOPTVOL	Partially supported[1]	Partially supported	Supported	Partially supported
CPYOPT	Supported	Not supported	Supported	Not supported
CVTOPTBKU	Not applicable	Not applicable	Supported	Not applicable
DSPOPT	Supported	Partially Supported	Partially supported	Partially Supported
DSPOPTLCK	Supported	Supported	Supported	Partially supported
DUPOPT	Not supported	Supported	Supported	Not supported
INZOPT	Not applicable	Supported	Supported	Not supported
WRKHLDOPTF	Not applicable	Not applicable	Supported	Not applicable
WRKOPTDIR	Supported	Not supported	Supported	Partially supported
WRKOPTF	Supported	Not supported	Supported	Partially supported
WRKOPTVOL	Supported	Supported	Supported	Partially supported

Notes:

1. *Partially supported* indicates that not all command parameters may apply when used with the indicated device.

Differences Between HPOFS and UDF

There are some significant differences between the OS/400 implementation for HPOFS and UDF. It is important to understand these differences when selecting a media format when initializing your erasable optical media. It is also important if you are an application writer using either HFS or the integrated file system to store and retrieve files from optical.

Here are the major differences between the two media formats:

- Media format and media type
  - HPOFS is available on *WORM or *ERASE media types.
  - UDF is available on *DVD-RAM and *ERASE media types.
  - HPOFS is the default media format for *ERASE media type.
- Space Reclaim

  The system reuses or reclaims media space on UDF media when it deletes or updates files. The system does not reuse media space on HPOFS when it deletes

or updates files. For HPOFS on *ERASE media type, space can be reclaimed through "bulk erase" by reinitializing the volume.

- File and directory authority

  File and directory-level authority (permissions) is available on UDF volumes. This level of authority is not available for HPOFS files.

- Command support

  The system does not support several optical commands such as CPYOPT, WRKOPTDIR, and WRKOPTF when using UDF volumes. Alternatives for these include CPY, DUPOPT, and WRKLNK.

- Volume id and path names
  - HPOFS volume ids can be 32 characters long. UDF volume ids can be 30 characters long.
  - A single path element can be a maximum of 255 characters for HPOFS and 254 characters for UDF.
  - In order to use variant characters to UDF through HFS, you must use the Change Optical Attributes (CHGOPTA) CL command as follows:

    ```
    CHGOPTA ALWVRNT(*YES)
    ```
  - The system preserves file case when creating files on UDF through the integrated file system interfaces. The system always stores file names in uppercase on HPOFS and UDF volumes when creating them through HFS and Save and Restore.

- Writers to UDF files are exclusive - no sharing with writers.
- The system does not create held files for UDF files.
- Synchronous writes

  Force Buffered Data and fsync() to HPOFS will force the data to AS/400 DASD. Recovery is through a held optical file. When you issue these APIs to files on UDF volumes, the system writes the data to optical disk. In addition, when using QHFOPNSF to create or update a file that is on a UDF volume, the write-through flag in the open information must be "0" (asynchronous).

- Save and Restore

  Save and Restore multi-volume processing works differently for UDF than it does for HPOFS. See "Appendix C. Optical Save and Restore" on page 139 for more information.

- File performance

  Since UDF is a hierarchical file system, performance is directly affected by the depth of the directory tree on the volume. For best results, you should evenly distribute files across directories on the volume. With the hash directory structure on HPOFS, the depth of the directory tree has less impact on performance than it does for UDF.

Appendix A. Information for the Optical PRPQ User

This appendix provides information to current users of the Optical Library Dataserver Support/400 Programming Request for Price Quotation (PRPQ). Starting with Version 3 Release 6, optical support is integrated into OS/400, and it is no longer a PRPQ. The following topics describe the major differences you see from the PRPQ support.

CD-ROM and DVD Access

The integrated optical support allows access to the CD-ROM and DVD device through HFS, save and restore, integrated file system, and the optical commands and utilities. Accessing volumes in these stand-alone devices from an application or command is no different than accessing a WORM or erasable media. Use the volume name to direct the request to the appropriate device. CD-ROM, DVD-ROM, and DVD-RAM media appear in the utilities as one-sided optical cartridges.

You cannot use the Add and Remove Optical Cartridge commands on the stand-alone CD-ROM and DVD devices. The processing necessary to add and remove the volumes performs automatically when the media inserts and ejects from the drive.

Integrated File System and Optical Support

In Version 3 Release 6, optical support is a mounted file system within the integrated file system. You can now access CD-ROM volumes, DVD volumes, and directly-attached WORM and erasable optical volumes through these interfaces. The following interfaces are now available to optical through the integrated file system support:

- UNIX-type APIs
- Generic CL Commands
- File server interfaces

Note: You cannot access optical volumes in LAN-attached devices through the integrated file system.

Security on Volumes

You can secure optical volumes by using authorization lists. This allows access to be restricted for individual volumes. You can secure groups of volumes by using a single authorization list. Volume level security is available for all optical volumes regardless of media type, media format, or device type.

Directory and file level security is available for Universal Disk Format (UDF) formatted optical volumes. For more information on performing optical security refer to "Chapter 6. Optical Security and Auditing" on page 53.

Optical Auditing

Auditing is now available for most of the interfaces to the optical file system. Optical auditing can be enabled by setting the system values QAUDCTL to *AUDLVL and QAUDLVL to *OPTICAL. Optical auditing is "all or nothing". Either all (defined) requests are audited or none are. For more information on auditing, refer to "Chapter 6. Optical Security and Auditing" on page 53, which describes how auditing works, which requests are audited, and the format of the audit records that are created.

Sector Read

Sector read capability is available to CD-ROM, DVD, and directly-attached optical volumes through the HFS Control File System API. By specifying a starting sector and number of sectors to read, an application can easily read any sector on the media. The data returns as a stream of bytes. See "Chapter 7. Using Application Programming Interfaces for Optical Support" on page 59 for more information that is on using the Control File System API to do sector read operations.

Note: Sector read capability is not available to optical volumes in LAN-attached devices.

Display Optical Locks

A new command, Display Optical Locks (DSPOPTLCK), has been added. You can use DSPOPTLCK to obtain information about jobs currently holding locks on optical files, directories, or volumes. Also, you can use it to get information about jobs that have active optical requests in progress. You can use this command to determine the user that is holding the lock when you receive messages that indicates any of the following:

- A file is in use.
- A directory is in use.
- A or a volume is in use.

Retrieve Volume Information

You can retrieve Volume information for CD-ROM, DVD, and directly-attached optical volumes by using the HFS Control File System API. Volume information returns to an output buffer when using the RTV function. In Version 3 Release 1, this support was already available for LAN-attached optical volumes. In Version 3 Release 6, additional use extends to all optical volumes. The output data is the same format regardless of the media type. Refer to "Chapter 7. Using Application Programming Interfaces for Optical Support" on page 59 for more information on using the Control File System API to retrieve volume information.

Save and Restore

You can now perform save and restore operations on CD-ROM, DVD, and directly-attached optical media library devices. You cannot save and restore to volumes in LAN-attached devices. For more details on using save and restore support to optical volumes, refer to "Appendix C. Optical Save and Restore" on page 139.

Configuration for Optical Devices

Starting with Version 3 Release 6, you can use the OS/400 device configuration support to configure your CD-ROM and directly-attached optical devices. Starting with Version 4 Release 4, you can configure a DVD-RAM device. This includes all configuration functions such as create, vary, work with, change, and delete. In the PRPQ, the configuration commands were not part of OS/400 and found in library QOPTICAL.

Also, before Version 3 Release 6, directly-attached optical devices reported in as 2440 tape devices. All of this changed in Version 3 Release 6.

The device configuration commands are part of OS/400 and found in library QSYS. For example, the Work with Configuration Status (WRKCFGSTS) command now displays optical devices. IBM added new device types for CD-ROM, DVD, and optical media library devices. IBM refers to the CD-ROM and DVD as an optical device and displays them as device type *OPT. IBM refers to directly-attached optical media libraries as optical media library devices and displays them as device type *OPTMLB.

Note: Configuration for LAN-attached optical devices has not changed since Version 3 Release 1.

Table 9 summarizes the configuration commands to use in Version 3 Release 6 or later for optical devices.

Table 9. Optical Configuration Commands in V3R6 or later

Command	Description
CHGDEVMLB	Change Device Description (Optical library)
CHGDEVOPT	Change Device Description (CD-ROM and DVD)
CRTDEVMLB	Create Device Description (Optical library)
CRTDEVOPT	Create Device Description (CD-ROM and DVD)
DLTDEVD	Delete Device Description
VFYOPT	Verify Optical
VRYCFG	Vary Configuration
WRKCFGSTS	Work with Configuration Status

Starting and Ending Optical Support

Starting with Version 3 Release 6, the system no longer requires the Start Optical Support (STROPTSPT) and End Optical Support (ENDOPTSPT) commands. Optical support to CD-ROM and directly-attached libraries initiates once the system loads. No further action is required.

Note: Using LAN-attached optical devices still requires an additional step after an IPL. See "Chapter 4. LAN-Attached Optical Media Libraries" on page 25 for more information about LAN support.

Optical PRPQ Objects

During the installation of Version 3 Release 6 or later, most of the optical PRPQ objects were deleted, or an attempt was made to delete them. This includes:
- QOPTICAL library
- QOPTICAL user profile
- Optical textual data in QSYS2924
- QAMOSTATS in QUSRSYS
- Optical database files in QUSRSYS (these were migrated)
- All internal optical tables

In Version 3 Release 6 or later, all optical programs, commands, and textual data are in QSYS. Users of optical support no longer need to add QOPTICAL to their library list as they did with the PRPQ.

CL Command Differences

With the integration of the optical PRPQ, most of the commands were either renamed or removed. In some cases, multiple commands were combined into a single command. (This was done, for instance, with the copy commands.)

In other cases, existing OS/400 commands can now be used to perform the desired function. The Work with Configuration Status (WRKCFGSTS) command is an example.

Other commands have no equivalent function in Version 3 Release 6 because the function is no longer necessary. The Start Optical Support (STROPTSPT) command is an example of such a command.

All optical commands are shipped with a public authority of *USE except the following commands, which are shipped with a public authority of *EXCLUDE:
- Add Optical Cartridge (ADDOPTCTG)
- Add Optical Server (ADDOPTSVR)
- Reclaim Optical (RCLOPT)
- Remove Optical Cartridge (RMVOPTCTG)
- Remove Optical Server (RMVOPTSVR)

This topic describes the differences in CL command support between the optical PRPQ and the integrated optical support in Version 3 Release 6. Table 10 on page 127

page 127 lists all commands in the PRPQ, and whether or not the command exists in Version 3 Release 6 or later. If not, the system lists an alternative or replacement, if one exists. IBM provides online information regarding CL commands. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Table 10. Optical PRPQ Commands and V3R6 or Later Support for Them

Command	Description	Exists in V3R6 or Later	Replacement or Alternative
ADDOPTCTG	Add Optical Cartridge	Yes	Not applicable
CHGCTLOPT	Change Controller (Optical)	No	None
CHGDEVOPTD	Change Device (Optical Drive)	No	CHGDEVOPT
CHGDEVOPTL	Change Device (Optical Library)	No	CHGDEVMLB
CHGOPTENV	Change Optical Environment	No	CHGOPTA
CHGOPTVOLA	Change Optical Volume Attributes	No	CHGOPTVOL
CLROPTHST	Clear Optical Host	No	None
CMTOPTDIR	Commit Optical Directories	No	None
CPYFRMOPTB	Copy From Optical Backup	No	CPYOPT
CPYOPTDIR	Copy Optical Directory	No	CPYOPT
CPYOPTF	Copy Optical File	No	CPYOPT
CPYTOOPTB	Copy To Optical Backup	No	CPYOPT
CRTCTLOPT	Create Controller (Optical)	No	None
CRTDEVOPTD	Create Device (Optical Drive)	No	CRTDEVOPT
CRTDEVOPTL	Create Device (Optical Library)	No	CRTDEVMLB
CVTOPTB	Convert Optical Backup	No	CVTOPTBKU
DLTCTLOPT	Delete Controller (Optical)	No	None
DLTDEVOPT	Delete Device (Optical)	No	DLTDEVD
DLTOPTVOL	Delete Optical Volume Description	No	RMVOPTCTG
DSPCTLOPT	Display Controller (Optical)	No	None
DSPDEVOPT	Display Device (Optical)	No	DSPDEVD

Table 10. Optical PRPQ Commands and V3R6 or Later Support for Them (continued)

Command	Description	Exists in V3R6 or Later	Replacement or Alternative
DSPOPTDIRA	Display Optical Directory Attributes	No	DSPOPT
DSPOPTENV	Display Optical Environment	No	CHGOPTA
DSPOPTFA	Display Optical File Attributes	No	DSPOPT
DSPOPTFUSE	Display Optical File Use	No	WRKHLDOPTF
DSPOPTLAN	Display Optical LAN	No	DSPOPTSVR and WRKOPTVOL
DSPOPTVOLA	Display Optical Volume Attributes	No	DSPOPT
DUPOPT	Duplicate Optical Volume	Yes	Not applicable
ENDOPTLAN	End Optical LAN	No	RMVOPTSVR
ENDOPTSPT	End Optical Support	No	None
INZOPTVOL	Initialize Optical Volume	No	INZOPT
RBDOPTIDX	Rebuild Optical Index	No	RCLOPT
RLSHLDOPTF	Release Held Optical File	No	WRKHLDOPTF or QHFCTLFS
RMVOPTCTG	Remove Optical Cartridge	Yes	Not applicable
RNMOPTOBJ	Rename Optical Object	No	RNM
SAVHLDOPTF	Save Held Optical File	No	WRKHLDOPTF or QHFCTLFS
STROPTLAN	Start Optical LAN	No	ADDOPTSVR
STROPTSPT	Start Optical Support	No	None
VRYOPTCFG	Vary Optical Configuration	No	VRYCFG
WRKCTLOPT	Work with Controller (Optical)	No	None
WRKDEVOPTD	Work with Device (Optical Drv)	No	WRKCFGSTS
WRKDEVOPTL	Work with Device (Optical Lib)	No	WRKCFGSTS
WRKHLDOPTF	Work with Held Optical Files	Yes	Not applicable
WRKOPTBDIR	Work Optical Backup Directory	No	WRKOPTDIR
WRKOPTBF	Work Optical Backup Files	No	WRKOPTF
WRKOPTCFG	Work Optical Configuration	No	WRKCFGSTS
WRKOPTDIR	Work with Optical Directories	Yes	Not applicable

Command	Description	Exists in V3R6 or Later	Replacement or Alternative
WRKOPTF	Work with Optical Files	Yes	Not applicable
WRKOPTVOL	Work with Optical Volumes	Yes	Not applicable

There were also changes to the commands that were carried forward to Version 3 Release 6 or later. Table 11 lists the commands in Version 3 Release 6, or later, that existed in Version 3 Release 1, and the changes to them. IBM provides online information regarding CL Commands. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Table 11. Changes to Existing Commands

Command	Changes
ADDOPTCTG	Keyword OPTLIB was renamed to MLB. Keyword RSTATTR, NEWNAME1, NEWNAME2 were removed. Keyword AUTL was added.
DUPOPT	The maximum number of characters for NEWVOL was changed from 12 to 32.
RMVOPTCTG	Keyword VOLUME was renamed to VOL. Keyword RMVOPT was renamed to VOLOPT.
WRKHLDOPTF	Keyword VOLUME was renamed to VOL and increased from 12 characters to 32 characters. Keyword OUTPUT was removed.
WRKOPTDIR	Keyword VOLUME was renamed to VOL and increased from 12 characters to 32 characters. Keyword LISTORDER was renamed to SORT. Keyword OUTPUT was removed.
WRKOPTF	Keyword VOLUME was renamed to VOL and increased from 12 characters to 32 characters. Keyword OUTPUT was removed.
WRKOPTVOL	Keyword OPTVOL was renamed to VOL and increased from 12 characters to 32 characters. Keyword OPTLIB was renamed to DEV. Keyword CSI was added. Keyword EXTINFO was renamed to RTVENTINFO. Keyword OUTPUT was removed.

Volume Name Length

Starting with Version 3 Release 6, the maximum length of a volume name for directly-attached optical volumes has increased from 12 characters to 32 characters.

In Version 3 Release 7 the maximum length of a directory name was increased from 63 characters to 256 characters.

Volume Naming Rules

Starting with Version 3 Release 6, the volume naming rules have changed for directly-attached optical volumes. Newly initialized optical volumes can consist of alphabetic characters (A-Z), numeric characters (0-9), the hyphen (-), or the period(.). The first character must be alphabetic or numeric. This only affects newly

created volumes. The system does not support volumes that are initialized on a prior release, even if they contain characters not in the range that is mentioned above.

Copying by Using *BUFF and *NOBUFF

Prior to Version 3 Release 6, you could set the COPYTYPE parameter on the Create Controller Optical (CRTCTLOPT) command to *BUFF or *NOBUFF. This parameter was used to indicate how copy and backup functions should buffer file data during the copy. The CRTCTLOPT does not exist in Version 3 Release 6 or later, but the COPYTYPE function does. The values are specified on the Copy Optical (CPYOPT) command using the COPYTYPE parameter. The parameter can be set to *IOP (*NOBUFF) or *SYSTEM (*BUFF). The underlying function works the same, but the interface has changed.

Access to the Optical Index Database Files

Access to the Optical Index Database Files is now restricted to IBM provided programs. Non-IBM programs cannot access these files. The information in these files can be retrieved using the optical CL commands and utilities. The old versions of these database files (QMOVAR and QMOPVR) no longer exist in the integrated optical support.

Object Authority

In the PRPQ, all programs and commands were shipped with PUBLIC(*EXCLUDE) authority. In Version 3 Release 6 or later, all programs are shipped with PUBLIC(*EXCLUDE) authority, and most of the commands are shipped with PUBLIC(*USE) authority. The following commands are shipped PUBLIC(*EXCLUDE).

- Add Optical Cartridge (ADDOPTCTG)
- Remove Optical Cartridge (RMVOPTCTG)
- Add Optical Server (ADDOPTSVR)
- Remove Optical Server (RMVOPTSVR)
- Reclaim Optical (RCLOPT)

Refer to the *Security - Reference* for information on controlling access to commands.

Media Usage Statistics

The media usage statistics database (QAMOSTAT) is no longer maintained in Version 3 Release 6 or later, and is deleted during migration.

LAN Changes

Existing PRPQ users who are using LAN support should be aware of the following changes in Version 3 Release 6 or later:

- Commands no longer supported

  Version 3 Release 6 or later command changes for LAN support include the following commands that are no longer supported. Please see "CL Command Differences" on page 126 for a complete list of command changes.

- The Start Optical LAN (STROPTLAN) command is replaced by the Add Optical Server (ADDOPTSVR) command
- The End Optical LAN (ENDOPTLAN) command is replaced by the Remove Optical Server (RMVOPTSVR) command
- The Display Optical LAN (DSPOPTLAN) command is replaced by the Display Optical Server (DSPOPTSVR) command and the Work with Optical Volumes (WRKOPTVOL) command

- New and existing optical commands which now support volumes in LAN devices for Version 3 Release 6 or later.

  The following is a list of existing PRPQ commands and optical commands which apply to the volumes that are located in optical LAN devices. All command parameters might not apply to volumes that are located in optical LAN devices. IBM provides complete command descriptions through online information. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

  - Work with Optical Volumes (WRKOPTVOL)
  - Work with Optical Directories (WRKOPTDIR)
  - Work with Optical Files (WRKOPTF)
  - Change Optical Volume (CHGOPTVOL)
  - Display Optical (DSPOPT)

- Security for volumes

  Security for volumes in directly-attached and LAN-attached devices is now handled in the same manner. Secure volumes by using authorization lists that restrict volume access. You can secure groups of volumes by using a single authorization list. Refer to "Chapter 6. Optical Security and Auditing" on page 53 for more information on initiating optical security.

- HFS API changes

  Two new functions have been added to the HFS/API Control File System (QHFCTLFS):

  - Retrieve volume information
  - Retrieve directory information

  For a complete explanation of these functions, refer to "Control File System Functions for LAN-Attached Optical Devices" on page 68.

Migration From the PRPQ to RISC

The migration of the PRPQ is a multiple step process. Some things need to be done by the user prior to loading Version 3 Release 6 or later. Other migration steps are done automatically during the upgrade. The last few steps are again required by the user after the upgrade is complete. This section highlights what is (or should be) done at each of these phases. Because you are reading this, you probably already have installed Version 3 Release 6. Even so, all of the steps are listed for the sake of completeness.

What Should Be Done Prior to Installing V3R6 or later?

1. Commit optical directories

   If migrating from a V2R3 system, run the CMTOPTDIR VOL(*ALL) DIR(*ALL) command to commit any uncommitted directories.

2. Save the statistics file QAMOSTATS

   The volume statistics database is not migrated. If you want to keep the old statistics, you must save the QUSRSYS/QAMOSTAT database file and the QOPTICAL/QOPTMEDIA statistics program before the upgrade (they are otherwise deleted).

3. Process held files

   Before you upgrade a system on which the optical PRPQ is installed, you should save or release the held optical files. Any held files that exist are deleted during the upgrade.

Note: This section only applies if you are moving to V4R1 from the PRPQ support. If you are already running on V3R6 or later, this section does not apply.

What Happens to the PRPQ When V3R6 or later Is Installed?

- Configuration objects

  The PRPQ configuration objects are not migrated from the AS/400. New configuration objects are built at IPL time (if auto-configuration is on) and will be in QSYS. The new configuration objects are fully supported by the OS/400 device configuration commands.

- PRPQ objects

  All PRPQ programs, commands, and internal objects are deleted during the upgrade. This includes the QOPTICAL user profile and the library QOPTICAL.

What Should be Done After Installation?

Reclaim the optical index. Issue the RCLOPT MLB(*ALL) OPTION(*SYNC) command to synchronize the optical index files with the new configuration objects.

Appendix B. Reclaiming 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. This 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 or CD-ROM 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.

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 in optical index files at different levels within the system. These 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 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 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) command.

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 MLB(*ALL) reclaims all of the optical media libraries one at a time. Issuing separate RCLOPT commands will allow reclaims to run in parallel which will run faster.

Reclaiming 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 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 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 the following 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. See "Choosing the Reclaim Type to Use" on page 136 for more information about determining which option to use. The following topics describe the processing during each reclaim option.

*SYNC—Synchronize Volume Index with Internal Library Index

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.

The *SYNC reclaim type requires exclusive use of all libraries whose indexes are being reclaimed. Also, when using the *SYNC reclaim type, the Volume identifier and Reclaim directory index fields are not used.

*UPDATE—Update Volume Index from Optical Volumes

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.

Reclaim Optical Directory Index Option

The update option lets you reclaim the optical directory index (QAMOPVR) file. The following values are available:
- *YES indicates that the optical directory index is reclaimed for each volume whose optical volume index is reclaimed.
- *NO indicates that the optical directory index is not reclaimed for the volume.

The *UPDATE type requires exclusive use of all volumes that are being updated. If an optical media library of *ALL is specified, this reclaim type requires exclusive use of all libraries whose indexes are being reclaimed.

*RESET—Reset Internal Library Index and Reclaim Volume Index

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. The *RESET option requires the mounting of each cartridge in the optical media library at least once. 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 volume was not located after the internal library index rebuild, and that the volume status for that volume is changed to *REMOVED.

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 hours for the Reclaim Optical Index command to complete. This is 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 RCLOPT 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

Once 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 reclaim command again before the optical media library is in a usable state.

Choosing the Reclaim Type to Use

Most optical support error messages that direct you to run reclaim optical index 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.

Following are hints on when to use the different reclaim options:

*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.

*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 a 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.

Appendix C. Optical Save and Restore

Introduction

The OS/400 Save and Restore CL commands support directly-attached optical library devices, CD-ROM standalone drive devices, and DVD-RAM standalone drive devices. LAN-attached optical library devices are not supported.

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 you want backed up, and the amount of system time available for backup.

CD-ROM and DVD-RAM media are also very 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 standalone drive optical devices also support the LODRUN CL command.

Save and Restore Command Summary

Optical devices support many of the most widely used OS/400 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 AS/400 systems. **The DVD-RAM standalone drive device supports all major save/restore functions.**

Refer to "Command Restrictions" on page 144 for a list of the save and restore commands restrictions. The automated library device enhances ease of use of save and restore operations that require volume lists.

See the "Command Restrictions" on page 144 section for more information on command operation.

Refer to the *Control Language (CL)* section of the *Programming* category in the **Information Center** for detailed information on Save and Restore command syntax and functions. The URL for the **Information Center** is http://publib.boulder.ibm.com/pubs/html/as400/infocenter.html.

Operational Hints

Optical Media Formats

Save and Restore volume list processing differs by optical media format. A volume list must designate volumes of the same media format. The system does not support volume lists for CD-ROM.

You must initialize media of type Permanent WORM and CCW WORM that is used by the AS/400 directly attached IBM 3995 Optical Dataserver Library with a media format of HPOFS.

You can initialize media of type MO (Rewriteable) used by the AS/400 directly attached IBM 3995 Optical Dataserver Library with a media format of HPOFS or UDF (Universal Disk Format).

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

Organizing Save and Restore Data on Optical Devices

The save data on optical media is uniquely identified by a pathname. This pathname has the form: **/directoryname/subdirectoryname/../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 pathname may be up to two hundred and fifty-six alphanumerics in length. Optical volume names may be up to thirty-two alphanumerics in length. Some caution is necessary when employing long names. Many OS/400 save and restore displays, messages, reports, out files, and object descriptions, support a maximum of six characters for volume names, and seventeen characters for pathnames. Longer names will appear truncated in these instances. Additionally, some automated data management software may not properly handle long volume names and long pathnames.

Performing a Save Operation to Optical Storage

For example, you can save the OS/400 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.

Displaying 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 **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(/)
```

OPTFILE Parameter

The OPTFILE parameter is used in Save and Restore commands to designate the optical file pathname 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 "*". Using the default parameter value places 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 OS/400 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.

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 for optical standalone drive devices or optical library devices.

Volume List Processing

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 display using the **DSPOPT** command.

Volume list information fields:
* **Continued from Previous Volume** Flag
  – This field applies only for UDF media
  – 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 for UDF media.
  – 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 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 unrelated to the volume list on the final volume. The remaining capacity does not affect this situation. UDF format volumes will 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

– Volume ID of the first volume in a multiple volume set (a volume list). For UDF format volumes, the volume list may 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

Only one file in a multi-volume 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 will not allow additional save files to Volume3, regardless of sufficient free space.

Note: Access to any previous save data is lost from Volume1, Volume2, and Volume3.

Note: All restores must begin on Volume1.

Volume Lists with UDF Format 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 will accept 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 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.

Performing a Save Operation to DVD-RAM, UDF, and HPOFS Media

Specifying the path for your files

Optical 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 '*' 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 AS/400 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.

Using the CLEAR parameter

Specifying CLEAR(*ALL) will clear all the files on the media.

Specifying CLEAR(*AFTER) automatically clears all media after the first volumes. 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. See the *CL and APIs* section under the *Programming* category in the **Information Center** at this Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm** for more information.

Using muliple volumes

After the system writes 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. See "Volume Lists with UDF Format Media" on page 142 for more information.

Command Restrictions

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)	UDF format media (not HPOFS media)
SAVDLO of more than one ASP	UDF format media (not HPOFS media)
SAVLIB of more than one library, including LIB(*ALLUSR), LIB(*IBM), and LIB(*NONSYS)	UDF format media (not HPOFS media)
SAVCFG	UDF and HPOFS
SAVCHGOBJ of one library	UDF and HPOFS
SAVDLO of one ASP	UDF and HPOFS
SAVLIB of one library	UDF and HPOFS
SAVOBJ of one library	UDF and HPOFS
SAVSAVFDTA	UDF and HPOFS

Command	Supported by Optical Device
SAVSECDTA	UDF and HPOFS
RSTCFG	UDF and HPOFS
RSTLIB	UDF and HPOFS
RSTOBJ	UDF and HPOFS
RSTUSRPRF	UDF and HPOFS
SAVAPARDTA	Not applicable, command does not ue a device
RSTAUT	Not applicable, command does not ue a device

Operational Differences by Device Types

IBM 3995 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 volume list: volC, volB, volA.

CD-ROM Standalone Optical Drive Devices

- CD-ROM devices are **read-only** devices. The system does not support Save commands for CD-ROM devices.
- Save files can not span multiple CD-ROM volumes; that is, the system does not support CD-ROM volume lists.
- 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 may increase the save and restore times. It uses considerable processing resources which may affect the overall system performance.

Appendix D. Recovering Held Optical Files

A **held optical file** is an optical file that could not be closed normally. It 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 appendix provides information on recovering held optical files.

How Optical Files Are Manipulated

An application can manipulate optical file data by using UNIX-type APIs or the hierarchical file system (HFS) as described in the **Information Center**. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**. 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 AS/400 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 API Force Buffered Data or UNIX-Type (fsync) functions.

The following benefits are realized with this implementation:
- Simulation of read and write access to optical files
- File locking and sharing
- Byte locking and sharing
- Random processing of optical file data
- Variable-length data buffers can be written to the optical file
- Reduction of input and output to the optical disk

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 does, it allows any application that already has the file open to continue operating on it. 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 a 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. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.)

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

Recovery for Held Optical Files

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.

Saving 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 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.

Releasing a Held Optical File

You can release a held file only 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. Once 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 or without any save operation. If a successful save 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*, provided that the cause for the earlier close failure has been resolved.

Implementing 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 utility provides this means, in addition to the ability to save and release. The save and release functions are also available as optical-specific functions of the Control File System HFS API.

The Work with Held Optical Files utility 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. See "Control File System Functions to Optical Support" on page 66 for details on coding syntax.

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 afterwards.

Disabling Held Optical File Support

OS/400 is shipped with held optical file support enabled. If desired, you may disable it by using the Change Optical Attributes (CHGOPTA) CL command. When held optical file support is disabled, a held file is not created when a file has failed to archive to optical disk. When using this option, it is up to the user application to manage recovery procedures for files that failed to archive. Consider the following scenarios:

Scenario #1

Application opens an optical file for write, 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 closes successfully before the job ends. The file will not become held, and all resources (virtual optical file) associated with the held file will be freed up.

Scenario #2

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 AS/400 then loses power.

- **Held File Support Enabled**
- After the IPL of the AS/400 completes 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 AS/400 completes, 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 writes to optical storage after the file closes successfully. Force Buffered Data will force the data to AS/400 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 will still be allowed when held file support is disabled but it will have no effect.

- Synchronize File Changes IFS API (fsync)

  This API will still be 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 will be allowed, but will be treated as asynchronous write-through flag.

Use the CHGOPTA CL command to enable, disable or determine the current status of held optical file support. Once 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. IBM provided online information that describes the CHGOPTA CL command. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Recovery Examples
- An application attempts to close a file but fails because the media is corrupted. The file is now held. The user saves the file to a different optical volume and releases the file. The file is no longer held.

- A user opens a file and writes to it. Meanwhile, the optical controller is varied off. The application fails in its attempt to close. The file is now held, but the user can still use the open file handle. The user varies on the optical controller and then closes the file. The file is automatically updated with the close because a release request was **not** issued. Also, the file is no longer held because the second close attempt was successful in saving the file.

Appendix E. Output File Support Structures

This appendix 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

Following is the record format for QAMODVA:

```
  * CENTURY                   CHAR(1)
  * DATE                      CHAR(6)
  * TIME                      CHAR(6)
  * VOLUME NAME               CHAR(32)
    OPTICAL DEVICE            CHAR(10)
  * CSI                       CHAR(8)
  * CSI LIBRARY               CHAR(10)
  * 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)
    DOUBLE VOLUME MEDIUM      CHAR(1)
    DOUBLE-SIDED MEDIUM       CHAR(1)
    RESERVED                  CHAR(25)
```

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)
                 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)
```

The following constants are used in the status fields:

```
                 VOLUME LOCATION
                   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")

                 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
                   UNINITIALIZED             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(254.)
```

Output File Structure for Directory Attributes

Following is the record format for QAMODPA:

```
        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)
        RESERVED             CHAR(25)
```

Output File Structure for File Attributes

Following is the record format for QAMODFA:

```
        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)
```

Appendix F. Handling Problems That Are Related to Optical Support

This appendix describes how users can expedite solutions to optical related problems.

Common Optical Support Problems and Questions

Following are hints to help with some common problems and questions encountered with optical devices. The data is presented in a question-answer format.

When writing objects, I receive a message indicating that there is not enough optical media space available. However, the volume is not full. What's 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 you are writing to using the 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 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 backup was restarted, the complete file was rewritten.
- If the backup volume type is WORM, it might have been initialized multiple times before the backup, thus wasting some volume space.
- If you are performing an incremental backup, 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 backup this volume.
- The primary volume is a 2X media and the backup volume is 1X.

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?

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 RMVOPTCTG command and add it back in using the ADDOPTCTG command with DIR(*YES)). The internal optical index will be updated with the new path.

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?

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" on page 85 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 a CPF1F83 message 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 can't 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). From past experience I know a RCLOPT of type *RESET can take a long time. Is there a quicker way to recover?

Yes, there is! First read "Appendix B. Reclaiming the Optical Index Database" on page 133 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 directly-attached optical library by using the ADDOPTCTG command, it takes a long time. Any suggestions?

When volumes are removed using the RMVOPTCTG command, remove them with *KEEP specified in 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 modifications 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 `volume not found` message when I attempted to access it. I did not see any error messages. What went wrong?

Refer to "Chapter 2. CD-ROM and DVD on AS/400" on page 9 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. Refer to the message queue for QSYSOPR to see if the CD-ROM volume entered successfully.

I can't seem to use my optical LAN servers. What's wrong?

Check that LAN support is active using the DSPOPTSVR command. It may be that there are no LAN devices defined for the system. The ADDOPTSVR command does not run successfully if there are no devices configured and varied on.

I can use some of my LAN servers, but not all of them. What happened?

The ADDOPTSVR command has a Communications Side Information (CSI) parameter. All CSIs which are going to be used must be specified for this parameter. If some CSIs have not been specified, they are not usable until the ADDOPTSVR command is issued for them.

How do I determine if a job that is using an optical LAN volume is actually sending or receiving information from the optical LAN server?

Use the Work with Job (WRKJOB) command to display information about your job. Select option 17 to display the jobs communications status. The display shows the input and output counts for all communications that are used by that job. APPC-CPIC is the communications method that is used with optical LAN servers.

I have issued the Add Optical Server (ADDOPTSVR) command but it never completes. How do I determine what could be wrong?

Start by displaying the messages in the QSYSOPR message queue. If there is some type of communications problem, it is most likely listed here. Next, check the job log for any diagnostic or escape messages. Also, check the status of the APPC controller that defines the optical LAN server. It may be in a failed state or it could be varied off.

Handling Installation Problems of LAN Optical Media Libraries

A majority of the problems you encounter when working with a LAN-attached optical library are experienced either at installation time or are problems with the configuration. Follow the steps in the Table 12 to help debug installation and configuration problems.

Table 12. Finding and Correcting Install Problems of LAN Optical Libraries Checklist

#	Check and Test	Problem Description and Action	Action or Solution
1	Get the CSI name	Do you know the CSI name?	**Yes:** Go to #2. **No/Unsure:** Use WRKCSI to view all CSIs. If no CSIs are found, either you need to add the library containing the CSIs, or you need to configure your AS/400 communications.
2	Is LAN Software operational?	From the command line (CALL QCMD) enter ADDOPTSVR, type the name(s) of the CSI, and press enter.	The message `ADDOPTSVR completed successfully` appears: Go to #3. The message `ADDOPTSVR completed successfully` appears along with the message `Target program not available. Not allowed to try again`. Go to #12. The message `ADDOPTSVR did not complete successfully` appears: Go to #4. The message CPF9801, `Object XXXXXX in library *LIBL not found` appears: Go to #5. The machine appears to hang: Go to #6.
3	Confirm ADDOPTSVR Operation	Enter WRKOPTVOL CSI(*ALL) and see if volumes are present.	**Volumes are Present:** LAN appears to be working correctly. **No Volumes Present from one or all servers:** The AS/400 software is installed correctly. The problem lies in either the AS/400 dataserver communications or the PC-controller software installation or configuration. Check for messages in the QSYSOPR message queue on the AS/400 to further isolate the problem.
4	Investigate why the ADDOPTSVR command failed	Press F10 to include detailed messages.	**Controller/Device Related Error:** Check the AS/400 communications setup (#7). **Other:** Contact your next level of support.
5	CSI missing	The CSI selected in the ADDOPTSVR command was not found. Use the WRKCSI command to display a list of available CSIs. Make sure the CSI library is in the library list.	Correct CSI and retry #2.
6	Job hangs	Display the system operator messages.	If message `Controller XXXXXX not replying. Remote system or configuration problem` appears, enter C to cancel the message. Either the server is down, or communications has not been properly configured. Go to #7.

Table 12. Finding and Correcting Install Problems of LAN Optical Libraries Checklist (continued)

#	Check and Test	Problem Description and Action	Action or Solution
7	PC Communications started?	On the PC controller, select the CM/2 icon and then select the Subsystem Management icon. Press F5 to refresh the screen. Verify that the APPC Attach Manager, Communications Manager Kernel, and SNA Subsystem all indicate started.	**Started:** Go to #8. **Not started:** Select "Start communications" in the CM/2 window and verify that all three items are started (this might take a minute). If the items are not started, there is a problem with the PC. Recheck the setup of the PC.
8	Perform Simple Communication	Enter WRKCFGSTS *CTL. Find the controller and device description and vary them both off. Perform a vary-on reset operation for both.	**Controller & Device become active:** Go to #11. **Controller & Device become Vary-on Pending:** Go to #9. **Controller or device will not vary-on.** There is a problem with the AS/400 device, controller, or line description. Recheck your AS/400 setup.
9	Check Line Status	Enter WRKCFGSTS *LIN. Verify that the line is in a vary on pending or active state.	**Line vary on pending or active:** Go to #10. **Line varied off:** Vary on the line and go back to #8.
10	Double-Check PC Information	Display the file C:\IBMCOM\LANTRAN.LOG on the PC. Check for error messages, verify LAN speed, and that the address matches the LAN remote adapter address for the controller (using the DSPCTLD command on AS/400).	**Information is correct:** The controller and device should become active. There is a problem with the AS/400 controller, device, line description, or the connection itself. Recheck the setup. **Information is incorrect:** Correct the problem and retry communications.
11	Check Volumes Present	Verify that volumes are present using the dynamic console's display volume information on the server, or on a 3431, by doing a directory of the disk.	**Volumes Are Present:** Go to #2. **No Volumes Present:** A volume is necessary to perform the rest of this test. Add a volume before continuing. Go to #2.
12	Check Transaction Program	On the PC-controller, select the CM/2 icon, then select the Subsystem Management icon, and then double click on the Display active Configuration line. Select the display menu, then the general SNA sub-menu, followed by the Transaction Definition menu. Confirm that there is a definition for the HFSSRV program and that the parameters are the drive letter for the server, followed by a D for a 3431 device or a L for anything else.	**Configuration Correct:** Go to #13. **Configuration Not Correct:** The transaction program has not been correctly defined in the communications manager. The problem lies in the transaction program definition.
13	Check AS/400 Transaction Program Definition	Display the CSI information using the WRKCSI command. Confirm that the transaction program selected is HFSSRV.	**Transaction Program Correct:** Verify information from #14. The problem is that somehow the transaction program cannot be reached. Otherwise, the system appears to be working correctly. **Transaction Program Not Correct:** Correct the transaction program and retry this step.

Follow the steps in Table 13 to help debug configuration or installation software problems encountered on the controller for LAN-attached libraries.

PC-Controller Software Installation/Configuration Problems

Table 13. PC-Controller Software Installation/Configuration Problems Checklist

#	Check or Test	Problem Description and Action	Action or Solution
1	Does the system start?	Does the PC start into OS/2?	**Yes:** Go to #3. **Stops After Memory Test and Displays Two Numbers:** Restart with the installation diskette and run the auto-configuration program. After the auto-configuration program has completed, restart again and go into the set configuration menu. Verify that the token ring speed is set correctly. Go into the set SCSI menu and set the presence-error reporting to disabled. If the machine still will not start contact your next level of support. **Starts to Come Up, but has Problems Loading Device Drivers or OS/2:** Go to #2.
2	How much memory does the PC have?	Does the PC have 12 Meg or more of memory?	**Yes:** The machine has a problem outside the scope of this document. Contact your next level of support. **NO:** 12 Meg of memory is needed to properly run the dataserver and communications programs.
3	Is the software installed?	Is the HPOFS and HFSSRV software installed?	**Yes:** Go to #4. **No:** Install the software diskette that came with the dataserver and follow the included instructions. **Unsure:** Verify that the PC-controller software is installed.
4	Type of library	Is the controller connected to a 3431 stand-alone, an A22 or A23, or a 022 or 023?	**3431 type stand-alone:** Go to #5. **A22 or A23:** Go to #8. **022 or 023:** Go to #8.
5	3431 Debug	Insert a formatted cartridge in the drive, open an OS/2 window and type DIR D:\. Does the drive light come on and the directory get displayed?	**Yes:** Go to #6. **No:** There is a problem with HPOFS. Re-install HPOFS according to the installation instructions.
6	Check HFSSRV Setup	On the PC-controller, select the CM/2 icon, then select the Subsystem Management icon, and then double click on the Display active Configuration line. Select the display menu, then the general SNA sub-menu, followed by the Transaction Definition menu. Confirm that there is a definition for the HFSSRV program and that the parameters are the drive letter for the server, followed by a D.	**Configuration Correct:** Record the HFSSRV path and go to #7. **No Definition Found:** CM/2 has not been started or been configured for the transaction program. **Configuration Not Correct:** The transaction program has not been correctly defined in the communications manager. The problem lies in the transaction program definition.

#	Check or Test	Problem Description and Action	Action or Solution
7	Check HFSSRV Operation	Open an OS/2 window and type the path recorded in the previous step. Does the version number display?	**Yes:** The 3431 software appears to be installed correctly. If the problems persist, verify the AS/400 and PC communications, or contact your next level of support. **No:** HFSSRV is incorrectly installed.
8	A22 - A23 - 022 - 023 Debug	On the PC-controller, is the dynamic console window open? If so, select the dynamic console program. Otherwise, click both mouse buttons simultaneously and see if the dynamic console program appears in the window list. If so, select the dynamic console program. Otherwise, see if there is an IBM Optical Library Dataserver icon. If so, select that.	**Dynamic Console Program Started:** Go to #9. **Dynamic Console Program Not Started:** The dataserver software has not been correctly installed. Re-install the software. If the problem persists, contact your next level of support.
9	Dynamic console verify	Does the dynamic console window show a white box under the auto-changer and drive icons?	**Yes:** The PC-controller software appears to be installed correctly. If problems persist, refer to the corresponding service manual or contact your next level of support. **No:** The dataserver is not functioning. Check the power on the dataserver and the connecting cables. Refer to the corresponding maintenance manual for further debugging, or contact your next level of support.

Collecting Information

Once you have determined that the next level of support must be called, having the following information ready will help speed up the problem analysis process.

- Detailed description of problem, including:
    1. Applications that are running.
    2. Is this a new installation or has the system or application been running?
    3. Is the problem reproducible?
- Type and model number of the dataservers
- Current PTF level
- How many dataservers
- How many volumes
- If LAN, then:
    1. Token ring or Ethernet
    2. LAN speed
    3. How many AS/400 systems are attached

Other System Commands

Other system commands to be familiar with to gather pertinent information include:

- 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.

- The 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.

IBM provides online information on each of the above commands. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Appendix G. Programming Examples

This appendix provides examples of using various interfaces to optical support. Although the examples are basic, they demonstrate the structures and steps necessary to use various APIs in different environments.

The examples demonstrate the following interfaces and environments:
- HFS programming examples using Integrated Language Environment® (ILE) RPG for OS/400
- Integrated file system programming example using Integrated Language Environment (ILE) C for OS/400
- Optical tools using OS/400 commands and CL programs

HFS API Program Examples Using ILE RPG for OS/400

This topic demonstrates how the HFS API can be used with the ILE RPG for OS/400 programming language.

The programming examples demonstrate the following functions:
- Retrieving a path name from an array
- Calling the HFS API to open a stream file
- Calling the HFS API to write a 256-byte buffer passed to the program as a parameter
- Calling the HFS API to close the stream file

IBM provides online information for HFS APIs. Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site - **http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm**.

Getting a Path and Calling Subroutines

```
E                   AR    1   5 36

C        *ENTRY        PLIST
* 2 PARAMETERS - A DATA BUFFER ID AND AN INDEX TO THE ARRAY
C                      PARM          DATAIN   256
C                      PARM          IDX         10
* MOVE THE ARRAY ELEMENT TO A FIELD CALLED "PATH"
C                      MOVE AR,IDX   PATH
* EXECUTE SUBROUTINES TO OPEN, WRITE AND CLOSE A FILE
C                      EXSR OPNSF
C        RTCD          IFEQ 0
C                      EXSR WRTSF
C                      EXSR CLOSF
C                      END
C                      SETON                    LR

* TABLE/ARRAY . . . . . . . . :   AR
**
/QOPT/MYVOL1/DIRA/FILE
/QOPT/MYVOL1/DIRA/SUBDIRB/FILE
/QOPT/MYVOL1/DIRA/SUBDIRB/C/FILE
/QOPT/MYVOL1/DIRA/SUBDIRB/C/D/FILE
/QOPT/MYVOL1/DIRA/SUBDIRB/C/D/E/FILE
```

Defining Data Structures for Opening Files

```
* PATH LENGTH PARAMETER
IPATHLN     DS
I                                   B   1     40PATHL
* OPEN INFORMATION PARAMETER
IOPNINF     DS
I                                       1    1 EXISTS
I                                       2    2 NOTTHR
I                                       3    3 SYNASY
I                                       4    4 RSV1
I                                       5    5 SHAREM
I                                       6    6 ACCESS
I                                       7    7 OTYPE
I                                       8   10 RSV3
* ATTRIBUTE LENGTH PARAMETER
IATTRLN     DS
I                                   B   1     40ATTRL
* RETURN CODE PARAMETER
IRETCD      DS
I                                   B   1     40RCLEN
I                                   B   5     80RTCD
I                                       9   15 CONDTN
I                                      16   16 RSV
I                                      17  272 MSG
* BYTES TO READ/WRITE PARAMETER
IBYTRDW     DS                      B   1     40BYT2RW

* BYTES ACTUALLY READ/WRITTEN PARAMETER
IBYTACT     DS                      B   1     40BYTARW
```

Opening an Optical File

```
* PARAMETER LIST FOR QHFOPNSF CALL
C           POPNSF   PLIST
C                    PARM           FHDLE  16
C                    PARM           PATH   36
C                    PARM           PATHL
C                    PARM           OPNINF
C                    PARM           ATRTBL 1
C                    PARM           ATTRLN
C                    PARM           ACTION 1
C                    PARM           RETCD


C* OPEN FILE SUBROUTINE
C           OPNSF    BEGSR
C* FILL IN THE PATH AND ATTRIBUTE LENGTHS
C                    Z-ADD36        PATHL           SET PATH LEN=36
C                    Z-ADD*ZEROS    ATTRL           ZERO ATTRIBUTE LNGTH
C* FILL IN THE OPNINF PARAMETER
C                    MOVE '0'       EXISTS 1        FAIL IF EXISTS
C                    MOVE '1'       NOTTHR 1        CREATE IF NOT THERE
C                    MOVE '0'       SYNASY 1        ASYNCHRONOUS
C                    MOVE *BLANKS   RSV1   1
C                    MOVE '1'       SHAREM 1        DENY NONE
C                    MOVE '2'       ACCESS 1        READ/WRITE
C                    MOVE '0'       OTYPE  1        NORMAL
C                    MOVE *BLANKS   RSV3   3
C* CALL THE API TO OPEN THE STREAM FILE
C                    CALL 'QHFOPNSF'POPNSF          50
C           OPNEND   ENDSR
```

Writing a File to an Optical Disk

```
* PARAMETER LIST FOR QHFRDSF OR QHFWRTSF CALL
C           PRWSF    PLIST
C                    PARM           FHDLE   16
```

```
C                    PARM           DATAIN
C                    PARM           BYT2RW
C                    PARM           BYTARW
C                    PARM           RETCD

C* CALL API TO WRITE TO THE FILE
C          WRTSF     BEGSR
C                    Z-ADD256       BYT2RW            SET WRITE LENGTH=256
C                    CALL 'QHFWRTSF'PRWSF           50
C          WRTEND    ENDSR
```

Closing an Optical File

```
* PARAMETER LIST FOR QHFCLOSF CALL
C          PCLOSF    PLIST
C                    PARM           FHDLE   16
C                    PARM           RETCD

C* CALL API TO CLOSE THE FILE
C          CLOSF     BEGSR
C                    CALL 'QHFCLOSF'PCLOSF          50
C          CLSEND    ENDSR
C* END OF SAMPLE RPG CALL TO THE HFS API
```

Integrated File System Program Examples Using ILE C for OS/400

This topic demonstrates the use of the integrated file system UNIX-type APIs that pertain to the QOPT physical file system and are used with the ILE C for OS/400 programming language.

The programming examples demonstrate the following functions:
- Retrieving optical directory entries
- Creating an optical file
- Writing a file
- Closing a file
- Opening a file
- Reading a file
- Changing the offset into a file

IBM provided online information for the "UNIX-Type APIs". Refer to the *CL and APIs* section that is found in the *Programming* category of the **Information Center** at the following Web site -
http://publib.boulder.ibm.com/pubs/html/as400/infocenter.htm.

Integrated File System Function Examples

```
/********************************************************************/
/*                                                                  */
/* This program demonstrates the use of various integrated file     */
/* system functions applied to the QOPT physical file system        */
/* including:                                                        */
/*    chdir()    - change current directory                         */
/*    close()    - close file                                       */
/*    closedir() - close directory                                  */
/*    creat()    - create file                                      */
/*    lseek()    - seek file (change file offset)                   */
/*    open()     - open file                                        */
/*    opendir()  - open directory                                   */
/*    read()     - read file                                        */
/*    readdir()  - read directory entry                             */
```

```
/*    rewinddir() - rewind directory entries                        */
/*    stat()      - directory statistics                            */
/*    write()     - write file                                      */
/*                                                                  */
/********************************************************************/
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <dirent.h>
#include <sys/stat.h>
#include <fcntl.h>

void main (void)
{
    /********************************************************************/
    /* local variables, contents and defines                         */
    /********************************************************************/
    char path[294];                      /* optical path            */
    DIR *dirP;                           /* pointer to the directory */
    int filedes;                         /* open file descriptor    */
    struct dirent *direntP;              /* directory entry structure */
    struct stat info;                    /* dir/file information    */
    int volume_number;                   /* what it says...         */
    int rc = 0;                          /* function return codes   */
    int kk = 0;                          /* local counter           */
    char data[] = "The quick red fox jumped over the fence";

    /********************************************************************/
    /* Retrieve the list of volumes from the QOPT physical file      */
    /* system by opening the QOPT pfs root directory and reading the */
    /* directory entries.                                            */
    /********************************************************************/
    memset(path,                         /* clear path name         */
    0x00,
    sizeof(path));
    strcpy(path,                         /* set physical file system */
    "/QOPT");
    rc = stat("/QOPT", &info);;          /* determine number of files */
    if (rc != 0)
    perror("stat() failed:");

    dirP = opendir(path);                /* open the directory       */
    if (dirP == NULL)
    perror("opendir() failed:");

    for (kk = 1; kk <= info.st_nlink; kk++)
    {
    direntP = readdir(dirP);
    if (direntP == NULL)
    perror("readdir() failed:");
    printf("%d) %s\n", kk, direntP->d_name);
    }

    /********************************************************************/
    /* Prompt user for the volume they want to work with and make it */
    /* the current directory.                                        */
    /********************************************************************/
    printf("\nEnter the number the volume you want to work with:\n");
    scanf("%d", &volume_number);;

    rewinddir(dirP);                     /* beginning of directory   */
    for (kk = 1; kk <= volume_number; kk++)
    direntP = readdir(dirP);     /* get requested dir. entry   */

    strcat(path, "/");
    strcat(path, direntP->d_name);
    rc = chdir(path);                    /* set current working dir.  */
```

```c
if (rc != 0)
perror("chdir() failed:");
if (getcwd(path, sizeof(path)) == NULL)
perror("getcwd() failed:");
printf("\nThe current working directory is:  %s\n", path);

rc = closedir(dirP);                 /* close the directory        */
if (rc != 0)
perror("closedir() failed:");

/*****************************************************************/
/* Create and open a file write only.  If the file exists it     */
/* will be truncated.  The owner will have read, write, and      */
/* execute authority to the file.                                */
/*****************************************************************/
strcat(path, "/");
printf("\nEnter a file name:\n");
scanf("%s", &path[strlen(path)]);

filedes = creat(path, S_IRWXU);
if (filedes == -1)
{
perror("creat() failed");
return;
}

rc = write(filedes, data, sizeof(data));
if (rc == -1)
perror("write() failed:");

close(filedes);

/*****************************************************************/
/* Read back the file and print it.                             */
/*****************************************************************/
memset(data, 0x00, sizeof(data));
filedes = open(path, O_RDWR);
if (filedes == -1)
{
perror("open() failed");
return;
}

read(filedes, data, sizeof(data));
if (filedes == -1)
{
perror("read() failed");
return;
}
printf("\nThe data written to file is:  %s\n", data);

/*****************************************************************/
/* Change the offset into the file and change part of it.  Read */
/* the entire file, print it out and close the file.            */
/*****************************************************************/
lseek(filedes, 4, SEEK_SET);
rc = write(filedes, "slow old ", 9);
if (rc == -1)
{
perror("write() failed");
return;
}
lseek(filedes, 18, SEEK_SET);
rc = write(filedes, "went under ", 11);
if (rc == -1)
{
perror("write() failed");
```

```
        return;
        }

        lseek(filedes, 0, SEEK_SET);
        read(filedes, data, sizeof(data));
        if (filedes == -1)
        {
        perror("read() failed");
        return;
        }
        printf("\nThe data now is:  %s\n", data);

        close(filedes);

        printf("Done...\n");
        return;

    }
```

Optical Tools

This topic contains examples of four CL tools that may be used to move spooled files and database members to and from optical storage:

- Copy stream file
- Copy database to optical
- Copy spooled file to optical
- Copy optical to database

Copy Stream File

Command Source

```
/*******************************************************************/
/*                                                                 */
/* COMMAND NAME:   CPYSTRF                                          */
/*                                                                 */
/* COMMAND TITLE:  Copy stream file                                */
/*                                                                 */
/* COMMAND DESCRIPTION: Copy stream file between two file systems   */
/*                                                                 */
/*******************************************************************/
        CMD   PROMPT('Copy Stream File')

        PARM      KWD(SRCFILE) TYPE(*CHAR) LEN(300) MIN(1) +
                  MAX(1) PROMPT('Source file name')        +
                  VARY(*YES)

        PARM      KWD(TGTFILE) TYPE(*CHAR) LEN(300) MIN(1) +
                  MAX(1) PROMPT('Target file name')        +
                  VARY(*YES)

        PARM      KWD(RPLFILE) TYPE(*CHAR) LEN(6) DFT(*NO) +
                  SPCVAL((*NO '0     ') (*YES '1     '))  +
                  PROMPT('Replace existing file')
```

CL Program Source

```
/*****************************************************************/
/*                                                               */
/*  PROGRAM:  CPYSTRF (Copy stream file)                         */
/*                                                               */
/*                                                               */
/*  DESCRIPTION:                                                 */
/*  This is the CL program for sample CL command CPYSTRF.  This   */
```

```
/*  program can be used to copy stream files between file          */
/*  systems.  The actual copy is done by making a call to          */
/*  the HFS API program QHFCPYSF (Copy stream file).               */
/*                                                                 */
/*                                                                 */
/*  INPUT PARAMETERS:                                              */
/*  - Complete source path                                         */
/*    Example: /filesystem/directory1/directoryx/file              */
/*             /QDLS/DIRA/DIRB/FILE01                              */
/*                  - or -                                         */
/*             /filesystem/volume/directory1/directoryx/file       */
/*             /QOPT/VOLN01/DIRA/DIRB/FILE01                       */
/*  - Complete target path                                         */
/*    Note:  Except for the file the path must already exist.      */
/*    Example: /filesystem/directory1/directoryx/file              */
/*             /QDLS/DIRA/DIRB/FILE01                              */
/*                  - or -                                         */
/*             /filesystem/volume/directory1/directoryx/file       */
/*             /QOPT/VOLN01/DIRA/DIRB/FILE01                       */
/*  - Replace existing target file                                 */
/*    *YES - replace existing file                                 */
/*    *NO  - do not replace existing file                          */
/*                                                                 */
/*                                                                 */
/*  LOGIC:                                                         */
/*  - Separate source file length and value                        */
/*  - Ensure source path is converted to upper case                */
/*  - Separate target file length and value                        */
/*  - Ensure target path is converted to upper case                */
/*  - Call copy stream file                                        */
/*                                                                 */
/*                                                                 */
/*  EXAMPLE:                                                       */
/*  The example will copy document THISWEEK from folder BILLS      */
/*  to optical volume YEAR1993.  The document will be put into     */
/*  directory /BILLS/DEC as file WEEK50.                           */
/*  Folders are stored in file system DLS (document library services)*/
/*                                                                 */
/*       CPYSTRF SRCFILE('/QDLS/BILLS/THISWEEK')                   */
/*               TGTFILE('/QOPT/YEAR1993/BILLS/DEC/WEEK50')        */
/*               RPLFILE(*NO)                                      */
/*                                                                 */
/*****************************************************************/

PGM  PARM(&SRCFILE &TGFILE &CPYINFO);

    /*************************************************************/
    /* Input parameters                                          */
    /*************************************************************/
    DCL  VAR(&SRCFILE);      TYPE(*CHAR)   LEN(300)
    DCL  VAR(&TGTFILE);      TYPE(*CHAR)   LEN(300)
    DCL  VAR(&CPYINFO);      TYPE(*CHAR)   LEN(6)

    /*************************************************************/
    /* Program variables                                         */
    /*************************************************************/
    DCL  VAR(&SRCLEN);       TYPE(*CHAR)   LEN(4)            +
                                   VALUE(X'00000000')
    DCL  VAR(&TGTLEN);       TYPE(*CHAR)   LEN(4)            +
                                   VALUE(X'00000000')
    DCL  VAR(&ERRCODE);      TYPE(*CHAR)   LEN(4)            +
                                   VALUE(X'00000000')
    DCL  VAR(&COUNT);        TYPE(*DEC)    LEN(5 0)
    DCL  VAR(&TBL);          TYPE(*CHAR)   LEN(10)           +
                                   VALUE('QSYSTRNTBL')
    DCL  VAR(&LIB);          TYPE(*CHAR)   LEN(10)           +
                                   VALUE('QSYS      ')
```

```
/****************************************************************/
/* Monitor for any messages sent to this program               */
/****************************************************************/
MONMSG     MSGID(CPF0000) EXEC(GOTO CMDLBL(DONE))
MONMSG     MSGID(OPT0000) EXEC(GOTO CMDLBL(DONE))


/****************************************************************/
/* The HFS API needs to be passed the file and the file length. */
/* By coding the VARY(*YES) parameter on the command definition */
/* for the source and target file we are passed the length of   */
/* entered value as a 2 byte binary field which precedes the    */
/* actual value entered.                                        */
/****************************************************************/

/****************************************************************/
/* Separate source file length and file value.  Ensure source   */
/* file is upper case.                                          */
/****************************************************************/
CHGVAR VAR(%SST(&SRCLEN 3 2)) VALUE(%SST(&SRCFILE 1 2))
CHGVAR VAR(%SST(&SRCFILE 1 300)) VALUE(%SST(&SRCFILE 3 298))

CHGVAR VAR(&COUNT); VALUE(%BIN(&SRCLEN 3 2))
CALL   QDCXLATE (&COUNT        +
                 &SRCFILE      +
                 &TBL          +
                 &LIB)

/****************************************************************/
/* Separate target file length and file value.  Ensure target   */
/* file is upper case.                                          */
/****************************************************************/
CHGVAR VAR(%SST(&TGTLEN 3 2)) VALUE(%SST(&TGTFILE 1 2))
CHGVAR VAR(%SST(&TGTFILE 1 300)) VALUE(%SST(&TGTFILE 3 298))

CHGVAR VAR(&COUNT); VALUE(%BIN(&TGTLEN 3 2))
CALL   QDCXLATE (&COUNT        +
                 &TGTFILE      +
                 &TBL          +
                 &LIB)

/****************************************************************/
/* Call the copy stream file HFS API to copy the source file to */
/* the target file.                                            */
/****************************************************************/
CALL   QHFCPYSF (&SRCFILE      +
                 &SRCLEN       +
                 &CPYINFO      +
                 &TGTFILE      +
                 &TGTLEN       +
                 &ERRCODE)

SNDPGMMSG MSG('CPYSTRF completed successfully')
RETURN

DONE:
SNDPGMMSG  MSGID(OPT0125) MSGF(QSYS/QCPFMSG)          +
           MSGDTA(CPYSTRF) MSGTYPE(*ESCAPE)
RETURN

ENDPGM
```

Copy Database File to Optical File

CL Command Source

```
/*******************************************************************/
/*                                                                 */
/* COMMAND NAME:   CPYDBOPT                                        */
/*                                                                 */
/* COMMAND TITLE:  Copy database to optical                       */
/*                                                                 */
/* DESCRIPTION:    Copy database file to an optical file          */
/*                                                                 */
/*******************************************************************/
CPYDBOPT:   CMD        PROMPT('Copy DB to Optical')

            PARM       KWD(FRMFILE) TYPE(QUAL1) MIN(1)      +
                       PROMPT('From file')

            PARM       KWD(FRMMBR) TYPE(*NAME)  LEN(10)     +
                       SPCVAL((*FIRST)) EXPR(*YES) MIN(1)   +
                       PROMPT('From member')

            PARM       KWD(TGTFILE) TYPE(*CHAR)  LEN(300)   +
                       MIN(1)  EXPR(*YES)                   +
                       PROMPT('Target file')

QUAL1:      QUAL       TYPE(*NAME) LEN(10)
            QUAL       TYPE(*NAME) LEN(10) DFT(*LIBL)       +
                       SPCVAL((*LIBL) (*CURLIB))            +
                       PROMPT('Library')
```

CL Program Source

```
/*******************************************************************/
/*                                                                 */
/*  PROGRAM:  CPYDBOPT (Copy database to Optical)                 */
/*                                                                 */
/*                                                                 */
/*  DESCRIPTION:                                                   */
/*  This is the CL program for sample CL command CPYDBOPT.  This  */
/*  program can be used to copy a member from a database file to  */
/*  optical storage.                                              */
/*                                                                 */
/*                                                                 */
/*  DEPENDENCIES:                                                  */
/*  - The sample command and program CPYSTRF exists.             */
/*  - There is an existing folder named OPTICAL.FLR              */
/*    This folder is used for temporary storage when copying     */
/*    from database to optical.  It is assumed that this folder is */
/*    empty and that the user will delete anything which gets     */
/*    copied into it.                                             */
/*                                                                 */
/*                                                                 */
/*  INPUT PARAMETERS:                                             */
/*  - From file                                                   */
/*  - From member                                                 */
/*  - Complete target path                                        */
/*     Assumption: - Except for the file the complete path currently */
/*                   exists.                                       */
/*                 - File does not currently exist.               */
/*     Example: /filesystem/volume/directory1/directoryx/file     */
/*              /QOPT/VOLN01/DIRA/DIRB/FILE01                     */
/*                                                                 */
/*                                                                 */
/*  LOGIC:                                                         */
/*  - Separate file and library                                   */
/*  - Copy file to folder                                         */
/*  - Build source file                                           */
```

```
/* - Copy file from Document Library Service (DLS) to OPT     */
/*                                                             */
/*                                                             */
/*  EXAMPLE:                                                   */
/*  The example will copy member MYMEMBER in file MYFILE in library */
/*  MYLIB to optical storage.  It will be stored as file       */
/*  MYFILE.MYMEMBER in directory /MYLIB on volume VOLN01.       */
/*                                                             */
/*       CPYDBOPT FRMFILE(MYLIB/MYFILE)                         */
/*                FRMMBR(MYMEMBER)                              */
/*                TGTFILE('/QOPT/VOLN01/MYLIB/MYFILE.MYMEMBER') */
/*                                                             */
/******************************************************************/

PGM  PARM(&FROMFILE &FROMMBR &TGTFILE);

    /****************************************************************/
    /* Input parameters                                            */
    /****************************************************************/
    DCL   VAR(&FROMFILE);     TYPE(*CHAR)    LEN(20)
    DCL   VAR(&FROMMBAR);      TYPE(*CHAR)   LEN(10)
    DCL   VAR(&TGTFILE);      TYPE(*CHAR)    LEN(300)


    /****************************************************************/
    /* Program variables                                           */
    /****************************************************************/
    DCL   VAR(&FILE);        TYPE(*CHAR)    LEN(10)
    DCL   VAR(&LIB);         TYPE(*CHAR)    LEN(10)
    DCL   VAR(&SRCFILE);     TYPE(*CHAR)    LEN(28)              +
    VALUE('/QDLS/OPTICAL.FLR/xxxxxxxxxx')


    /****************************************************************/
    /* Monitor for all messages sent to this program              */
    /****************************************************************/
    MONMSG     MSGID(CPF0000) EXEC(GOTO CMDLBL(DONE))
    MONMSG     MSGID(IWS0000) EXEC(GOTO CMDLBL(DONE))
    MONMSG     MSGID(OPT0000) EXEC(GOTO CMDLBL(DONE))


    /****************************************************************/
    /* Separate file and library names then copy the DB file to a */
    /* PC folder.                                                  */
    /****************************************************************/
    CHGVAR VAR(&FILE); VALUE(%SST(&FROMFILE 1 10))
    CHGVAR VAR(&LIB);  VALUE(%SST(&FROMFILE 11 10))

    CPYTOPCD FROMFILE(&LIB/&FILE);                          +
            TOFLR(OPTICAL.FLR)                              +
            FROMMBR(&FROMMBR);                              +
            TRNTBL(*NONE)


    /****************************************************************/
    /* Complete the source file path name with the member and copy */
    /* the stream file from DLS to optical                         */
    /****************************************************************/
    CHGVAR VAR(%SST(&SRCFILE 19 10)) VALUE(&FROMMBR);

    CPYSTRF  SRCFILE(&SRCFILE);                             +
            TGTFILE(&TGTFILE);

    SNDPGMMSG MSG('CPYDBOPT completed successfully')
    RETURN

DONE:
    SNDPGMMSG  MSGID(OPT0125) MSGF(QSYS/QCPFMSG) +
```

```
                      MSGDTA(CPYDBOPT) MSGTYPE(*ESCAPE)
             RETURN

         ENDPGM
```

Copy Spooled File to Optical

CL Command Source

```
/*******************************************************************/
/*                                                                 */
/* COMMAND NAME:   CPYSPLFOPT                                      */
/*                                                                 */
/* COMMAND TITLE:  Copy spooled file to optical                   */
/*                                                                 */
/* DESCRIPTION:    Copy spooled file to an optical file           */
/*                                                                 */
/*******************************************************************/
CPYSPLFO:   CMD         PROMPT('Copy Spooled File to Optical')

            PARM        KWD(FRMFILE) TYPE(*NAME) LEN(10)     +
                        MIN(1)                               +
                        PROMPT('From file')

            PARM        KWD(TGTFILE) TYPE(*CHAR)  LEN(300)   +
                        MIN(1)   EXPR(*YES)                  +
                        PROMPT('Target file')

            PARM        KWD(JOB) TYPE(Q2)                    +
                        DFT(*) SNGVAL(*)                     +
                        MIN(0) MAX(1)                        +
                        PROMPT('Jobname')

            PARM        KWD(SPLNBR) TYPE(*CHAR) LEN(5)       +
                        SPCVAL((*ONLY) (*LAST)) DFT(*ONLY)   +
                        PROMPT('Spool number')

Q2:         QUAL        TYPE(*NAME) LEN(10)                  +
                        MIN(1)                               +
                        EXPR(*YES)
            QUAL        TYPE(*NAME) LEN(10)                  +
                        EXPR(*YES)                           +
                        PROMPT('User')
            QUAL        TYPE(*CHAR) LEN(6)                   +
                        RANGE(000000 999999)                 +
                        EXPR(*YES) FULL(*YES)                +
                        PROMPT('Number')
```

CL Program Source

```
/*******************************************************************/
/*                                                                 */
/*  PROGRAM:  CPYSPLFOPT (Copy Spooled File to Optical)           */
/*                                                                 */
/*                                                                 */
/*  DESCRIPTION:                                                   */
/*  This is the CL program for sample CL command CPYSPLFOPT.  This */
/*  program can be used to copy a spooled file to optical storage. */
/*                                                                 */
/*                                                                 */
/*  DEPENDENCIES:                                                  */
/*  - The sample command and program CPYDBOPT exists.             */
/*  - The sample command and program CPYSTRF exists.             */
/*  - There is an existing folder named OPTICAL.FLR               */
/*    This folder is used for temporary storage when copying      */
/*    from spooled files to optical.  It is assumed that this folder */
/*    is empty and that the user will delete anything which gets   */
```

```
/*    copied into it.                                                 */
/* - This CL program uses the CL command CPYSPLF to copy the          */
/*   spooled files to a physical file before copying them to          */
/*   optical.  When you use the CPYSPLF command to copy               */
/*   a spooled file to a physical file, certain information can       */
/*   be lost or changed.  Before using this command please            */
/*   refer to the CL Reference Book for the limitations and           */
/*   restrictions of the CPYSPLF command.                             */
/* - There is an existing file named LISTINGS in library QUSRSYS.     */
/*   It is assumed that this file contains no existing members        */
/*   and that any members that are created will be deleted by the     */
/*   user.  The record length of the file is 133.                     */
/*                                                                    */
/*                                                                    */
/*   INPUT PARAMETERS:                                                */
/* - From file                                                        */
/*   Specify the name of the spooled file to be copied.              */
/* - Target file                                                      */
/*   Assumption: Except for the file the path must already exist.    */
/*   Example: /filesystem/volume/directory1/directoryx/file          */
/*            /QOPT/VOLN01/DIRA/DIRB/FILE01                           */
/* - Job                                                              */
/*   Specify the name of the job that created the spooled file        */
/*   which is to be copied.  The possible values are:                */
/*   *          The job that issued this command is the job that     */
/*              created the spooled file.                             */
/*              - or -                                                */
/*   job-name   Specify the name of the job that created the         */
/*              spooled file.                                         */
/*   user-name  Specify the user name that identifies the user        */
/*              profile under which the job was run.                 */
/*   job-number Specify the system assigned job number.              */
/* - Spool number                                                     */
/*   If there are multiple files for a job specify the files          */
/*   spool number.                                                    */
/*                                                                    */
/*                                                                    */
/*   LOGIC:                                                           */
/* - Separate job into its three parts: job name, user, job number   */
/* - Copy spooled files to database                                  */
/* - Copy database to optical                                        */
/*                                                                    */
/*                                                                    */
/*   EXAMPLE:                                                         */
/*   The example will copy spooled file QSYSPRT spool number 2 which */
/*   the current process has printed to optical storage.            */
/*   It will be stored on volume YEAR92 in directory                 */
/*   /DEC/WEEK01/MONDAY as file INVOICES                             */
/*                                                                    */
/*       CPYSPLFO SPLFILE(QSYSPRT)                                    */
/*                TGTFILE('/QOPT/YEAR92/DEC/WEEK01/MONDAY/INVOICES') */
/*                SPLNBR(2)                                           */
/*                                                                    */
/********************************************************************/

PGM  PARM(&FROMFILE &TGTFILE &JOB &SPLNBR);

    /************************************************************/
    /* Input parameters                                         */
    /************************************************************/
    DCL   VAR(&FROMFILE);    TYPE(*CHAR)    LEN(10)
    DCL   VAR(&TGTFILE);     TYPE(*CHAR)    LEN(300)
    DCL   VAR(&JOB);         TYPE(*CHAR)    LEN(26)
    DCL   VAR(&SPLNBR);      TYPE(*CHAR)    LEN(5)


    /************************************************************/
    /* Program variables                                        */
```

```
              /*************************************************************/
              DCL    VAR(&JNAME);        TYPE(*CHAR)   LEN(10)
              DCL    VAR(&JUSER);        TYPE(*CHAR)   LEN(10)
              DCL    VAR(&JNUM);         TYPE(*CHAR)   LEN(6)


              /*************************************************************/
              /* Monitor for all messages that can be signalled           */
              /*************************************************************/
              MONMSG     MSGID(CPF0000) EXEC(GOTO CMDLBL(DONE))
              MONMSG     MSGID(OPT0000) EXEC(GOTO CMDLBL(DONE))


              /*************************************************************/
              /* Separate each part of the job name and call the copy spool */
              /* file command using the current job or the specified name.  */
              /*************************************************************/
              CHGVAR VAR(&JNAME); VALUE(%SST(&JOB 1 10))
              CHGVAR VAR(&JUSER); VALUE(%SST(&JOB 11 10))
              CHGVAR VAR(&JNUM);  VALUE(%SST(&JOB 21 6))

              IF COND(&JNAME *EQ '*') THEN(DO)
                 CPYSPLF  FILE(&FROMFILE);                          +
                          TOFILE(QUSRSYS/LISTINGS)                  +
                          TOMBR(&FROMFILE);                         +
                          SPLNBR(&SPLNBR);                          +
                          CTLCHAR(*FCFC)

                 ENDDO

              ELSE DO
                 CPYSPLF  FILE(&FROMFILE);                          +
                          TOFILE(QUSRSYS/LISTINGS)                  +
                          TOMBR(&FROMFILE);                         +
                          JOB(&JNUM/&JUSER/&JNAME);                 +
                          SPLNBR(&SPLNBR);                          +
                          CTLCHAR(*FCFC)

                 ENDDO


              /*************************************************************/
              /* Copy the database file to optical storage                 */
              /*************************************************************/
              CPYDBOPT FRMFILE(QUSRSYS/LISTINGS)                    +
                       FRMMBR(&FROMFILE);                           +
                       TGTFILE(&TGTFILE);

              SNDPGMMSG MSG('CPYSPLFOPT completed successfully')
              RETURN

         DONE:
              SNDPGMMSG  MSGID(OPT0125) MSGF(QSYS/QCPFMSG) +
                         MSGDTA(CPYSPLFOPT) MSGTYPE(*ESCAPE)

              RETURN

         ENDPGM
```

Copy Optical to Database

CL Command Source

```
/*****************************************************************/
/*                                                               */
/* COMMAND NAME:   CPYOPTDB                                       */
/*                                                               */
/* COMMAND TITLE:  Copy optical to database                      */
/*                                                               */
/* DESCRIPTION:    Copy optical file to database file            */
/*                                                               */
/*****************************************************************/
```

```
CPYOPTDB:   CMD        PROMPT('Copy Optical to DB ')
            PARM       KWD(SRCFILE) TYPE(*CHAR) LEN(300)   +
                       MIN(1)  EXPR(*YES)                  +
                       PROMPT('Source file')

            PARM       KWD(TOFILE) TYPE(QUAL1) MIN(1)      +
                       PROMPT('To file')

            PARM       KWD(TOMBR) TYPE(*NAME)  LEN(10)     +
                       SPCVAL((*FIRST)) EXPR(*YES) MIN(1)  +
                       PROMPT('To member')

QUAL1:      QUAL       TYPE(*NAME) LEN(10)
            QUAL       TYPE(*NAME) LEN(10) DFT(*LIBL)      +
                       SPCVAL((*LIBL) (*CURLIB))           +
                       PROMPT('Library')
```

CL Program Source

```
/**********************************************************************/
/*                                                                    */
/*  PROGRAM:  CPYOPTDB (Copy Optical to Database)                     */
/*                                                                    */
/*                                                                    */
/*  DESCRIPTION:                                                      */
/*  This is the CL program for sample CL command CPYOPTDB.  This      */
/*  program can be used to copy a file which is on optical            */
/*  storage to a member of an existing file.                          */
/*                                                                    */
/*                                                                    */
/*  DEPENDENCIES:                                                     */
/*  - The sample command and program CPYSTRF exist.                   */
/*  - There is an existing folder named OPTICAL.FLR                   */
/*    This folder is used for temporary storage when copying          */
/*    from optical to database.  It is assumed that this folder is    */
/*    empty and that the user will delete anything which gets         */
/*    copied into it.                                                 */
/*                                                                    */
/*                                                                    */
/*  INPUT PARAMETERS:                                                 */
/*  - Complete source path                                           */
/*     Example: /filesystem/volume/directory1/directoryx/file         */
/*              /QOPT/VOLN01/DIRA/DIRB/FILE01                         */
/*  - To file                                                         */
/*    Assumptions:                                                    */
/*     - Target library already exists.                               */
/*     - Target file already exists and has the same attributes       */
/*       as that which contained the original file.                   */
/*  - To member                                                       */
/*                                                                    */
/*                                                                    */
/*  LOGIC:                                                            */
/*  - Build target file                                               */
/*  - Copy file from OPT to Document Library Services (DLS)           */
/*  - Separate file and library                                       */
/*  - Copy from folder to database file                               */
/*                                                                    */
/*                                                                    */
/*  EXAMPLE:                                                          */
/*  The example will copy file invoices which is in directory         */
/*  DEC on volume YEAR1992.  INVOICES was originally a spooled file   */
/*  which had a record length of 133.  It will be placed in file      */
/*  LISTINGS which is in library QUSRSYS as member INVOCDEC92.        */
/*                                                                    */
/*       CPYDBOPT TGTFILE('/QOPT/YEAR1992/DEC/INVOICES')              */
/*                TOFILE(QUSRSYS/LISTINGS)                            */
/*                TOMBR(INVOCDEC92)                                   */
/*                                                                    */
```

```
/*****************************************************************/

PGM  PARM(&SRCFILE &TOFILE &TOMBR);

   /*****************************************************************/
   /* Input parameters                                            */
   /*****************************************************************/
   DCL   VAR(&SRCFILE);      TYPE(*CHAR)   LEN(300)
   DCL   VAR(&TOFILE);       TYPE(*CHAR)   LEN(20)
   DCL   VAR(&TOMBR);        TYPE(*CHAR)   LEN(10)


   /*****************************************************************/
   /* Program variables                                           */
   /*****************************************************************/
   DCL   VAR(&FILE);         TYPE(*CHAR)   LEN(10)
   DCL   VAR(&LIB);          TYPE(*CHAR)   LEN(10)
   DCL   VAR(&TGTFILE);      TYPE(*CHAR)   LEN(28)              +
                                  VALUE('/QDLS/OPTICAL.FLR/xxxxxxxxxx')


   /*****************************************************************/
   /* Monitor for all messages signalled                          */
   /*****************************************************************/
   MONMSG    MSGID(CPF0000) EXEC(GOTO CMDLBL(DONE))
   MONMSG    MSGID(IWS0000) EXEC(GOTO CMDLBL(DONE))
   MONMSG    MSGID(OPT0000) EXEC(GOTO CMDLBL(DONE))


   /*****************************************************************/
   /* Build the target file name and copy the stream file from    */
   /* optical to DLS                                              */
   /*****************************************************************/
   CHGVAR VAR(%SST(&TGTFILE 19 10)) VALUE(&TOMBR);

   CPYSTRF   SRCFILE(&SRCFILE);                               +
             TGTFILE(&TGTFILE);


   /*****************************************************************/
   /* Separate the file and library names.  Copy the folder to DB. */
   /*****************************************************************/
   CHGVAR VAR(&FILE); VALUE(%SST(&TOFILE 1 10))
   CHGVAR VAR(&LIB);  VALUE(%SST(&TOFILE 11 10))

   CPYFRMPCD FROMFLR(OPTICAL.FLR)                             +
             TOFILE(&LIB/&FILE);                              +
             FROMDOC(&TOMBR);                                 +
             TOMBR(&TOMBR);                                   +
             TRNTBL(*NONE)

   SNDPGMMSG MSG('CPYOPTDB completed successfully')
   RETURN

DONE:
   SNDPGMMSG  MSGID(OPT0125) MSGF(QSYS/QCPFMSG) +
              MSGDTA(CPYOPTDB) MSGTYPE(*ESCAPE)
   RETURN

ENDPGM
```

Bibliography

The following publications, listed with their full title and base order number, provide additional information about topics described or referred to in this book.

- *APPC Programming*, SC41-5443-00, provides information about developing an application that uses the APPC support.
- *AS/400e Handbook*, GA19-5486-18, provides a basic understanding of the AS/400 architecture and operating system.
- *AS/400 Road Map for Changing to PowerPC Technology*, SA41-5150-05.
- *Backup and Recovery*, SC41-5304-04, provides information about the different media available to save and protect system data.
- *Communications Configuration*, SC41-5401-00, provides information about configuring communications between systems.
- *IBM 3995 AS/400 Compact Optical Library Dataserver Maintenance Information*, SY32-7034 or SA37-0245, provides IBM service representatives with information on how to install, maintain, and repair the IBM 3995 Optical Support, Model 042.
- *IBM 3995 AS/400 Compact Optical Library Dataserver: Operator's Book*, GA32-0140, provides system operators with information on how to perform basic tasks required by an optical media library dataserver.
- *IBM 3995 AS/400 Compact Optical Library Dataserver: Parts Catalog*, SI32-0024, provides information about the parts that can be ordered for the Compact Optical Library Dataserver, Model 042.
- *IBM 3995 Optical Library Dataserver: Introduction and Planning Book*, GA32-0121, provides introductory information on optical storage, and planning instructions for installation and conversion to optical storage.
- *IBM 3995 Optical Library Dataserver: Introduction and Planning Guide for C-Series Models*, GA32-0350, provides introductory information on optical storage, and planning instructions for installation and conversion to optical storage.
- *IBM 3995 Optical Library Dataserver: Media Requirements*, GA32-0146, describes the minimum requirements for media to be used in the optical library dataserver.
- *IBM 3995 LAN Optical Library Dataserver: Reference*, GA32-0147, provides information regarding the use of the supported optical media library models that are attached through a token-ring LAN.
- *IBM 3995 Optical Library Dataserver Reference for C-Series Models*, GA32-0351, provides information regarding the use of the supported optical media library models that are attached through a token-ring LAN.
- *IBM 3995 Optical Library and IBM 3431 Optical Drive APPC Interface*.
- *Local Device Configuration*, SC41-5121-00, provides information about configuring local devices on the AS/400 system. This includes information on how to configure the following:
  - Local work station controllers (including twinaxial controllers)
  - Tape controllers
  - Locally attached devices (including twinaxial devices)
- *Security - Reference*, SC41-5302-04, provides information about system security concepts, planning for security, and setting up security on the system. This manual does not describe security for specific licensed programs, languages, and utilities.

This book tells how system security support can be used to protect the system and the data from being used by people who do not have the proper authorization, protect the data from intentional or unintentional damage or destruction, keep security information up-to-date, and set up security on the system.

- *Software Installation*, SC41-5120-04.
- *Basic System Operation, Administration, and Problem Handling*, SC41-5206-04, provides information about the system unit control panel, starting and stopping the system, using tapes and diskettes, working with program temporary fixes, as well as handling problems.
- *Work Management*, SC41-5306-03, provides information about creating and changing the work management environment, working with system values, collecting and using performance data to improve system performance.

Notices

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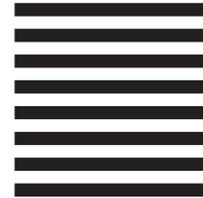
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