IBM
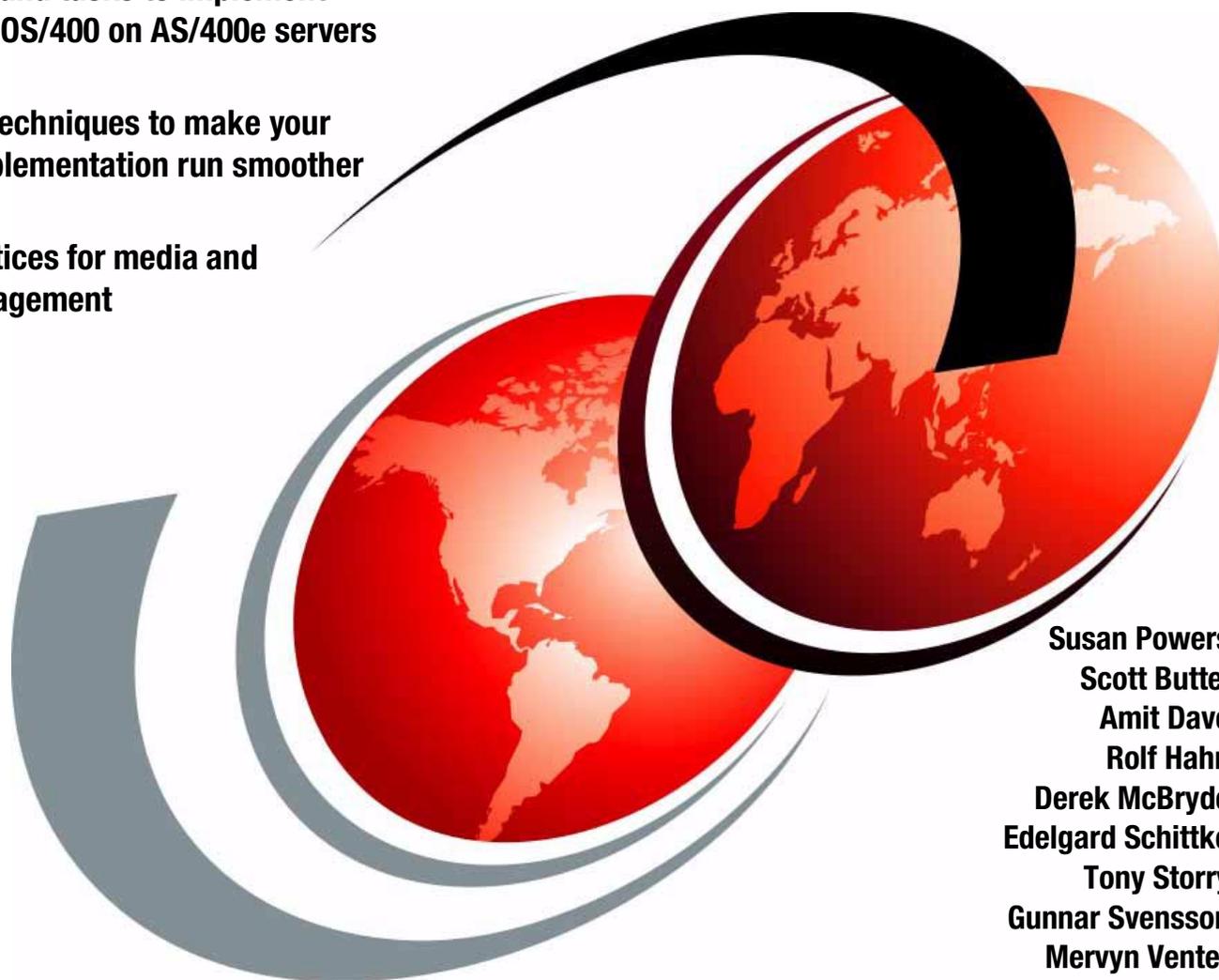
Backup Recovery and Media Services for OS/400

A Practical Approach

Concepts and tasks to implement
BRMS for OS/400 on AS/400e servers

Tips and techniques to make your
BRMS implementation run smoother
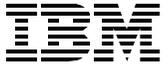
Best practices for media and
tape management

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Redbooks

International Technical Support Organization

**Backup Recovery and Media Services for OS/400:
A Practical Approach**

February 2001

Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix I, "Special notices" on page 317.

Second Edition (February 2001)

This edition applies to Version 3, Release 2 of Backup Recovery Media Services for OS/400, 5769-BR1, for use with V4R5 of OS/400.

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Contents

Figures

Tables

Preface

This IBM Redbook preserves the valuable information from the first edition of *A Practical Approach to Managing Backup Recovery and Media Services for OS/400*, SG24-4840, which is based on CISC implementations. The updates in this edition were made to reflect the documentation and URL values that were available at the time of publication.

This publication is unique in its detailed coverage of using BRMS/400 with tape libraries within a single AS/400 CISC system, or within multiple AS/400 CISC configurations across multiple levels of OS/400 ranging from OS/400 V3R1 to and through OS/400 V3R7. Coverage for BRMS for OS/400 for RISC and iSeries systems will be found in a redpaper that is planned for publication later in 2001.

Note: At the time this redbook was written, V4R2 and earlier releases of OS/400 and BRMS were no longer supported by IBM.

This redbook focuses on the installation and management of BRMS/400 using tape libraries such as IBM 9427, IBM 3494, IBM 3570, and IBM 3590. It provides implementation guidelines for using BRMS/400 to automate your save, restore, archive, and retrieve operations. It also contains practical examples of managing your media inventory across multiple AS/400 CISC systems. This redbook also identifies functional differences between BRMS/400 and OS/400 CISC releases, where appropriate.

This redbook is written for customers who are familiar with the basic functions of BRMS/400 and are in the process of implementing media management and tape management solutions. This publication is also intended for IBM Business Partners, marketing specialists, availability specialists, and support personnel.

Prior to reading this redbook, you must be familiar with the native OS/400 save and restore command interfaces and their options.

How this redbook is organized

The redbook is organized as follows:

- Chapter 1, "Backup Recovery and Media Services/400 introduction" on page 1

  This chapter provides an overview of BRMS/400 components and sets your expectations on the scope of this book.

- Chapter 2, "Installation planning for BRMS/400" on page 7

  This chapter takes you through the planning considerations when implementing BRMS/400. It takes you through the importance of naming conventions and introduces the concepts of media and media management, followed by instructions on how to install BRMS/400 on your AS/400 system.

- Chapter 3, "Implementing BRMS/400" on page 17

  This chapter provides information on the initial configuration and setup of BRMS/400 to become productive immediately. It provides an overview of the defaults that BRMS/400 uses for media class, media policy, backup control groups, enrolling and initializing media, and restoring saved data.

- Chapter 4, "Managing BRMS/400" on page 57

  This chapter provides information on how you can tailor BRMS/400 to use additional functions and features such as saving spooled files, using the save-while-active function, and using the job scheduler through BRMS/400. It also takes you through the tasks that need to be completed to manage BRMS/400.

- Chapter 5, "BRMS/400 networking" on page 97

  This chapter provides an overview of managing your media inventory across multiple AS/400 systems and provides instructions on how to configure a BRMS/400 network, remove systems from a network, and merge systems within a network. It also explains how you can change the system name and media information for a system within the BRMS/400 network.

- Chapter 6, "Saving and restoring the integrated file system" on page 123

  This chapter starts by providing an introduction of the integrated file system, using LAN Server/400 as an example. It covers authority issues related to saving LAN Server/400 data and the considerations for saving and restoring the integrated file system data from the Integrated PC Server (FSIOP).

- Chapter 7, "AS/400 hardware support for automated tape libraries" on page 151

  This chapter provides an overview of the hardware configuration for certain automated tape libraries that are supported on the AS/400 CISC systems.

- Chapter 8, "AS/400 software support for automated tape libraries" on page 157

  This chapter discusses the software support requirements for supporting tape automation on the AS/400 system, particularly aimed at the IBM 3494 Automated Tape Library Data Server.

- Chapter 9, "Implementing automated tape libraries" on page 165

  This chapter discusses some of the actions required to set up automated tape libraries in BRMS/400. It also covers the functional differences between CISC and RISC releases of OS/400, in the area of automated tape library management.

- Chapter 10, "Recovery using BRMS/400" on page 191

  This chapter deals with the most important function of BRMS/400 – recovery. The objective of this chapter is to describe the recovery of a complete system and identify the key differences the CISC and RISC BRMS/400 releases so that you can plan accordingly.

- Chapter 11, "Planning for upgrades to PowerPC AS" on page 209

  This chapter lists the BRMS/400 planning considerations when upgrading your IMPI processor to PowerPC AS processor (CISC to RISC). It lists the steps you need to perform on the source (CISC) system and the target (RISC) system during the upgrade process.

- Chapter 12, "Planning for the hierarchical storage management archiving solution" on page 217

  This chapter provides a description of how archiving is implemented with BRMS/400 and how your data can be retrieved dynamically. It also discusses

various application design considerations to be aware of to aid the planning and design of your archive solution.

- Chapter 13, "Practical implementation of hierarchical storage management archiving capabilities" on page 261

This chapter lists the type of objects that you may consider for archiving. Then, it explains how to set up BRMS/400 to produce an operational dynamic retrieval solution.

- Appendix A, "Summary of changes" on page 289

This appendix provides a summary of the functional enhancements that have been made to BRMS/400 beginning with V3R1 to and through V3R7. It can help you understand the enhancements that are available for each of the releases available for CISC systems.

- Appendix B, "Save and restore tips for better performance" on page 301

This appendix provides some of the hints and tips on improving your save and restore performance.

- Appendix C, "Example LAN configuration for 3494" on page 303.

This appendix provides sample line, controller, and device configuration for attaching the 3494 through a token-ring.

- Appendix D, "Performing restricted saves to a 3494 on CISC" on page 305

This appendix provides a sample CL program that shows how you can use the 3494 for restricted state processing on CISC operating systems.

- Appendix E, "Media missing from the 3494" on page 309

This appendix provides a sample query that can be used to identify volume mismatches between the BRMS/400 media inventory and the 3494 tape library inventory.

- Appendix F, "The QUSRBRM library" on page 311

This appendix provides information on the BRMS/400 files in the QUSRBRM library.

- Appendix G, "QUSRBRM/QA1AMM file specifications: V3R1" on page 313

This appendix provides file field specifications for the QA1AMM media management file for V3R1.

- Appendix H, "QUSRBRM/QA1AMM file specifications: V3R2/V3R6/V3R7" on page 315

This appendix provides file field specifications for the QA1AMM media management file for V3R2, V3R6, and V3R7.

The team that wrote this redbook

The second edition of this redbook preserves the content for those customers maintaining CISC systems. The team who updated this redbook for the second edition includes:

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The ITSO also thanks the participants of the BRMS/400 Forum for sharing their experiences with the BRMS/400 product and for providing valuable hints and tips to the BRMS/400 community.

Comments welcome

Your comments are important to us!

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- Fax the evaluation form found in "IBM Redbooks review" on page 335 to the fax number shown on the form.

- Use the online evaluation form found at **ibm.com**/redbooks

- Send your comments in an Internet note to redbook@us.ibm.com

Chapter 1. Backup Recovery and Media Services/400 introduction

You can plan, control and automate the backup, recovery, and media management services for your AS/400 systems with Backup Recovery and Media Services for OS/400 (BRMS/400).

BRMS/400 contains default values so you can begin using it immediately. It allows you to define *policies* for backup, recovery, archive, retrieve, and media and to tailor a backup recovery and media strategy that precisely meets your business requirements. BRMS/400 can be implemented on a single AS/400 system or on multiple AS/400 systems that are in a shared network.

Proper planning is the key to success, and skills are available to help you plan the hardware, media, and administrative resources needed for successful implementation and operation. This includes recovery planning, particularly disaster recovery planning, where you identify and *document* your critical resources and your plans to recover them.

Contact your local IBM representative for more information on how IBM can help you with your planning.

1.1 Overview of BRMS/400 functions

Figure 1 shows how the elements of BRMS/400 interact to provide your backup and recovery solution.
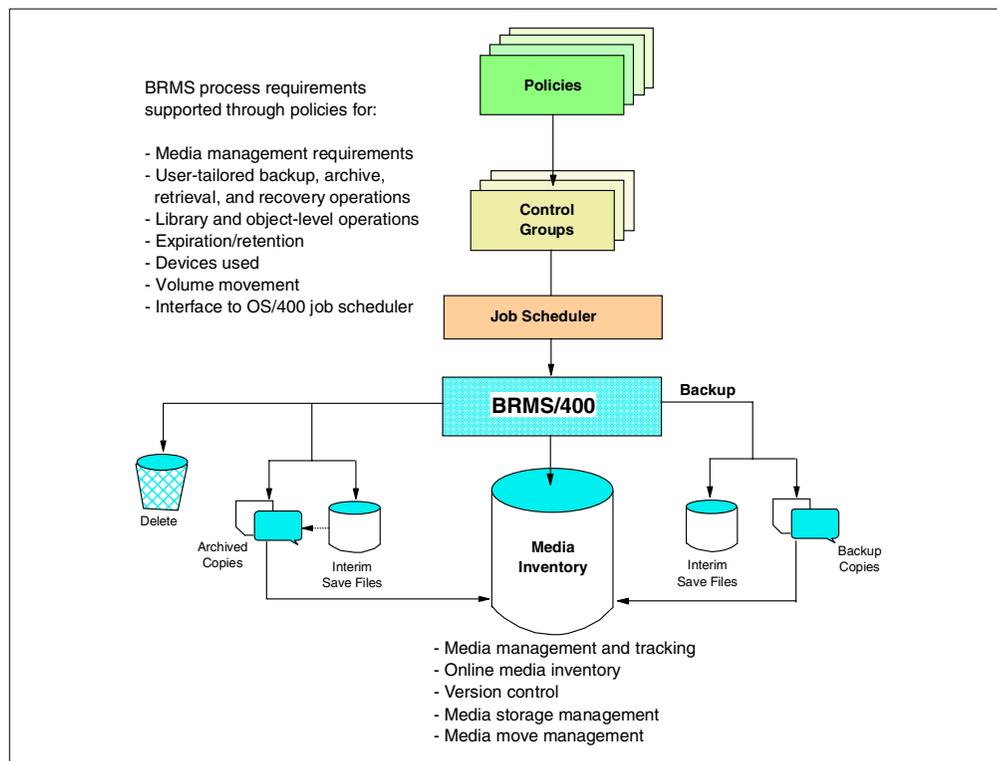
Figure 1. Overview of BRMS/400 operations

Five basic services are provided with a provision for customizing each to your specific process needs:

- **Backup**: A service for defining, processing, monitoring, and reporting backup operations for libraries, objects, members, folders, and spooled files. Backup *control groups* provide a simple way of grouping together libraries, objects, folders and documents, and directories that share common characteristics, such as:

    – Type of save (full or incremental)
    – Job queues to process
    – Subsystems to process
    – Media movement and media retention

- **Archive**: A service for analyzing direct access storage usage, based on user-defined criteria, and offloading aged objects, folders, or spooled files to tape. The retrieve function provides for dynamic online location and restoration of data, when required. Typical types of objects you may want to archive are:

    – History files
    – Period-end data
    – Non-current data kept for legal reasons
    – Query definitions
    – Folders, documents, and office mail
    – Performance data
    – Spooled printer output

- **Recovery**: A service for implementing your recovery plan. You can restore individual items or groups of saved items by date, by control group, or by auxiliary storage pool (ASP). Through single or phased recovery operations, you can restore your entire system.

    As well as a detailed report showing all steps required for recovery, BRMS/400 provides you with a concise report of all tape volumes needed for the recovery, including their current location.

- **Retrieve**: A service for the automatic retrieval of archived files. This is a dynamic retrieval that is totally transparent to the user trying to access the file.

- **Media**: A service for managing media usage on your AS/400 system. With media management, you can:

    – Enroll and initialize new media.
    – Manage media sets.
    – Display media contents.
    – Move media.
    – Expire media.
    – Duplicate media.

    Media management interfaces with backup, recovery, archive, and retrieve services to record and update media usage in the media inventory. For AS/400 systems in a network, you can coordinate enrollment and manage a common pool of tape volumes (*scratch pool*) across all systems.

BRMS/400 also provides a comprehensive set of reports to assist you in your backup and recovery management tasks.

1.2 Policies and control groups

The backup, archive, retrieve, and recovery functions are managed and controlled by policies and control groups. Policies establish the actions and assumptions used during processing. BRMS/400 is delivered with predefined policies that you can review and change as necessary to meet your system processing requirements.

Control groups define logical groups of libraries and objects that possess similar backup, retention, and recovery requirements. In addition to allowing you to define the order in which backup, archive, and recovery processing occurs, control groups also provide for special related actions such as tape loads, processing subsystems, and job queues. Control groups provide exits for user-defined processing during the backup cycle.

During installation, BRMS/400 can retrieve information from your AS/400 internal configuration tables and configure defaults for your environment. For example, it automatically creates BRMS/400 device information for the tape drives that you configured on your system. You must review the default options that are selected by BRMS/400 for further changes.

Chapter 2, "Installation planning for BRMS/400" on page 7, and Chapter 3, "Implementing BRMS/400" on page 17, discuss the planning and implementation aspects of BRMS/400 in more detail.

1.3 Functional enhancements with BRMS/400 releases

Each release of BRMS/400 has introduced functional enhancements. If you are upgrading from a previous release of BRMS/400, you need to be aware of the changes.

If you use BRMS/400 commands in user control language programs, you should be particularly aware of new or changed commands, new or changed parameters, and any changes in defaults. See *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) for information on this. Information is also available in Appendix A, "Summary of changes" on page 289. We strongly recommend that you also review *Automated Tape Library Planning and Management*, SC41-5309, for details on significant enhancements in the areas of tape automation.

For example, Version 3 Release 1 (V3R1) of BRMS/400 for CISC processors saw enhancements on Dynamic Retrieval and improvements in BRMS/400 networking. It saw the introduction of the chargeable OS/400 Media and Storage Extensions (QMSE) feature for OS/400. Communications for 3494 Automated Tape Library Data Server was integrated into OS/400 and new media library commands were introduced. Other commands were changed. For example, Confirm Moves using BRM (CFMMOVBRM) was changed to Verify Moves using BRM (VFYMOVBRM); Save Recovery using BRM (SAVRCYBRM) was changed to Save Media Information using BRM (SAVMEDIBRM).

Version 3 Release 6 (V3R6) of BRMS/400 for RISC processors represents the total integration of tape automation. Media library devices are now fully functional devices with configurations and resources. All of the OS/400 commands for tape and cartridges use the media library (MLB) device. The 3494 Media Library

Device Driver (MLDD) application and the corresponding subsystems are not required. Additional enhancements have also been made to BRMS/400 in the areas of backup functions and media management.

Version 3 Release 2 (V3R2) of BRMS/400 for CISC processors has many of the features that were available in V3R6 but retains its identity with V3R1. The functions are equivalent to those provided with the BRMS/400 V3R1 release.

Version 3 Release 7 (V3R7) of BRMS/400 for RISC processors includes the enhancements that were made with BRMS/400 V3R2. For example, BRMS/400 supports the enhancements made under OS/400 save and restore commands to use optimum block size for significantly improving the save and restore performance using an IBM 3590 tape drive.

Version 4 Release 1 and Version 4 Release 2 (V4R1 and V4R2) of BRMS/400 for RISC processors includes enhancements to support generic folder names for backup and supports large tape file sequence numbers up to 16,777,215. It allows the ability to omit an ASP from a backup, an *ERR keyword on select commands to help identify the objects in error on a backup, and other command and menu improvements.

Version 4 Release 3 (V4R3) of BRMS/400 for RISC processors includes support for Hierarchical Storage Management functions, such as migration, archiving, and retrieval across storage layers, and the ability to use the AS/400e as an ADSM/400 client.

Version 4 Release 4 (V4R4) and Version 4 Release 5 (V4R5) of BRMS/400 for RISC processors includes a re-packaging of the product options, support for parallel save, support for online backup of Domino servers, and the introduction of functional usage models.

A rich portfolio of functions is now available from the OS/400 and BRMS/400 combinations. It is a challenging portfolio for those in the process of migration, for those who have mixed levels of software in a network, and for those who are introducing new media types and having them coexist with the existing types.

Hint

At times, it can be difficult to remember the enhancements made in every release. One way you can be certain of enhancements within a particular release of BRMS/400 is to understand the actual release cycle. For example, V3R7 provides functional equivalency with V3R2 and contains additional enhancements. Likewise, V3R2 provides functional equivalency with V3R6, and contains additional enhancements. You can draw similar comparisons for V3R6 and V3R1.

We *strongly* recommend that you move to the latest BRMS/400 release to achieve the most benefits from the significant enhancements that BRMS/400 offers.

1.4 Scope of this book

This redbook recognizes the challenges of having multiple BRMS/400 releases within a network and aims to provide pointers to areas where special focus is needed.

The authors have made an attempt to pull together the threads of the overall picture. However, it is not the objective of this redbook to paint the picture itself. For more detail and for self-education, you are still asked to refer to the BRMS/400 manuals and other information that has already been published.

We have taken BRMS/400 V3R1 as the starting level and assume that most people are already familiar with the BRMS/400 functions. We have not addressed V2R3 or V3R0M5 because these releases of OS/400 were no longer supported by IBM at the time this redbook was published. Most of the examples documented in this book are primarily based on V3R2, V3R6, or V3R7 releases of BRMS/400.

Note: We intend to update all the relative information in this publication to V4R5 at a later date.

In writing this book, we assume that you have a working knowledge of the basics of BRMS/400. The redbook attempts to focus on areas that are not so familiar such as automated tape libraries, managing BRMS/400, networking BRMS/400 for media synchronization, the integrated file system, and automated recovery.

Chapter 2. Installation planning for BRMS/400

Implementing an effective and practical backup, archive, recovery, and retrieval strategy requires considerable planning and management efforts. In general, the strategy that you develop and use for your backup is dictated by your plans for recovery.

This chapter addresses the planning considerations for BRMS/400 along with details on how to install BRMS/400 on your AS/400 system. For additional planning information on backup on recovery functions, you should also consult *Backup and Recovery - Basic*, SC41-4304.

You also need to be aware of the various functional enhancements that have been made to the BRMS/400 releases since V3R1. See Appendix A, "Summary of changes" on page 289, for additional information.

2.1 Before you begin

Before you begin using BRMS/400, review your backup and recovery strategy. If you have not used BRMS/400 before, review your skills requirements and education and training opportunities available to you. Read the implementation considerations in the following sections of this redbook.

2.1.1 AS/400 systems

Review where BRMS/400 is going to be installed. Even if you are planning to install BRMS/400 on a single system initially, we strongly recommend that you plan as if you were implementing a BRMS/400 solution across multiple AS/400 systems. Your machine type (that is, CISC or RISC processor) and your OS/400 release are also important for planning considerations.

Some of the important tasks that you should consider are:

- Is the system name going to change? Many installations retain the S44XXXXX system name that was shipped with their system. While this is a perfectly valid system name, it is less manageable than, for example, SYSTEM01, SYSTEM02, and so on.

  BRMS/400 caters to changes in a system name. However, updating the media information on every system in a large network to reflect the new name can be a significant task. We, therefore, recommend that if you intend to change your system names, make the change prior to loading BRMS/400. If you plan to have a network of AS/400 systems, ensure that the system names appropriately identify them within your organization.

- If you are installing BRMS/400 on a new system, we recommend that you have the latest OS/400 release (V3R2 for CISC processors, V3R7 for RISC). These releases provide you with the latest BRMS/400 enhancements. See Appendix A, "Summary of changes" on page 289, for details on the enhancements.

- If you have an automated tape library (ATL), understand how it will be shared between multiple systems. You also need to understand how the systems share tape media and make provisions to have sufficient media in the shared scratch pool.

- One of the strengths of BRMS/400 is its ability to manage media inventory on a single AS/400 system or multiple AS/400 systems. To achieve this, you must have unique volume identifiers in your media inventory. See 2.1.3, "Media naming convention", for more information.

2.1.2 Media

In addition to strategies for save and restore, you should have a strategy for media to use for your save and restore. This should include the number of copies of your saved objects that you keep, where you keep these copies, and which media to use. It ensures that, in the event of a backup being unavailable or unreadable, you can restore the system from another copy. You should consider keeping at least one of these backups off-site to protect your data in the event of a major disaster, such as fire or flood, at your main site.

2.1.3 Media naming convention

To successfully manage all of your media volumes either on a single AS/400 system or on multiple AS/400 systems, it is *vital* that you have some thoughts on how you are going to name your media. BRMS/400 tracks your media volumes by their volume identification and duplicate media volumes within a BRMS/400 network can create problems. Even if you plan to install BRMS/400 on a single system initially, it is important that you allow for a potential networking of AS/400 systems using BRMS/400.

The following items will help you design standards for your media volumes:

- **Scratch pool**: With a scratch pool, tapes are not allocated to specific sets. When a tape is required for output, any available scratch tape can be used. This requires that you keep an inventory of all tapes so that available tapes can be identified. The advantage is that tapes do not need to be allocated in advance. If the inventory is well managed, tape usage can be balanced rather than some tapes being used more than others. You can control the retention periods down to the file level on the tape. A scratch pool is easily managed by BRMS/400, which is the preferred option.

Table 1. Media scratch pool

A1001	A8276	A3456	A1223	A1234	A4356	A2376
A6453	A6778	A3450	A4390	A5697	A3432	A0976
A0124	A3211	A2144	A7666	A3323	A8909	A7366
A0343	A4432	A2390	A5466	A3345	A3333	A5444
A1111	A2232	A2222	A4443	A5678	A7654	A6543
A4321	A9876	A2109	A1098	A1087	. . . .	Annnn
Note: Select any tape from the scratch pool.						

- **Numbered volume identifiers**: Since customized tape labels are more expensive than standard numeric labels, you may assign a range of numbers based on the number of systems that you have in your enterprise as follows:

```
1000 through to 1999      SYSTEM01
2000 through to 2999      SYSTEM02
```

```
3000 through to 3999      SYSTEM03
4000 through to 4999      SYSTEM04
5000 through to 5999      SYSTEM05
6000 through to 6999      SYSTEM06
.... and so on
```

> **Note**
>
> This technique may not be suitable if there are plans to merge two
> enterprises that adopt the volume naming conventions described in the
> preceding example.

- **Alphanumeric volume identifiers**: This approach allows you to prefix your
  volume identifiers with some alphabetic characters that are meaningful to the
  system or applications that run on it (for example, multiple warehouses
  running on multiple systems).

```
xx1000   through to xx1999    SYSTEM01
xx2000   through to xx2999    SYSTEM02
xx3000   through to xx3999    SYSTEM03
xx4000   through to xx4999    SYSTEM04
xx5000   through to xx5999    SYSTEM05
xx6000   through to xx6999    SYSTEM06
.... and so on
```

Here, *xx* identifies your system. With this approach, you may not have the
same issues of duplicate volume identifiers, but labeling (for use in a tape
library) may become expensive.

> **Note**
>
> If you already use this system, you can change to a *scratch pool* without
> renaming the media. With the scratch pool, any AS/400 system in the
> BRMS/400 network can use an expired volume so your volumes may not
> always get used by the system to which they were originally assigned. This
> should not concern you, since within a BRMS/400 network, the media
> information is shared across all of the AS/400 systems that are participating
> in the network. Most importantly, you have a unique volume in the media
> inventory that you can track and manage using BRMS/400.

When you physically label cartridges for the 3494 Automated Tape Library Data
Server, you add an `E` as the suffix (seventh character) to the enhanced capacity
3490 cartridges and a `J` to the 3590 cartridges. Within BRMS/400, you do not
have to create special volume identifiers for these types of cartridges. BRMS/400
automatically adds the suffix during media enrollment.

2.1.4 Storage locations

Storage locations identify where your media resides throughout its life-cycle. One
example is to have a storage location of OFFSITE.

The purpose of taking an offline copy of your system and applications is to protect
against a major failure. Save files in a user auxiliary storage pool (ASP) do not
protect if your entire AS/400 configuration is affected. Keeping your offline tapes

in a rack next to the AS/400 system may be fine for retrieving them quickly, but a fire or flood in the computer room can affect these as well as your online data.

Even a fire-proof safe or vault close to the computer room cannot guarantee a fully-protected environment in the event of an explosion or major fire. Therefore, you should plan to have *at least one copy of your backups stored off-site*. You should consider two off-site copies (in different locations) for your most critical objects.

Moving media between storage locations can be scheduled on a daily basis. However, if you use a specialist service to move your media, you may have agreed to a schedule other than the recommended daily schedule. In this case, use the Calendar for Move days in the BRMS/400 move policy to ensure that media moves are scheduled to correspond with the collection schedule.

Note: Do not forget to include a copy of your updated recovery report with the media. It is also a good idea to keep a copy of your recovery procedures off-site with the media. This ensures that you have procedures to follow even if your main site has been destroyed.

2.1.5 Tape drives and media types

There are many different media types and associated devices on an AS/400 system that can be used for storing offline copies. The most common media types are:

- A ¼-inch cartridge
- A ½-inch cartridge

- A ½-inch reel
- An 8 mm cartridge

You should consider both the device and media type that you require for your backups. Each has its own characteristics, and you should decide which to use for different types of saves.

Generally, for backup purposes, you use the fastest and most dense media. For systems with a large amount of disk storage, you probably require the speed and capacity of a 3590 tape device.

Hint

Your SAVSYS activity is restricted by your alternate IPL device. You must also consider whether you need to be able to read your offline backups on another system and what limitations that may impose.

2.2 Installing BRMS/400

Before you start the installation of BRMS/400 on your AS/400 system, be sure to check that your system has the latest program temporary fixes (PTFs). You must also have access to Informational APARs that contain the latest hints and tips related to either BRMS/400 or automated tape library installation.

Informational APAR II09772 is the master index for all of the Informational APARs related to BRMS/400. You should download this APAR and any subsequent APARs that you may feel are relevant for your installation.

This information is readily available through the Internet and from the AS/400 home page. If you do not have access to the Internet, contact your IBM Support or Service Representative to assist you with the information.

To access information on PTFs from the AS/400 Internet home page, follow these steps:

1. Go to `http://www.as400.ibm.com/` using your Web browser.
2. Select the **Support** fast path from the options.
3. Select **AS/400** under **Integrated mid-market business servers**. This takes you to the iSeries and AS/400 Technical Support home page.
4. Select the **Technical Information and Databases** fastpath.
5. Select the **Authorized Problem Analysis Reports (APARS)** fastpath. This takes you into a multiple selection display for APARs.
6. Select the **All APARs by Component** fastpath. This gives you a list of licensed program products by their release.
7. Select the **57XXBR1 - BRMS/400** component fastpath to review all the PTFs and APARs related to the product for your appropriate release of BRMS/400.

Before you begin installing BRMS/400 on your AS/400 system, make sure you have:

- Appropriate documentation. At a minimum, you should have the latest copy of:
  - *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171).
  - *Automated Tape Library Planning and Management*, SC41-5309, if you have a library device.
  - *AS/400 Road Map for Changing to PowerPC Technology,* SA41-4150, if you are planning to upgrade from CISC to RISC.
- 57xxSS1 Option 18 - Media and Storage Extensions (MSE) is installed on your system. Use `GO LICPGM` and option `10` (Display installed licensed programs) to verify. MSE is a prerequisite for using BRMS/400. It should be installed using option `1` on the LICPGM menu or by using the Restore Licensed Program (`RSTLICPGM`) command.

  If this feature is not installed, you receive messages in the job log (CPD3D91 and CPF9899) indicating that the save did not complete. Once BRMS/400 is successfully installed, it registers two exit programs in the registration information. If you install MSE after you install BRMS/400 licensed programs, it is necessary to issue the following command:

  ```
  INZBRM OPTION(*DATA)
  ```

  This automatically registers the exit programs. You can verify the registration by entering the Work with Registration Information (`WRKREGINF`) command. Then, check the following exit points and exit programs by selecting option `8` (Work with exit programs) for these entries:

  ```
  Exit Point            Exit Program           Library
  ----------            ------------           --------
  QIBM_QTA_STOR_EX400    Q1ACSX                 QBRM
  QIBM_QTA_TAPE_TMS      Q1ARTMS                QBRM
  ```
- BRMS/400 licensed program: Also the latest cumulative PTF package and the latest BRMS/400 PTFs.
- Library QSYS2 in your *system library list*. Use the Work with System Values (`WRKSYSVAL QSYSLIBL`) command to check, and add the QSYS2 library to the system library list, if required.
- The correct authorization to your user profile. You need QSECOFR special authority.
- BRMS/400 user license details. You do not need this to install BRMS/400, but you do need it afterwards to enroll your media as "users". You need to change license information before you can use any media through BRMS/400.
- AS/400 Media Library Device Driver (MLDD - 5798RZH) installed with the latest PTFs for MLDD.

> **Note**
>
> MLDD is only required if you are using the 3494 Automated Tape Library Data Server with OS/400 V3R1 or V3R2 (CISC-based processors). It is not required for AS/400 with PowerPC technology with V3R6 or V3R7.
>
> For additional information about MLDD installation and setup on your AS/400 system, see *IBM 3494 User's Guide: Media Library Device Driver for Application System/400*, GC35-0153.

If BRMS/400 is not already installed on your system, enter GO LICPGM on the command line and select option 11 to install the Licensed Program Product. Alternatively, you can use the Restore License Program (RSTLICPGM) command to install BRMS/400. After the licensed program is successfully installed, you need to load the latest cumulative PTF package for BRMS/400 and any additional PTFs that you may have downloaded using Electronic Customer Support (ECS). This completes your BRMS/400 installation.

BRMS/400 creates two libraries on your system: QBRM and QUSRBRM. The QBRM library contains BRMS/400 program objects. The installation program also copies all of the BRMS/400 commands into the QSYS library. The QUSRBRM library is used to store BRMS/400 database objects and logs, including a history of media information, user-defined control groups, policies, and other installation specific information. We strongly recommend that you include these two libraries in a backup control group to be saved for disaster recovery purposes.

Note

Beginning with V3R2 and V3R7, a default user profile QBRMS is shipped as part of OS/400 even if you do not install BRMS/400. This user profile QBRMS must *not* be deleted.

The rationale behind shipping a QBRMS profile as part of OS/400 is to resolve security and authority related issues with BRMS/400 during a recovery, since BRMS/400 code is required to run before the rest of the user profiles are restored. Section 5.3.1, "Network security considerations" on page 101, discusses additional considerations related to QBRMS user profile and secured networks.

After you have installed BRMS/400, verify that the Allow user domain in user libraries (QALWUSRDMN) system value is set to *ALL, which is the default shipped value. This value allows user domain objects in libraries and determines which libraries on the system may contain the user domain objects *USRSPC (user space), *USRIDX (user index), and *USRQ (user queue).

If this value is not set to *ALL, you must add QBRM and QUSRBRM libraries to the list of libraries specified for the QALWUSRDMN value.

2.2.1 Updating BRMS/400 license information

Before you can use and manage any media through BRMS/400, you are required to update the licensing information.

Use the Change License Information (CHGLICINF) command to change the license information as shown in Figure 2 on page 14.

```
                    Change License Information (CHGLICINF)

 Type choices, press Enter.

 Product identifier . . . . . . . > 57xxBR1      Identifier
 License term . . . . . . . . . . > V3           Vx, VxRy, VxRyMz, *ONLY
 Feature  . . . . . . . . . . . . > 5050         5001-9999
 Usage limit  . . . . . . . . .    *NOMAX        0-999999, *SAME, *NOMAX
 Threshold  . . . . . . . . . .    0             0-999999, *SAME, *CALC...
 Message queue  . . . . . . . . .  *NONE         Name, *SAME, *NONE, *OPSYS
   Library  . . . . . . . . . .                  Name, *LIBL, *CURLIB
                  + for more values

 Log  . . . . . . . . . . . . . .  *NO           *SAME, *NO, *YES
```

Figure 2. Changing BRMS/400 license information

Although the BRMS/400 license is purchased in groups of 10 media, you have to enter the total number of media on this display. For example, if you have purchased a license for 20 media, you should enter 200 in the Usage limit parameter. Tape media licenses are ordered in blocks of 10, with a maximum charge for 500 tape media per basic license. If you purchased an unlimited license for BRMS/400, you should enter *NOMAX for the Usage limit parameter.

Usage limit is monitored and controlled by the license management functions of OS/400.

Note: If you are upgrading from a V2R3 system to a V3R1 or a later release, you must register your media using the INZBRM *REGMED command. This time stamps the media at the time the command is run. If you continued to update media on other systems in your network during this process, the updates may have an older time stamp and are ignored. Make sure that all network activity has completed before you register the media.

2.2.2 Initializing the BRMS/400 environment

Although a default BRMS/400 environment is created after you install the product, we recommend that you use the Initialize BRM (INZBRM OPTION(*DATA)) command to update the BRMS/400 definitions. For example, the command checks all of your hardware changes in conjunction with media devices in between the installation of the BRMS/400 licensed program and the beginning of the setup of BRMS/400.

The INZBRM command builds default control groups, BRMS/400 policies, and tables based on the characteristics of the system that is being initialized.

If you are re-installing on a V3R6, V3R7, or a V3R2 system, you might choose to use INZBRM OPTION(*DEVICE). This performs the same functions as INZBRM OPTION(*DATA), as well as clearing the device and media library information. It re-initializes the BRMS/400 files only with information on the tape units that are currently configured on your system, resetting defaults as it does so. You should review these defaults if you have implemented your own specific environment for BRMS/400.

You are now ready to use BRMS/400 on your AS/400 system. Before you start tailoring BRMS/400 to meet your requirements, we recommend that you become familiar with the BRMS/400 menu options, commands, and their parameters.

2.3 BRMS/400 menus and commands

To start using BRMS/400, enter GO BRMS from any command line. This takes you to the BRMS main menu as shown in Figure 3.

```
BRMS                    Backup Recovery and Media Services/400
                                                      System:    SYSTEM09
Select one of the following:

      1. Media management
      2. Backup
      3. Archive
      4. Recovery

     10. Scheduling
     11. Policy administration
     12. Reports
```

Figure 3. BRMS/400 main menu

Beginning with V3R2 and V3R7, an additional option was added to the BRMS/400 main menu (option 12; Reports) as shown in Figure 3. These reports include:

- Media expiration report (QP1AEP)
- Media report (QP1AMM)
- Media information report (QP1AHS)
- Media movement report (QP1APVMS)
- Media volume statistics report (QP1AVU)
- Saved objects report (QP1AOD)
- Link information report (QP1ADI)
- Recovery activities report (QP1ARW)
- Recovery analysis report (QP1ARCY)
- BRMS/400 log report (QP1ALG)

From this BRMS/400 main menu, you can "drill down" to the media management functions, backup, archive, recovery, retrieve, scheduling, and report analysis menus.

If you select F13 from the BRMS/400 main menu, you go to some of the commonly used BRMS/400 functions as shown in Figure 4 on page 16.

```
  BRMF                                    Functions
                                                       System:    SYSTEM09

  Select one of the following:


            1. Move management
            2. Display log
            3. Work with expired media
            4. Save BRM save files to tape
            5. Schedule BRM maintenance
            6. Restart subsystems
            7. Work with job scheduler
            8. Duplicate media
            9. Work with active jobs
           10. Work with spooled files
           11. Work with system status
           12. Display system operator messages
```

Figure 4. BRMS/400 functions

Selecting F10 from the BRMS/400 main menu takes you to a list of all of the
BRMS/400 commands grouped by functional area (Figure 5). This is the
equivalent of typing GO CMDBRM on the command line.

```
  CMDBRM                              BRMS/400 Commands
                                                       System:    SYSTEM09
  Select one of the following:

    Media commands
       1. Add media to BRM                                      ADDMEDBRM
       2. Add media information to BRM                          ADDMEDIBRM
       3. Add media library media to BRM                        ADDMLMBRM
       4. Change media using BRM                                CHGMEDBRM
       5. Copy media information using BRM                      CPYMEDIBRM
       6. Display duplicate media                               DSPDUPBRM
       7. Duplicate media using BRM                             DUPMEDBRM
       8. Initialize media using BRM                            INZMEDBRM
       9. Move media using BRM                                  MOVMEDBRM
      10. Print labels using BRM                                PRTLBLBRM
      11. Print media movement                                 PRTMOVBRM
      12. Print media exceptions for BRM                        PRTMEDBRM
      13. Remove media volumes from BRM                         RMVMEDBRM
                                                                   More...
```

Figure 5. BRMS/400 commands by functional areas

Alternatively, you can use the Select Command (SLTCMD QBRM/*ALL) command to
list all of the commands in library QBRM in an alphabetical sequence.

Finally, you can access BRMS/400 functions directly by explicitly entering the
menu name. For example, you can enter GO BRMSYSPCY to access the System
Policy Menu or the Work with Control Groups in the BRM (WRKCTLGBRM)
command.

Chapter 3. Implementing BRMS/400

This chapter describes the implementation of a BRMS/400 environment for a single AS/400 system. Special considerations about different releases of BRMS/400 and about automated tape libraries are also included. See the "BRMS/400 Overview and Installation" chapter in *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) for additional information.

The BRMS/400 functions for archive and retrieval are not covered here because they closely follow the functions provided by the backup and recovery policies. These are covered in 13.3, "Using BRMS/400 for hierarchical storage management" on page 267.

The chapter is presented in order of implementation. With some exceptions (for example, the optional sections for containers), the information created in each section is required for subsequent sections.

This chapter does not cover the actual installation and configuration instructions for using automated tape libraries with BRMS/400. See Chapter 7, "AS/400 hardware support for automated tape libraries" on page 151, and Chapter 9, "Implementing automated tape libraries" on page 165, for information on using automated tape libraries with BRMS/400. Where required, this chapter highlights the importance of setting some of the parameters correctly if you have a media library attached to your AS/400 systems. These parameters are discussed during the various implementation stages throughout this chapter.

You should also review the BRMS/400 enhancements that are highlighted in Appendix A, "Summary of changes" on page 289.

3.1 Getting started with BRMS/400

The following list provides an overview of the tasks that you need to complete when setting up BRMS/400. All of these tasks are discussed in detail throughout this chapter:

- Storage locations
- Media devices
- Media library devices
- Media classes
- Containers
- Move policies
- Media policies
- Default system, archive, recovery, and retrieval policies
- Backup policies
- Backup control groups
- Enrolling and initializing media
- Performing a save operation
- Review status of media
- BRMS maintenance and report printing
- Recovery test

17

3.2 The building blocks of BRMS/400

As discussed in Chapter 2, "Installation planning for BRMS/400" on page 7, defining your company's backup strategy involves making decisions that reflect your company's own business policies. These decisions are implemented in BRMS/400 as follows:

- **What**: The first decision is what to back up. This information is held in the backup *control group*. The timing of the backup is determined by how often you schedule the backup of each backup control group. You also need to identify any dependencies.

- **How**: Having determined what to backup, the next task is to choose the media. This is determined by *media class*, which is determined by the *media policy*. The media policy also specifies if the data should be "staged" through a save file before being committed to the media. The media policy is specified in the attributes of the backup control group.

- **Where**: The next decision is what to do with the media that now contains the latest backup. Typically, media is moved into a fireproof safe, to another location, or to a combination of both. The journey that media makes after it has been used until it expires and returns to the home location is defined in a *move policy*. The move policy is specified in the media policy.

- **How long**: The retention period of the data (that is, until it is no longer required) is the next piece of information. This period varies. Nightly backups may need to be retained for one week, where monthly backups may need to be retained for one or more years. The retention information is specified in the media policy.

Before you start implementing BRMS/400, you should decide on the naming conventions that you will use for your media policies, media classes, move polices, volume identifiers, and control groups. The naming conventions become more and more important when you use automated tape libraries along with BRMS/400. See 2.1.3, "Media naming convention" on page 8, for more information.

3.3 Storage locations

Storage locations define any place where media is stored. Two storage locations are provided as defaults with BRMS/400:

- *HOME: The default on-site storage location
- VAULT: The default off-site storage location

We recommend that you leave these defaults unchanged and create additional storage location entries to match the additional locations that you want BRMS/400 to manage.

BRMS/400 refers to storage locations in several places:

- System Policy: "Home Location"
- Media Policy: "Storage Location"
- Device Description: "Device Location"
- Move Policy: "Home Location"

When BRMS/400 encounters a tape that has a location error (a rare occurrence), it assigns that tape to the "Home Location" in the system policy. You can create your own location to capture any errors such as DONOTUSE.

> **Hint**
>
> If you have different types of media, you need to ensure that your *System Policy Home Location* can accommodate all types. We recommend that you specify a location other than the media library for the home location. If the system identifies a mismatch on the media in the tape library, you want it to be ejected and not "returned" to the library device.

The "Storage Location" in the media policy instructs BRMS/400 where to look for a tape to perform your backup. Normally this is the scratch pool or the automated tape library, but it can also be another location. The default for the *storage location* parameter in the media policy is *ANY. You should review this parameter, especially if you permit media to expire in a location other than the "home" location so that BRMS/400 does not request the mount of a tape that is not even on-site. If you have media libraries, you have to be careful how you specify the storage location to ensure it only indicates tapes that are "inside" of the library.

If you have more than one library, or if you have stand-alone drives as well as a library (for example, 3590 devices inside and outside a 3494 Automated Tape Library Data Server), you need to ensure that neither requests the other's media. You also need to ensure that the device description is updated to indicate its location (for example, from *HOME to MLB01).

The "Home Location" on the move policy tells BRMS/400 where it should put the tape when it completes the moves in the move policy. Typically, this is the computer room or the scratch tape rack. If you use media libraries, it may be returning from the vault to the library.

Some examples of storage locations are:

- **COMPROOM**: The main tape rack in the computer room, assuming that you do not have all of your tape media in the tape library.
- **MLB01**: Media in a tape library.
- **MLB02**: Media in another tape library. This tape library may be located in another building.
- **SCRATCH**: Scratch tapes only. Tapes that have expired are stored here.
- **VAULT**: Secure off-site storage.
- **DONOTUSE**: Tapes that are lost or destroyed, or are past their useful life, can be "tracked" here. This location does not need to exist physically. For example, if a tape with volume ID of A10005 was damaged, it is moved to the DONOTUSE location.

You can use the Work with Storage Locations (WRKLOCBRM) command to display the storage locations that are defined for BRMS/400. The WRKLOCBRM command can also be used to add, change, or remove storage locations. In addition, you can work with media or containers that are in the storage locations by selecting additional parameters when using the change option for a specific storage location.

Figure 6 shows an example of creating a storage location called COMPROOM. When you create a storage location, it is important that you provide the required details for name, address, contact name, contact telephone number, and so on.

```
                           Add Storage Location

 Storage location  . . . . . . . . :    COMPROOM

 Type choices, press Enter.

 Address line 1  . . . . . . . . . .    Building 3
 Address line 2  . . . . . . . . . .    1st Floor
 Address line 3  . . . . . . . . . .    Computer Room
 Address line 4  . . . . . . . . . .    Tape Rack near the fire safe
 Address line 5  . . . . . . . . . .
 Contact name  . . . . . . . . . . .    Kris Peterson
 Contact telephone number. . . . . .    (555) 111-2222
 Retrieval time  . . . . . . . . . .    .0            Hours
 Allow volumes to expire . . . . . .    *YES          *YES, *NO
 Media slotting  . . . . . . . . . .    *NO           *YES, *NO
 Text  . . . . . . . . . . . . . . .    Onsite safe
```

Figure 6. Add Storage Location example

There are two important field parameters that you need to set correctly:

- **Allow volumes to expire**: Should be set to *NO for your off-site location. You could select *YES for a storage location that is physically located near the system such as the computer room or a tape library.

> **Note**
>
> A choice of *NO indicates that volumes whose retention period has passed (as specified in the media policy) must be transferred to a location that allows tapes to expire before the media can become eligible for reuse (scratch).

- **Media slotting**: If media is to be filed and tracked by individual slot numbers at storage locations, you must specify that you are using media slotting on the Add or Change Storage Location displays. The use of media slotting is optional and can be used for some storage locations and not for others, based on your specific storage procedures. Of the two default storage locations provided (*HOME and VAULT), *HOME is set to a media slotting value of *NO. VAULT is set to a media slotting value of *YES. You should change these values to match your storage procedures.

  Media can be assigned a slot number when it is added to the BRMS/400 media inventory using the Add Media to BRM (ADDMEDBRM) command. Slot numbers can be changed using the Change Media in BRM (CHGMEDBRM) command.

  Volumes moved to a storage location that allows media slotting are automatically updated with a volume slot number for the new location (beginning with the lowest available volume slot number) unless they have been assigned a slot number previously.

If you chose media to be stored in containers, containers processed through a move command resulting in movement to a storage location that allows media slotting are automatically updated with a container slot number for the new location (beginning with the lowest available container slot number). Media volumes assigned to containers are not assigned volume slot numbers. See Figure 7.

```
                              Change Storage Location

   Storage location  . . . . . . . . :     COMPROOM

   Type choices, press Enter.

   Container count . . . . . . . . . .          0       Number
   Container threshold . . . . . . . .      *NOMAX      *NOMAX, Number
   Container maximum . . . . . . . . .      *NOMAX      *NOMAX, Number
   Volume count  . . . . . . . . . . .          0       Number
   Volume threshold  . . . . . . . . .      *NOMAX      *NOMAX, Number
   Volume maximum  . . . . . . . . . .      *NOMAX      *NOMAX, Number
```

Figure 7. Change Storage Location

For additional information, see *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171).

3.4 Media devices

A BRMS/400 media device entry must exist for every tape unit that BRMS/400 uses. It specifies additional controls over what can be specified in the device description, for example, if the tape drive is shared between two systems.

At the time of installation, BRMS/400 determines the media libraries and tape devices on your system and develops corresponding *device information* entries. You should review these entries for accuracy and make any necessary changes to reflect your device specifications as shown in Figure 8 on page 22.

The Work with Devices using BRM (WRKDEVBRM) command shows all of the devices and their associated type and model that are defined to BRMS/400. This command also allows you to add, change, or remove a device from a list of devices that you want to use in BRMS/400 processing. If you are adding a device, it must already be defined to the system through the device description (CRTDEVD) function.

Beginning with V3R6, a new function key (F8) has been added on the WRKDEVBRM display that allows you to access the Work with Configuration Status (WRKCFGSTS) display.

When you add a device, you can specify both read and write densities for that device. Most devices have the same read and write densities. However, such devices as the 3490-B40 can read lower densities, but can only write in higher densities.

```
                        Change Device Information

    Device name . . . . . . . . . . . :    TAP01

    Type changes, press Enter.

    Type  . . . . . . . . . . . . . .      6369         2440, 3422, F4 for list
    Model . . . . . . . . . . . . . .      001          001, 002, F4 for list
    Allow densities:
       Read  . . . . . . . . . . . . .     *DEVTYPE     *DEVTYPE, F4 for list



       Write . . . . . . . . . . . . .     *DEVTYPE     *DEVTYPE, F4 for list



    Device location . . . . . . . . . 1    *HOME        Name, F4 for list
    Next volume message . . . . . . . 2    *YES         *YES, *NO
    Tape mount delay  . . . . . . . . .    *IMMED       *IMMED, 1-999
    Auto enroll media . . . . . . . . 3    *SYSPCY      *SYSPCY,*NO, *YES
    Shared device . . . . . . . . . . 4    *NO          *YES, *NO
    Shared device wait  . . . . . . . .     30          Seconds
    Device uses IDRC  . . . . . . . . .    *NO          *NO, *YES
    Use optimum block size  . . . . . 5    *NO          *NO, *YES
    Transfer rate per second  . . . . .    *DEVTYPE     *DEVTYPE, Number nnnnn.nn
       Unit of measure . . . . . . . . .                1=MB, 2=GB
    Text  . . . . . . . . . . . . . .      Entry created by BRM configuration - *

    QIC2GB
```

Figure 8. Changing device using BRM for V3R7

The reverse bold numbers that follow correspond to the reverse bold numbers shown in Figure 8:

1 If, for example, COMPROOM is a defined location, you should change the tape devices to be at the COMPROOM location rather than the default *HOME location. If you have a media library device, such as a 3494 Automated Tape Library Data Server, the Device location parameter should contain the same name as the media library unit.

2 The Next volume message parameter specifies whether you want BRMS/400 to notify you through messages to place another tape into the device. For media libraries (MLB), this parameter should be set to *NO.

3 The Auto enroll media parameter specifies if BRMS/400 should automatically add media used in output operations to the media inventory if the operation has been done using a BRMS/400 media class and is on this device. If you specify *YES, the number of media volumes to be registered to BRMS/400 is increased. This function is *not* available in V3R1.

4 The Shared device support parameter allows a tape device to be shared by multiple systems. When you specify *YES for shared devices, the device is varied on when the save or restore operation begins and is varied off when the save or restore operation ends. You should leave this parameter to *YES if you are planning to share a media library device with more than one AS/400 system. If the command that you are running specifies ENDOPT(*LEAVE), the device is left in a varied on state after your request to save or restore is complete.

5 The Use optimum block size parameter is available with V3R7 and can improve performance significantly. However, the tape volume produced is only compatible with devices that support the block size used (256 KB). Currently, the IBM 3570 and 3590 are the only tape devices that support the increased block size and, therefore, support this parameter. You should consider the following restrictions when you specify *YES for this parameter:

- There are restrictions caused by the AS/400 operating system's inability to duplicate tape when the output tape device uses a block size that is smaller than the size of the blocks being read by the input tape device.

- If the target release is prior to V3R7, the optimum block size is ignored because the AS/400 operating system supports this only in V3R7 and later releases of OS/400.

- Choosing to use the optimum block size causes compression to be ignored.

See Appendix B, "Save and restore tips for better performance" on page 301, for tips on save and restore performance. It also explains how you should set the Data compression and Data compaction parameters on the save commands when using various kinds of tape devices.

Note

All of the settings for devices (for example, shared device support, media library devices, vary on or vary off, allocate unprotected, and so on) depend on which libraries and which level of OS/400 are being used. See Chapter 9, "Implementing automated tape libraries" on page 165, for additional information.

3.5 Media library device

If you have a media library device (MLB), you can define the MLB to the AS/400 system through the Work with Media Libraries (WRKMLBBRM) command. You should select option 1 to add a new media library as shown in Figure 9.

```
                    Add Media Library

 Type choices, press Enter.

 Media library . . . . . . . . . . .   MLB01        Name
 Location  . . . . . . . . . . . .     MLB01        Name, F4 for list
 Library type  . . . . . . . . . . .   *SYSTEM      *SYSTEM, *USRDFN
 Text  . . . . . . . . . . . . . .     IBM 3494 Tape Library Dataserver
```

Figure 9. Add Media Library

Library type *USRDFN permits you to define third-party media libraries. For information on third-party media libraries, refer to *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171).

3.6 Media classes

Media classes define the types of physical media that are used for backup, archive, or recovery operations. Typical physical media are cartridge, reel, or any removable storage medium available on the system. Within each type of physical media, there may be a further distinction by format or capacity.

At the time of installation, BRMS/400 creates media classes to match the tape devices that you have installed on your system. The Shared media parameter is set to *YES for these default media classes.

You may need to create extra media classes if you have tapes that are physically different but can be read by the same tape drive. For example, a 120 MB ¼-inch cartridge is classified differently than a 525 MB ¼-inch cartridge so you create classes with meaningful names, such as QIC120 and QIC525, for each of these cartridge categories.

BRMS/400 creates classes for all media types supported by the drive. The Work with Media Classes (WRKCLSBRM) command can be used to add, change, or remove media classes as shown in Figure 10.

```
                            Add Media Class

 Type choices, press Enter.

 Media class . . . . . . . . . . . .    QIC120        Name
 Density . . . . . . . . . . . . . .    *QIC120_      *FMT3480, F4 for list
 Media capacity  . . . . . . . . . .    *DENSITY      *DENSITY, Number nnnnn.nn
   Unit of measure . . . . . . . . .                  1=KB, 2=MB, 3=GB
 Mark for label print  . . . . . . .    *NONE         *NONE, *MOVE, *WRITE
 Label size  . . . . . . . . . . . .    1             1=6 LPI, 2=8 LPI, 3=9 LPI
 Label output queue  . . . . . . . .    *SYSPCY       Name, *SYSPCY, *PRTF
   Library . . . . . . . . . . . . .                  Name, *LIBL
 Shared media  . . . . . . . . . . .    *YES          *YES, *NO
 Text  . . . . . . . . . . . . . . .    QIC120 shared media class
 Media life  . . . . . . . . . . . .    *NOMAX        Number of days, *NOMAX
 Usage threshold . . . . . . . . . .    *NOMAX        Times used, *NOMAX
 Read error threshold  . . . . . . .    12500         Number (KB), *NOMAX
 Write error threshold . . . . . . .    1250          Number (KB), *NOMAX
 Uses before cleaning  . . . . . . .    *NOMAX        Number, *NOMAX
 Media manufacturer  . . . . . . . .    Lexmark
 Manufacturer part number  . . . . .    DC6150
 Compatible part number  . . . . . .
 Media supplier  . . . . . . . . . .    IBM Direct
 Supplier representative . . . . . .    Rolf Hahn
 Supplier telephone number . . . . .    800-426-2468
 Reorder point . . . . . . . . . . .    *NONE         Number, *NONE
```

Figure 10. Add Media Class

When adding a media class, you must make the text field as descriptive as possible because this field is shown on the WRKCLSBRM display. You should also consider updating the additional options that are accessed through the F10 key. Using these options simplifies the maintenance of your tape library in the future.

An additional media class called SAVSYS is automatically created by BRMS/400 for the alternate IPL tape device. The Shared media prompt (highlighted in bold in

Figure 10) for this media class is set to *NO because you do not want to share your SAVSYS media with other AS/400 systems. If you choose to create your own media class for a SAVSYS operation, we highly recommend that you leave the Shared media prompt set to *NO. This is because the AS/400 system is in a restricted state during a system save. The communication links are not active. Therefore, no check can be made that a shared volume is not also being selected on another system. Using a non-shared volume for SAVSYS avoids this problem.

Beginning with V3R1, BRMS/400 networking provides additional protection for shared media in a shared media library. A DDM job is initiated to verify the status of the tapes any time one system goes to use a tape owned by another system. If DDM communications cannot be established (for example, when you are performing a SAVSYS operation or the communications link is not active), BRMS/400 does not use that tape and chooses another.

> **Hint**
>
> You should consider creating a user media class, such as USER3490, as the default media class so unscheduled saves do not interfere with the regular saves.

3.7 Container classes

If media is to be stored in containers, you can specify container names and descriptions in the container management displays. Using containers is optional, and no default entries are created.

Quarter-inch cartridges can be moved in a container defined by a class, called QICCASE, with a capacity of 20 cartridges.

To update your container classes (Figure 11), you can use the command:

```
WRKCLSBRM TYPE(*CNR)
```

```
                           Add Container Class

 Type choices, press Enter.

 Container class . . . . . . . . . .   QICCASE      Name
 Container capacity  . . . . . . . .   20           Number
 Media classes . . . . . . . . . . .   QIC120       Class, *ANY, F4 for list
                                       QIC525
                                       QIC2GB

 Different expiration dates  . . . .   *NO          *YES, *NO
 Automatic unpack  . . . . . . . . .   *YES         *YES, *NO
 Text  . . . . . . . . . . . . . . .   Quarter Inch Cartridge Tape Container
```

Figure 11. Container class for ¼-inch cartridges

The Automatic unpack value (*YES) in Figure 11 breaks the link between the tape volumes and the container. The media can be used and assigned to another container. Likewise, other volumes can be assigned to the container. Automatic unpack in the container class essentially moves the volume to container *NONE when the volumes have expired. Note that if you move the container to be

*NONE, the container is shown as expired immediately at V3R1. Beginning in V3R6, the container does not expire until after you run the Start Maintenance BRM (STRMNTBRM) command with EXPMED(*YES). You can also use the Start Expiration using BRM (STREXPBRM) command.

3.8 Containers

If you created a container class, you can enroll the containers that you have. When adding the containers to the BRMS/400 database, you need to specify the container ID. This is a unique name for the container similar to the way you specify a volume ID for a tape. You specify the class to which this container belongs and also the current location of the container (Figure 12).

```
                              Add Container

 Type choices, press Enter.

 Container ID  . . . . . . . . . . .     QICCASE001    Name
 Container class . . . . . . . . . .     QICCASE       Name, F4 for list
 Container location  . . . . . . . .     *HOME         Name, F4 for list
```

Figure 12. Adding a container

Once you have added your containers, you can use the change option to change various other parameters for your containers such as the move policy. The other values used in the container definition are changed automatically when containers are used and moved. You might want to manually change either the container status or the move policy if a different container is used than is recommended by BRMS/400. The Change Container option allows you to do this so BRMS/400 knows about any changes you make (Figure 13).

```
                             Change Container

 Container ID  . . . . . . . . . . :     QICCASE001
 Container location  . . . . . . . :     *HOME

 Type changes, press Enter.

 Container class . . . . . . . . . .     QICCASE       Name, F4 for list
 Container status  . . . . . . . . .     *OPEN         *OPEN, *CLOSED
 Volume count  . . . . . . . . . . .     0             Number
 Last moved date . . . . . . . . . .     8/17/00       Date, *NONE
 Expiration date of media. . . . . .     *NONE         Date, *NONE, *PERM
 Move policy . . . . . . . . . . . .     MOVVAULT      Name, F4 for list
 Slot number . . . . . . . . . . . .     2             Number
```

Figure 13. Change Container showing a move policy

3.9 Move policy

When multiple locations are used to store media for one or more AS/400 systems, BRMS/400 tracks the location of the media. You can identify when the media is moved, and reports can be produced providing a complete inventory of media held at a particular location. This is especially useful when recovering from a system failure. The BRMS/400 move policy defines the movement of media

between storage locations and the length of time that the media stays in each location.

A default move policy of OFFSITE is created when BRMS/400 is installed. You may want to modify this move policy or create a new one. For example, if you want to create a new home location of COMPROOM to represent your computer room tape rack, a secure location of FIRESAFE to hold the media for five days, and an off-site location of VAULT, you can create a move policy as shown in Figure 14. COMPROOM, FIRESAFE, and VAULT are all storage locations that are already defined in BRMS/400 using the WRKLOCBRM command.

In this case, the home location is COMPROOM. Once you save data on the tape, it is moved to the FIRESAFE. Five days later, the tape is moved to the VAULT. The tape stays in the VAULT until it expires. Once the tape expires, it is returned to COMPROOM for re-use.

```
                          Create Move Policy                    SYSTEM09

Move policy  . . . . . . . . . .  MOVECOM
Home location  . . . . . . . . .  COMPROOM  ▇1  Name, *SYSPCY, F4 for list
Use container  . . . . . . . . .. *NO          *YES, *NO
Verify moves . . . . . . . . . .▇2 *YES         *YES, *NO
Calendar for working days  . . .  *ALLDAYS     Name, *ALLDAYS, F4 for list
Calendar for move days . . . . .  *ALLDAYS     Name, *ALLDAYS, F4 for list
Text . . . . . . . . . . . . . .  SYS9 - Offsite storage at the Vault


Type choices, press Enter.

   Seq     Location      Duration

   10      FIRESAFE      5
   20      VAULT         *EXP
```

Figure 14. User-created move policy

The reverse bold numbers that follow correspond to the reverse bold numbers shown in Figure 14:

▇1 It is good practice to create your own "home" location for media. When BRMS/400 detects an error in media movement, or when there is an anomaly (for example, if the move policy for active media is accidentally deleted), BRMS/400 moves the tape to default *HOME location as defined by the system policy. Media found in the *HOME location can be easily distinguished from normal moves to the storage location specified in the move policy.

▇2 You can confirm media moves automatically or manually for each move policy. If you choose to confirm media moves automatically, BRMS/400 performs this task for you when you set the Verify moves parameter to *NO. By setting the parameter to *NO, the media is moved immediately as far as BRMS/400 is concerned, although it may not have physically moved to the new location. If you choose to confirm the media moves manually, you are supplied with a Verify Media Movement display to confirm that media movement, scheduled by BRMS/400 according to this move policy, is complete. You leave the Verify moves parameter to *YES, which is the default. The decision to confirm moves comes from two points:

- The experience of the operators. If operators are not experienced, move confirmation ensures that operations personnel move the required volumes to meet the requirements of your backup and recovery plan.

  Note: A tape volume only appears on the Verify Media Moves display *after* the Move Media using BRM (MOVMEDBRM) command is run. See 4.1.5, "Moving media" on page 60, for additional information on this command.

- The number of volumes being moved daily. If many volumes are to be moved daily, performing movement confirmation can be tedious for every volume.

We recommend that you leave the Verify move parameter set to `*YES` until you are completely confident that media is also physically moved to the new location, as indicated by the move policy.

There is no step defined in the move policy to return media to the home location. When the move pattern is complete, the media moves to the home location defined in the move policy. The ability to return to home location is important, for instance, in the case of a media library device (MLB), where tapes are only written to the MLB itself.

Hint

- The value you specify in the *Duration* field is important when you create a move policy. Besides being able to enter the number of days or a specific date that you want to keep the media in that particular location, you can also specify *EXP (expire media) or *PERM (permanent retention in that location). Move policy entries after a *PERM entry are ignored for move processing since move policies move only active volumes that are not assigned a permanent storage location. If you want to retain the volumes permanently for audit records, you should specify *PERM in the duration field.

- If you are planning to use APPEND(*YES) as part of your backup policy, you must make sure that the move policy keeps the tape on-site for enough days. See 3.13.1, "Appending to media rules" on page 44, for details on how BRMS/400 selects volumes for append processing.

For additional information on using the *Calendar* options within a move policy, see *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) for your appropriate release.

3.10 Media policy

The key to a successful implementation of BRMS/400 is the media policy. As shown in Figure 15, the media policy ties together much of the required information to implement BRMS/400. The media policy combines the media management characteristics and defines the retention of the data that is being saved. When saving through BRMS/400, you have to specify a media policy. The media policy directly defines the type and length of retention for data saved on media. It also references the media class and move policy to be used for the save.
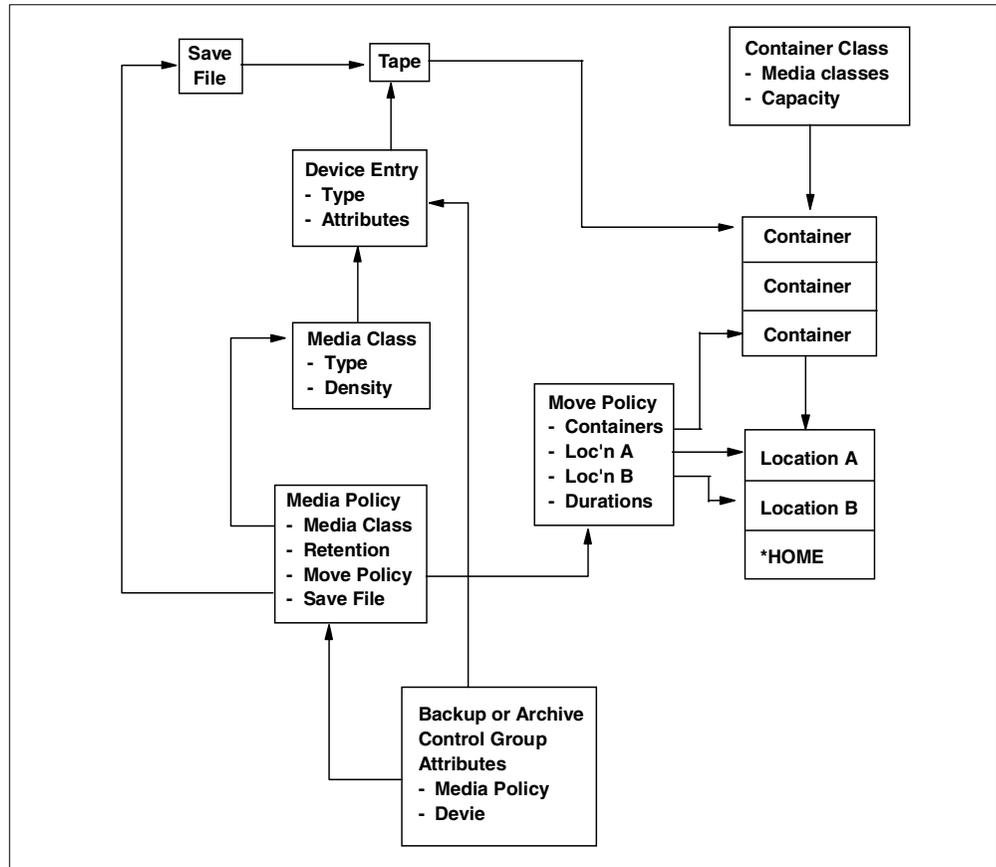
Figure 15. Media management summary

We recommend that you create a media policy for every combination of retention, media location, media class, or move policy that you plan to use.

With the installation of BRMS/400, there are three default media policies:

- FULL (35 days retention) with a move policy of OFFSITE
- INCR (incremental, 14 days retention) with a move policy of *NONE
- ARCHIVAL (1725 days retention) with a move policy of *NONE

Figure 16 on page 30 shows a change to the default media policy FULL to include the MOVECOM move policy that we created earlier.

```
                         Change Media Policy

  Media policy . . . . . . . . . . :    FULL


Type choices, press Enter.

  Retention type . . . . . . . . . .   3            1=Date, 2=Days,
                                                    3=Versions, 4=Permanent
    Retain media . . . . . . . . .     2            Date, Number
  Move policy  . . . . . . . . . . .   MOVECOM      Name, *NONE, F4 for list
  Media class  . . . . . . . . . . .   QIC120       Name, *SYSPCY, F4 for list
  Storage location . . . . . . . . .   *ANY         Name, *ANY, F4 for list
  Save to save file  . . . . . . . .   *NO          *YES, *NO
    ASP for save files . . . . . . .   01           1-16
    Save file retention type . . . .   4            1=Date, 2=Days,
                                                    3=Permanent, 4=None
      Retain save files  . . . . . .   *NONE        Date, Number, *NONE
    ASP storage limit  . . . . . . .   90           1-99
  Required volumes . . . . . . . . .   *NO          *YES, *NO
  Secure volume  . . . . . . . . . .   *NO          *YES, *NO
  Text . . . . . . . . . . . . . . .   SYS9 - Media Policy FULL for QIC120
 Secure volume  . . . . . . . . . .    *NONE        *NONE, 1-9999
 Mark volumes for duplication . . .    *NO          *NO, *YES
```

Figure 16. Change Media Policy example

The Storage location parameter is particularly important when using a save
command that specifies the device as *MEDCLS in the system policy. By
specifying a value other than *ANY in the Storage location parameter, BRMS/400
assures that a save or a restore operation is directed to a proper devices. For
example, if you have a 3490 device in the MLB and a 3490 device as a
stand-alone unit, the *MEDCLS parameter in the system policy directs the save
operation to the MLB or non-MLB device based on the media policy and its
associated storage location value. If *ANY is specified, your save goes to *any*
available tape device. In order for your saves to go directly to the MLB, you have
to specify the location name of the MLB that you have created, such as MLB01.

Important

Use care if you choose versions for retention of media. For example, assume
that you are saving *ALLUSR with a retention of three versions. After the
second save, you delete TESTLIB from your system. The next save does not
include TESTLIB and, therefore, this library never reaches the third version.
Media containing this library, therefore, normally *does not* expire.

To expire the media, you must use the Work with Media using BRM (WRKMEDBRM)
command and select option 7 for the volume to expire the media. Alternatively,
you can use the Start Expiration for BRM (STREXPBRM) command as shown in
Figure 17.

```
                   Start Expiration for BRM (STREXPBRM)

 Type choices, press Enter.

 Active file count  . . . . . . . > 0             0-999
 Active file action . . . . . . . > *EXPMED       *REPORT, *EXPMED
 File retention type  . . . . . . > *VERSION      *ANY, *VERSION
 Select creation dates:
   Beginning creation date  . . .   *BEGIN        Date, *CURRENT, *BEGIN, nnnnn
   Ending creation date . . . . .   *END          Date, *CURRENT, *END, nnnnn
```

Figure 17. Expiring media using the STREXPBRM command

3.11 BRMS/400 policies

Policies define the controls and default values for BRMS/400 and the various operational tasks required for media management and movement, backup, archive, and recovery. The seven types of policies are:

- System policy
- Media policy
- Move policy
- Backup policy
- Archive policy
- Retrieve policy
- Recovery policy

References to the default values can be easily identified by the parameter keywords as follows:

- ***SYSPCY**: System policy
- ***BKUPCY**: Backup policy
- ***ARCPCY**: Archive policy

Be sure to review these policies and update the values to suit your installation.

They can be accessed by selecting option 11 from the BRMS main menu. For additional information, see the "Policy Administration" section in *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171). Archive and retrieve policies are also discussed in 12.1.1, "How archiving is done by BRMS/400" on page 217, and in 12.8, "Retrieval methods" on page 231.

During the initial implementation of BRMS/400, you should review the system policy and the backup policy to ensure that the default values match your backup and recovery strategy.

3.11.1 System and backup policies

The system policy is the same as a set of system values. Unless other controls are in effect, the system policy determines the default for all users. The system policy provides defaults for the following items:

- Default media policy, tape device, location of media

- Whether to sign off interactive users before a backup or archive function is started, or specify a list of users and devices that continue to remain active.

- List of subsystems to check before performing an IPL. If any of the subsystems in the list are active when an IPL is scheduled, BRMS/400 does *not* perform an IPL.
- Presentation controls such as characters used for full backup, incremental backups, and defining the first day of the week.
- License information and default values for displaying BRMS/400 log.

For additional information and explanations for each of these items, see *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171).

An example of changing the system policy is shown in Figure 18.

```
    V3R2M0                  Change System Policy                    SYSTEM09


  Type choices, press Enter.

    Media policy . . . . . . . . . . . . . . FULL          Name, F4 for list
    Devices  . . . . . . . . . . . . . . . . *MEDCLS       Name, F4 for list




    Home location for media  . . . . . . . . *HOME         Name, F4 for list
    Media class  . . . . . . . . . . . . . . QIC120        Name, F4 for list
    Sign off interactive users . . . . . . . *NO           *YES, *NO
    Sign off limit . . . . . . . . . . . . . 30            0-999 minutes
    Output queue . . . . . . . . . . . . . . *PRTF         Name, *PRTF
      Library  . . . . . . . . . . . . . .                 Name, *LIBL
    Day start time . . . . . . . . . . . . . 0:00:00       Time
    Media monitor  . . . . . . . . . . . . . *YES          *YES, *NO
    Shared inventory delay . . . . . . . . . 60            30-9999 seconds
    Auto enroll media  . . . . . . . . . . .  *YES         *NO, *YES
```

Figure 18. Changing defaults for the BRMS/400 system policy

As the need for system availability increases, the window of opportunity for backup decreases. Therefore, it may be necessary to schedule backups before midnight that continue into the following morning.

This presents a challenge to operations to manage the daily backup, since a portion of it will have the next day's date which has an effect on media movement and on expiration. There is also the possibility that the after-midnight media can be confused with the following evening's media.

The Day start time parameter in the System Policy allows you to change the start of day from 0:00:00 to another time (for example, 06:00:00). Any media created before the time set in this parameter is treated as having been created the previous day. Therefore, this makes it much easier to run saves over midnight and keep all of the media together when performing the movements.

You may want to create a special output queue for BRMS/400, such as BRMOUTQ. You can then specify the new output queue in the system policy. This way, all of your BRMS/400 related spooled files are directed to the BRMOUTQ output queue.

You may also want to change the First day of week parameter value in the
Change Presentation Controls display shown in Figure 19.

```
                     Change Presentation Controls              SYSTEM09


Type choices, press Enter.


  Character representing
     full backup  . . . . . . . . . . . F          Character
  Character representing
     incremental backup . . . . . . . . I          Character
  Character representing
     general activity . . . . . . . . . *          Character
  First day of week  . . . . . . . . . . MON        SUN, MON, TUE...
```
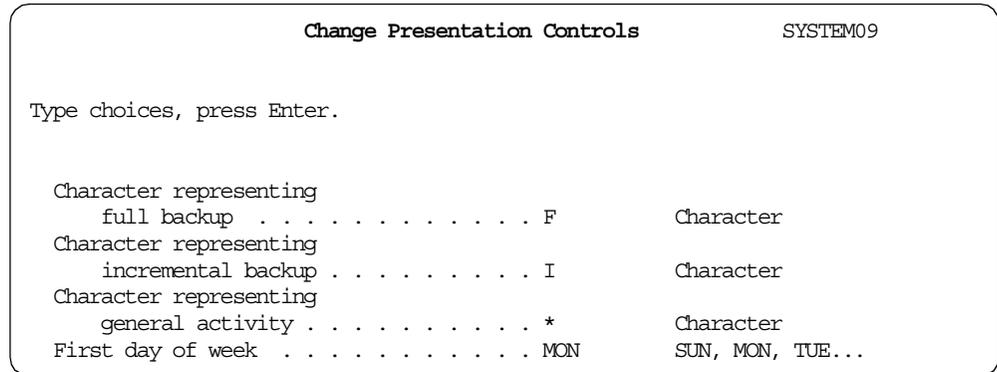
Figure 19. Change Presentation Controls display

Most users prefer Monday as the first day of the week. Therefore, the value
should be changed from SUN to MON (Monday).

As with the system policy, you can also change the backup policy to tailor some
of the parameters based on your backup strategy. For example, you may want to
save the information that forms part of your backup history at the object level
instead of the library level. You can do so by setting the Automatically backup
media information parameter to *OBJ as shown in Figure 20 on page 34. The
default is *LIB.

```
                        Change Backup Policy                        SYSTEM09


    Type choices, press Enter.

    Media policy for full backups  . . . . . *SYSPCY     Name, F4 for list
    Media policy for
       incremental backups . . . . . . . . . *SYSPCY     Name, F4 for list
    Backup devices . . . . . . . . . . . . . *SYSPCY     Name, F4 for list




    Default weekly activity  . . . . . . .[1] FFFFFFF    SMIWTFS(F/I)
    Incremental type . . . . . . . . . .[2]   *CUML      *CUML, *INCR
    Sign off interactive users . . . . . . .  *SYSPCY    *YES, *NO, *SYSPCY
    Sign off limit . . . . . . . . . . . . .  *SYSPCY    0-999 minutes, *SYSPCY
    Save journal files when saving
       changed objects . . . . . . . . . .[3] *NO        *YES, *NO
    Automatically backup
       media information  . . . . . . . . .   *LIB       *LIB, *OBJ, *NONE
    Save access paths  . . . . . . . . .[4]   *YES       *YES, *NO
       Save contents of save files . . . . . *YES       *YES, *NO
       Data compression . . . . . . . . . .  *DEV       *DEV, *YES, *NO
       Data compaction  . . . . . . . . . .  *DEV       *DEV, *NO
       Target release . . . . . . . . . . .  *CURRENT   *CURRENT, *PRV
       Clear  . . . . . . . . . . . . . . .  *NONE      *NONE, *ALL, *AFTER
       Object pre-check . . . . . . . . . .  *NO        *YES, *NO
       Append to media  . . . . . . . . .[5] *NO        *YES, *NO
       End of tape option . . . . . . . . .  *REWIND    *UNLOAD, *REWIND, *LEAV
       IPL after backup . . . . . . . . . .  *SYSPCY    *YES, *NO, *SYSPCY
          How to end  . . . . . . . . . . .  *SYSPCY    *CNTRLD, *IMMED, *SYSPC
          Delay time, if *CNTRLD  . . . . . *SYSPCY    Seconds, *NOLIMIT
          Restart after power down  . . . . *SYSPCY    *YES, *NO, *SYSPCY
          IPL source  . . . . . . . . . . . *SYSPCY    *PANEL, A, B, *SYSPCY
```

Figure 20. Change Backup Policy display

Figure 20 shows a combination of two displays related to changing the backup policy. The numbers in reverse bold that follow correspond to those numbers in reverse bold in Figure 20:

[1] The Default weekly activity parameter specifies how you are going to perform your backups during the week. The weekly activity is seven separate fields where you can enter which type of backup activity you want to occur each day. For example, if you want a full backup (similar to SAVLIB), specify "F" for that week. If you want an incremental backup (similar to SAVCHGOBJ), specify an "I" for that day. A blank indicates that you do not want to perform any backups for that particular day.

[2] The Incremental type parameter specifies the type of incremental backup that you want to use. If you want to save all of the changes to the objects since the last time you performed a full backup, you have to specify the *CUML value for this parameter. This is similar to performing a SAVCHGOBJ command with default values. We recommend that you keep the default value of *CUML. If you want to save the changes to the objects since the last time you performed an incremental backup, you have to specify *INCR for this parameter. This is similar to performing the SAVCHGOBJ command with the reference date (REFDATE) and reference time (REFTIME) values.

3 The Save journal files when saving changed objects parameter specifies whether you want to save files that are being journaled (using the Start Journal Physical File (STRJRNPF) command) during your incremental saves. The default for this value is `*NO`, which means that you rely on your journal receivers to retrieve the changes during the recovery. We recommend that you change this default to `*YES` for ease of use and to reduce the number of steps that you have to complete during recovery.

4 The Save access paths parameter specifies whether you want to save access paths associated with your physical and logical files. We recommend that you save the access paths during your save operations. There are instances where you may find that the overall save operation will take considerably longer if you have access paths over large physical files. There is a tendency not to save these access paths, which can result in a tremendous loss of system availability if you were to recover the file or the system after a disaster.

When you design your backup strategy, it is extremely important to understand how your saves affect your recovery. For example, when you perform full and incremental saves, you are prompted to restore your full saves first followed by incremental saves during disaster recovery. In this case, if you do not do anything, your access paths are rebuilt twice assuming that you did not save them in the first place (once during the restore of your library from full backup set and again during the restore of incremental saves). The recommendation here is to use the Edit Rebuild Access Path (`EDTRBDAP`) command and hold the rebuild of the access paths immediately after the restore of the full save has completed. You can then restore the incremental saves and use the `EDTRBDAP` command to change the sequence number. See *Backup and Recovery - Basic*, SC41-4304, when designing your save and restore strategy.

5 The Append to media parameter specifies whether to add data files on existing media with active files or to begin a new volume. If *YES is specified, files are written to the volume immediately following the last active file. This allows the user to maximize media usage. However, if you want to separate data on separate tapes, you should specify `APPEND(*NO)`. See 3.13.1, "Appending to media rules" on page 44, for more information.

3.11.2 Libraries to omit from backups

Whenever you specify *IBM, *ALLUSR, or *ASPnn in any backup control group, you can also list specific libraries that are omitted from the save operation. This is the simplest way to exclude any library that you do not want to save.

Important

Use this facility with care. As when working with a control group, it is easy to overlook the fact that you have specified omissions in the policy.

Select option 2 from the BRMBKUPCY menu, and add or remove the libraries that you want to omit as shown in Figure 21 on page 36.

```
                    Work with Libraries to Omit from Backups



 Type options, press Enter.
    1=Add    4=Remove

 Opt   Type          Library

  _    _____      _____
  _    *ALLUSR       TEMP*
  _    *IBM          Q1ABRMSF*
  _    *ALLUSR       QGPL
  _    *ALLUSR       QUSRBRM
  _    *ALLUSR       QUSRSYS
  _    *IBM          QMLD
  _    *IBM          QUSRMLD
```

Figure 21. Adding and removing libraries

In the example in Figure 21, all libraries beginning with TEMP are omitted from the *ALLUSR backups. Also, if you are using BRMS/400 to save data to save files, these files are placed in a library called Q1ABRMSFxx, where *xx* is the ASP number in which the library is placed. When a control group containing the *IBM special value is backed up to tape, this save file library is not included in the save. Typically, you use the Save Save File using BRM (SAVSAVFBRM) command to save the save files. They may also be quite large and can take much time and media to back up. Therefore, you may want to omit this library from the *IBM group using the method previously described. See 4.2.1, "Considerations for libraries that affect BRMS/400" on page 65, for information on why the QGPL, QUSRSYS, QUSRBRM, QMLD, and QUSRMLD libraries are not omitted from the backup policy.

3.12 Backup control groups

The backup function is the cornerstone of the BRMS/400 product. It is the option that controls the save process, which ultimately determines how effectively a system can be restored. Careful planning is required in determining a backup strategy before using BRMS/400 (Figure 22).
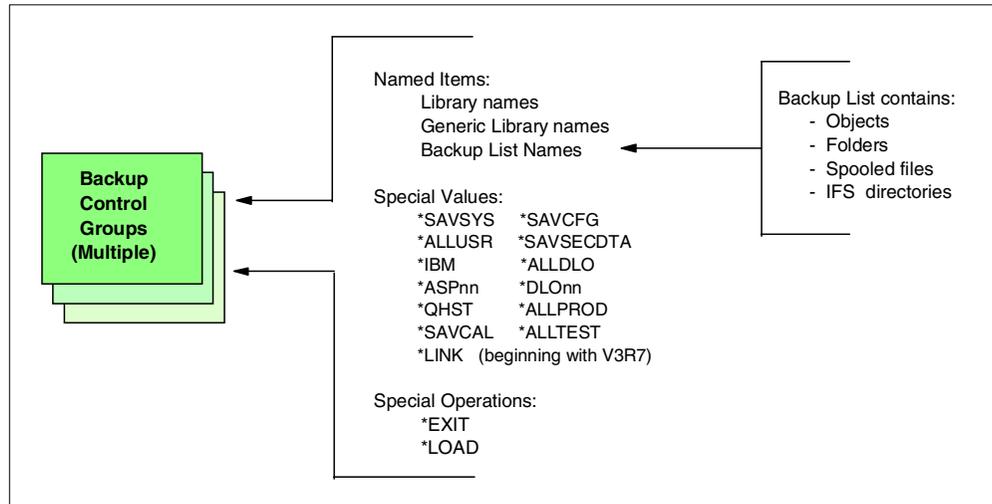
Figure 22. Backup control group

A backup control group can be considered to be an interpretive CL program for performing backup. The advantage over a CL program is that it is easy to create, easy to change, easy to execute, and provides full error checking while maintaining the flexibility and function that a CL program offers, all without requiring CL programming skills. A save strategy for a system consists of multiple backup control groups. These backup control groups define what is backed up and when.

A backup control group can include one or many of the items listed in Figure 22. For example, it can be used to back up a single library, a group of related libraries, a set of objects or folders defined by a Backup List, and certain predefined components of the system such as configuration or security data. It can also include special operations to tell the operator to load a new tape or execute an exit program. This program can send a message to operations or users, start a subsystem, or do anything you choose.

As part of the backup control group, you also must define a *backup activity*. The backup activity identifies which days of the week the backup list performs a backup and whether the backup is a full (save entire object) or incremental (save changed object) save.

You can use the Work with Control Groups (WRKCTLGBRM) command to access the backup control groups on your system (Figure 23 on page 38).

```
                      Work with Backup Control Groups              SYSTEM09

   Position to . . . . . .               Starting characters


   Type options, press Enter
     1=Create    2=Edit entries    3=Copy      4=Delete   5=Display
     6=Add to schedule   8=Change attributes   9=Subsystems to process ...
                      Full        Incr        Weekly
             Control  Media       Media       Activity
   Opt Group          Policy      Policy      SMTWTFS  Text


       *BKUGRP    *BKUPCY    *BKUPCY    *BKUPCY  Entry created by BRM configura
       *SYSGRP    SAVSYS     SAVSYS     *BKUPCY  Entry created by BRM configura
```

Figure 23. Work with Backup Control Groups

3.12.1 Default backup control groups

BRMS/400 automatically creates *BKUGRP and *SYSGRP default control groups for you. The *SYSGRP control group controls backing up IBM data, where the *BKUGRP control group controls backing up user data. By running both of these backup control groups, you can save your entire system. Figure 24 and Figure 25 show the default *backup items* that are saved.

Note

In the examples shown here, both of the displays are from a V4R2 system. In V3R1, you may notice that the backup item of LINKLIST does not exist to save IFS directories. For a workaround, see 6.6, "Saving and restoring V3R1 IFS data with BRMS/400" on page 146. The LINKLIST backup item was added with V3R2 and V3R6. In V3R7, the LINKLIST item was changed to *LINK. See 6.4, "Saving IFS using BRMS/400" on page 137, for additional information on saving IFS directories with BRMS/400.

```
                  Display Backup Control Group Entries            SYSTEM09

   Group . . . . . . . . . . . : *SYSGRP
   Default activity  . . . . : *BKUPCY
   Text  . . . . . . . . . . : Entry created by BRM configuration


                                 Weekly    Retain   Save    SWA
             Backup      List     Activity  Object   While   Message
      Seq    Items       Type     SMTWTFS   Detail   Active  Queue
      10     *SAVSYS              *DFTACT
      20     *IBM                 *DFTACT   *NO      *NO
```

*Figure 24. Backup control group *SYSGRP for backing up IBM data*

```
                  Display Backup Control Group Entries          SYSTEM09

 Group . . . . . . . . . . . : *BKUGRP
 Default activity  . . . . : *BKUPCY
 Text  . . . . . . . . . . : Entry created by BRM configuration

                            Weekly    Retain  Save        SWA
           Backup      List  Activity  Object  While       Message
    Seq    Items       Type  SMTWTFS   Detail  Active      Queue
    10     *SAVSECDTA        *DFTACT   *NO
    20     *SAVCFG           *DFTACT   *NO
    30     *ALLUSR           *DFTACT   *NO     *NO
    40     *ALLDLO           *DFTACT   *NO     *NO
    50     LINKLIST    *LNK  *DFTACT   *NO     *NO
    60     *EXIT             *DFTACT
```

*Figure 25. Default backup control group *BKUGRP for saving all user data*

For your first backup, you should use the default backup control groups to
perform a full save. With the default control groups, you are not able to hold a job
and release certain job queues or subsystems, or save your spooled files. You
have to either change the default control groups or create your own to tailor how
you want to manage your system during a BRMS/400 save. It is important to
understand that BRMS/400 *does not* put the system in a restricted state when it
performs an *ALLUSR save. It is equally important to understand which of the "Q"
libraries are considered to be user libraries when you perform an *ALLUSR or
*ALLPROD save operation. Table 2 on page 40 contains a list of libraries that are
considered as part of an *ALLUSR or *ALLPROD save under BRMS/400.

To avoid conflicts with library locks, we recommend that you end all of the
subsystems prior to starting the *BKUGRP saves. If you have an Integrated PC
Server (FSIOP), you should also vary this off before you start the save.

Hint

A change was made to BRMS/400 implementation to allow for a native RSTLIB
LIB(*ALLUSR) operation to work when the QGPL, QUSRBRM, and QUSRSYS
libraries span across multiple volumes. The following BRMS/400 PTF is
required for your appropriate BRMS/400 release:

- V3R1 - SF37714
- V3R2 - SF37715
- V3R6 - SF37716
- V3R7 - SF37718

When you apply the PTF, BRMS/400 will save the QGPL and QUSRSYS
libraries during the *ALLUSR or *ALLPROD save. It will no longer separate
these libraries and save them ahead of other libraries. The QUSRBRM library
will be saved at the end of your control group, unless it is being omitted. See
the PTF cover letter for additional information.

See 4.2, "Setting up your own control groups" on page 64, for additional
information on creating your own control groups.

3.12.1.1 Libraries saved by *ALLUSR or *ALLPROD in BRMS/400

When you plan your overall backup strategy, it is important to know which of the "Q" libraries are saved when you use the *ALLUSR or *ALLPROD value in your backup control group. Table 2 summarizes the libraries that are saved with the *ALLUSR value, by OS/400 release.

*Table 2. List of Q libraries saved by *ALLUSR or *ALLPROD in BRMS/400*

Library	V3R1	V3R2	V3R6	V3R7
QDSNX	Yes	Yes	Yes	Yes
QGPL	Yes	Yes	Yes	Yes
QGPL38	Yes	Yes	Yes	Yes
QPFRDATA	Yes	Yes	Yes	Yes
QRCL	Yes	Yes	Yes	Yes
QS36F	Yes	Yes	Yes	Yes
QUSER38	Yes	Yes	Yes	Yes
QUSRADSM	No	Yes	No	Yes
QUSRBRM	Yes	Yes	Yes	Yes
QUSRIJS	No	Yes	No	Yes
QUSRINFSKR	No	Yes	Yes	Yes
QUSRRDARS	No	Yes	No	Yes
QUSRSYS	Yes	Yes	Yes	Yes
QUSRV2R3M0	Yes	Yes	Yes	n/a
QUSRV3R0M5	n/a	Yes	Yes	Yes
QUSRV3R1M0	n/a	Yes	Yes	Yes
QUSRV3R2M0	n/a	n/a	n/a	Yes

3.12.2 Job queue processing from control group

After adding the libraries you want to omit, you can specify the job queues that you may want to hold during the control group processing. For example, you can use BRMSJOBQ to submit jobs from the control group using exits (*EXIT). BRMS/400 releases this job queue once all of the backup items specified in your control group have finished processing.

From the Work with Backup Control Groups display, select F9 to go directly to the Job Queues to Process display (Figure 26). Enter the values for BRMS JOBQ as shown in Figure 26. You must ensure that the BRMS JOBQ is created on your system and that you have added a job queue entry to your default batch subsystem description. In most cases, this is the QBATCH subsystem.

```
                          Job Queues to Process                    SYSTEM09

   Use . . . . . . . . . . :   *BKU
   Control group . . . . :   WKLIBM09


   Type choices, press Enter.


    Seq      Job queue       Library       Hold        Release


    10       BRMSJOBQ        QGPL           *YES         *YES
```

Figure 26. Job Queues to Process

3.12.3 Subsystem processing from control groups

You can also include a list of subsystems that you may want to shut down and restart (if required) after the backup control group has completed. In BRMS/400 V3R1, this requires some thought and sometimes using *EXIT coding because the subsystems that are stopped prior to backing up the contents of the control group are restarted again afterwards.

Another area for special attention is when a control group specifies a weekly activity that, for example, excludes Mondays, and that control group is run on a Monday.

Note: The subsystems are still brought down even though there is no subsequent save.

Beginning with V3R6 and V3R2, BRMS/400 provides enhanced subsystem and job queue processing that addresses these challenges.

It is now possible to end a subsystem in one control group, but not to restart it until a subsequent control group has been processed. This also applies to job queues to be held and released.

From the Work with Backup Control Groups display, go to your backup control group and select option 9 to create a list of subsystems that you want the control group to process.

Figure 27 on page 42 shows how you can end the subsystems at the start of one control group (EDELM09) and restart them when you have completed processing another control group (SAVIFS).

```
                        Subsystems to Process                    SYSTEM09

      Use . . . . . . . . . :   *BKU
      Control group . . . . :   EDELM09


      Type choices, press Enter.
                                       End

        Seq     Subsystem     Library      Option     Delay     Restart



        10      QINTER        *LIBL        *IMMED                *NO
        20      QCMN          *LIBL        *CNTRLD    300         *NO ∎1
```

Figure 27. Ending subsystems in the EDELM09 control group

Subsystems QINTER and QCMN are ended by backup control group EDELM09
∎1. They will remain ended after the control group has finished processing (Figure
28).

```
                        Subsystems to Process                    SYSTEM09

      Use . . . . . . . . . :   *BKU
      Control group . . . . :   SAVFIFS


      Type choices, press Enter.
                                       End

        Seq     Subsystem     Library      Option     Delay     Restart



        10      QINTER        *LIBL        *NONE                 *YES ∎2
        20      QCMN          *LIBL        *NONE                 *YES
        30      QSERVER       *LIBL        *CNTRLD ∎3  300         *YES
```

Figure 28. Restarting ended subsystems in the SAVIFS control group

The backup control group SAVIFS will restart subsystems QINTER and QCMN
after it has finished processing ∎2.

The backup control group SAVIFS also has an additional subsystem to end
(QSERVER) and restart after it has finished processing ∎3.

You now need to ensure that your backup control group attributes are set
correctly, as per your backup and media policies. From the Work with Backup
Control Groups display, select option 8 for your backup control group. This brings
up the Change Backup Control Group Attributes display shown in Figure 29.

```
                    Change Backup Control Group Attributes

    Group  . . . . . . . . . . . . . . . . :  WEEKLY09

    Type information, press Enter.

    Media policy for full backups  . . . . . WEEKLY09     Name, F4 for list
    Media policy for
        incremental backups  . . . . . . . . WEEKLY09     Name, F4 for list
    Backup devices . . . . . . . . . . . . . *MEDCLS      Name, F4 for list




    Sign off interactive users . . . . . . . *BKUPCY      *YES, *NO, *BKUPCY
    Sign off limit . . . . . . . . . . . . . *BKUPCY      0-999 minutes, *BKUPCY
    Default weekly activity  . . . . . . . . *BKUPCY      SMTWTFS(F/I), *BKUPCY
    Incremental type . . . . . . . . . . . . *BKUPCY      *CUML, *INCR, *BKUPCY
    Automatically backup media information . *BKUPCY      *LIB, *OBJ, *NONE, *BKU
```

Figure 29. Change Backup Control Group Attributes

You should change the Media policy for full backups, Media policy for incremental backups, and the Backup devices parameters to the appropriate values. In our example, we used WEEKLY09 for the media policy and *MEDCLS for the backup device values.

Additional options for the backup control group attributes are discussed in 4.2.6, "Backup control group attributes" on page 69. Review these options and set them appropriately to reflect your installation requirements.

3.13 Enrolling and initializing media

You can enroll media to the media inventory or initialize it for processing by using one of the following approaches:

- Work with Media (WRKMEDBRM) command and select option 1 (Add)
- Add Media to BRM (ADDMEDBRM) command
- Add Media Library Media to BRM (ADDMLMBRM) command to add volumes to a media library (MLB) such as the 3494 Automated Tape Library Data Server

Media can be enrolled into the BRMS/400 media inventory at any time. The only requirement is that the media must be known to BRMS/400 prior to any save or restore operation.

To add media to BRMS/400, use the ADDMEDBRM command as shown in Figure 30 on page 44.

```
                        Add Media to BRM (ADDMEDBRM)

Type choices, press Enter.

Volume identifier  . . . . . . . >  A10001         Character value
Media class  . . . . . . . . . . >  QIC120         NETCHK, QIC1000, QIC120...
Number to add  . . . . . . . . .    6              1-999
Initialize tape  . . . . . . . .    *NO            *NO, *YES
Text . . . . . . . . . . . . . . >  'Setup media for QIC120'
Expiration date  . . . . . . . .    *NONE          Date, *PERM, *NONE
System . . . . . . . . . . . . .    *LCL
Creation date  . . . . . . . . .    *CURRENT       Date, *CURRENT

                            Additional Parameters

Location . . . . . . . . . . . .    SCRATCH        *HOME, COMPROOM, LOCATION3...
Slot number  . . . . . . . . . .    *none          1-999999, *NEXT, *NONE
  Last moved date  . . . . . . .    *NONE          Date, *NONE
  Container ID . . . . . . . . .    *NONE          *NONE, TEST01
```

Figure 30. Adding media using the ADDMEDBRM command

You can also use the `ADDMLMBRM` command as described in Figure 136 on page
188. You need to decide whether you want to initialize the media during
enrollment. This is done using the Initialize tape parameter on both commands.

3.13.1 Appending to media rules

If you are planning to use APPEND(*YES) as part of your backup control groups,
or as part of your backup policy, you must ensure that the volumes are still
available on-site. The rules that BRMS/400 uses when selecting a media for
append are as follows:

- Selection is done for all devices (media libraries and stand alone devices). For
  media libraries, selection is done automatically. For stand-alone drives, the
  BRM1472 message is issued nominating a "suitable" candidate volume or
  volumes.

- BRMS/400 selects an active volume that matches the requesting media
  policies, and the volume must pass the following checks:

  – Same expiration date
  – Owned by the requesting system
  – Same move policy
  – Same secure attributes

- If BRMS/400 is unable to identify a suitable volume in the previous point, it
  tries to find a volume with an earlier expiration date, starting with the earliest.
  All other tests must match.

- If BRMS/400 is unable to identify a suitable volume in the previous point, it
  selects an expired volume from the same system.

- If no expired volumes are available in the previous point, BRMS/400 selects an
  expired volume from another system that can be contacted through DDM if
  you have a media library.

3.13.2 Media security

BRMS/400 enrolled media cannot be initialized by using the native OS/400 Initialize Tape (INZTAP) command with option *NO. If you use this command, the exit program detects that you have BRMS/400 installed. It then checks to see whether the user has *SECOFR, *SAVSYS, *SERVICE, or *ALLOBJ special authority and allows the media to be initialized. If the user does not have proper authority, BRMS/400 issues the BRM1726 message indicating that the user does not have appropriate authority to initialize the media. The user is asked to use the INZMEDBRM command instead.

INZMEDBRM is a BRMS/400 command, and when it is used with CHECK(*NO), it checks the BRMS/400 database to see if the media that you are trying to initialize is expired. If the media contains active files, the command fails with an error. Therefore, BRMS/400 prevents accidental initialization of active media.

3.13.3 Extracting media information from non-BRMS saves

You can enroll tapes that were not created through BRMS/400 by using one of two ways. You can use the Add Media Information to BRM (ADDMEDIBRM) command, or you can use the Extract Media Information (EXTMEDIBRM) command. Both commands support file-level information only. You cannot transfer object detail information from a non-BRMS/400 created volumes using any BRMS/400 commands. This restriction is due to OS/400 not being able to support the DSPTAP command with DATA(*SAVRST) to an output file. If you require BRMS/400 to hold object detail information, you have to first restore the library and then save the library again using BRMS/400 with object details.

Note

Beginning with V3R7, you can perform a DSPTAP operation to an output file as long as you use *LABEL information *only*. The output file option is not valid for the *SAVRST option.

3.13.3.1 The ADDMEDIBRM command

The ADDMEDIBRM command allows you to add library-level information to the BRMS/400 media inventory. The information gathered by this command is stored in the QA1AHS history file. This command also allows you to enter the original save date and save time, along with the number of objects that were saved in a particular library. This command requires that you to have a printout from the DSPTAP command using DATA(*SAVRST) for input.

With the ADDMEDIBRM command, you have to manually enter data for each sequence number that appears on the tape or on the printout as shown in Figure 31 on page 46.

```
                Add Media Information to BRM (ADDMEDIBRM)

 Type choices, press Enter.

 Volume . . . . . . . . . . . . . > A00001        Character value
               + for more values   _____
 Volume sequence  . . . . . . . . > 1             1-9999
 Sequence number  . . . . . . . . > 1             1-9999
 File label . . . . . . . . . .    *TYPE
 Type . . . . . . . . . . . . .    *LIB           *LIB, *ALLDLO, *SAVCAL..
 Library  . . . . . . . . . . . > APILIB          Name
 File origin  . . . . . . . . . > *SAVLIB         *FILE, *SAVLIB, *SAVOBJ
 Entry date.. . . . . . . . . . > '02/01/01'      Date, *CURRENT
 Entry time . . . . . . . . . . > '10:35:00'      Time, *CURRENT
 Expiration date  . . . . . . . .  *PERM          Date, *PERM, *VERnnn
 Device . . . . . . . . . . . . > TAP02           Name, *NONE
               + for more values
                          Additional Parameters

 Objects saved  . . . . . . . . .  1              1-999999
 Objects not saved  . . . . . . .  0              0-999999
 Auxiliary storage pool ID  . . .  1              1-16
```

Figure 31. Add Media Information to BRM display

You need to perform the following steps to record media content information
using the ADDMEDIBRM command:

1. Use the DSPTAP command with DATA(*SAVRST) to produce a printout of your tape
   volume for reference.

2. Add your media to BRMS/400 using the ADDMEDBRM command.

3. Run the ADDMEDIBRM command. Specify the name of the tape drive where the
   volume is, the saved library name, the file origin, date and time of the save,
   and the number of objects saved. This is where you have to check your
   DSPTAP report listing to see how your libraries were saved, the sequence
   number, the number of objects that were saved, and the date and time they
   were saved.

   You have to use this command for every library or sequence number that is on
   the saved tape.

4. Check the media contents information after the ADDMEDIBRM command has
   completed using WRKMEDBRM command or WRKMEDIBRM command.

5. Move the media to the appropriate storage location.

You cannot use the ADDMEDIBRM command to add media contents information
for a volume that contains active files or that is not expired.

The BRMS/400 recovery reports will include information so that you can use the
media for recovery purposes.

Besides using the ADDMEDIBRM command to register non-BRMS tapes, you
can also use this command to register library-level information if you have an
*ALLUSR, *ALLPROD, or *ALLTEST save that *aborted* during the save.

When BRMS/400 performs a save operation, it creates a temporary file in the
QTEMP library called QA1ASLIB, which contains important post-processing
information about your save, such as the *save type* that should be created in the
media content information file. For example, a full save will create a save type of
*FULL, or an incremental save will create a save type of *CUML or *INCR. This
file also holds the number of objects that are saved or not saved. If your
BRMS/400 save operation aborts due to a tape failure, a user error, or a system
error, the QA1ASLIB file in library QTEMP will be deleted when your job ends
abnormally. Therefore, the crucial post-processing of the QA1ASLIB file that
updates QA1AHS file (media history records) cannot happen. BRMS/400 has no
knowledge of what was saved on the tapes up to the point of failure. Without this
information, and a value greater than zero in the *number of objects saved* field
when you display media information (using the WRKMEDIBRM command and
option 5), BRMS/400 *cannot* perform a recovery of the saved contents, and the
media volumes *will not* appear on your recovery reports.

The following options are available to circumvent this situation:

• Restart your control group processing again. This may not be suitable if your
  save terminated after several hours and you need to make the system
  available to your users.

• Rebuild the media information from the tape using the `DSPTAP` command and
  the `ADDMEDIBRM` command. This can be *very* time consuming. Depending on
  when your save job terminated, you may find that the safest and the
  recommended approach is to restart backup control group.

  If you do not have the time to restart the backup control group, and you have
  to release the system to the users, you can perform the following steps to
  create media information, after you have completed saving the remaining data
  from the point of failure. These steps may vary depending on how your backup

control groups are set up and when the save job terminated abnormally. You must *thoroughly* understand the entire process of verifying your media using the DSPTAP command with the WRKMEDIBRM command before you begin.

a. Display the contents of all your save tapes with DATA(*SAVRST) OUTPUT(*PRINT) options. Use this report to compare the information displayed with the command:

WRKMEDIBRM CTLGRP(*control group name*)

Depending on how BRMS/400 "built" the list of libraries to be saved, it is possible that not all libraries on the tapes need to be processed by the ADDMEDIBRM command.

b. Remove the history records from the WRKMEDIBRM command that show the status of *FILE, with a value of zero for the number of objects saved.

c. From the WRKMEDBRM display, you need to expire the media volumes. The ADDMEDIBRM command needs expired volumes. Your data on the media volumes will not be deleted and can still be accessed using the native OS/400 restore commands.

d. Use the ADDMEDIBRM command to add each sequence number from the DSPTAP report, providing information for the volume name, volume sequence number, save sequence number, file label, the type of save command that was used to perform the save, the date and time of the save, and the number of objects saved.

Note: This process is time consuming, so please be patient!

e. Verify the media information using the WRKMEDIBRM command.

f. You should check if a move policy is attached for the media you have enrolled. If not, use the following command for your media volumes:

CHGMEDBRM MOVPCY(*move policy name*)

The MOVMEDBRM command will then initiate your move processing.

g. Verify your media moves.

3.13.3.2 The EXTMEDIBRM command

The EXTMEDIBRM command should allow you to extract media information from a non-BRMS/400 created tape. It gathers information at the library level. The EXTMEDIBRM command scans through a tape and builds content information for the BRMS/400 history file, without having to key in each sequence number as with the ADDMEDIBRM command.

Important

At the time this redbook was written, the EXTMEDIBRM command registered the media content information as *FILE, instead of using *FULL, *INCR, *CUML, and so on. You cannot recover data that has a save type of *FILE, with no saved objects in it. BRMS/400 recovery will be enhanced so that it will allow you to recover *FILE save types at a future date. Until then, you *must not* use the EXTMEDIBRM command.

3.14 Backing up using BRMS/400 control groups

You can perform a full system backup with BRMS/400 using the supplied default backup control groups *SYSGRP and *BKUGRP or by using similar user-defined control groups.

The *SYSGRP control group contains the *SAVSYS and *IBM special values that save OS/400 and IBM Licensed Program Products (mostly, the Q-libraries). It also includes *SAVSECDTA and *SAVCFG data.

The contents of *SAVSYS and *IBM change infrequently, usually only when:

- Applying PTFs
- Adding a new program product
- Performing a release upgrade

The *SAVSECDTA command and *SAVCFG values can be run separately and do not require restricted state processing. They should be scheduled frequently.

Restricted state saves, such as the *SAVSYS save, must be run from the system console. Beginning with V3R2 and V3R6, the console monitor function allows saves to be run in a secure unattended mode. See 4.5, "BRMS/400 console monitor" on page 87, for information on how you can use console monitoring to schedule unattended saves. Prior to this function, you were unable to schedule unattended saves without security exposures. For example, if the console is left unattended, there is nothing to stop someone from issuing the ENDRQS command (ALT and SYSREQ keys) and obtaining access to a command line.

Control group *SYSGRP should use a media class with the Shared media parameter set to *NO. The reason for this is because the network media inventory cannot be updated when a system is in a restricted state (communication links that are at a varied on status to manage media integrity). Selecting SHARE(*NO) prevents accidentally overwriting of active tape volumes.

Control group *BKUGRP contains the special values *SAVSECDTA, *SAVCFG, *ALLUSR, *ALLDLO, and link list (*LNK, *LINK, or LINKLIST depending on the BRMS/400 release). This control group saves the non-system portion of your AS/400 system, such as user libraries, documents, and folders, and IFS directories. This control group can use media belonging to a media class with SHARE(*YES) and typically uses your fastest drive. It can be scheduled to run unattended providing there are enough expired media volumes of the correct class.

You can run the STRBKUBRM CTLGRP(*BKUGRP) command interactively, or in batch, or use a job scheduler. You can also use the Console Monitor function to perform unattended saves.

To invoke a backup using BRMS/400, you can issue any of the save commands such as:

- Save DLO using BRM (SAVDLOBRM)
- Save Folder List using BRM (SAVFLRLBRM)
- Save Library using BRM (SAVFLRBRM)
- Save Object using BRM (SAVOBJBRM)
- Save Object List using BRM (SAVOBJLBRM)
- Save Save Files using BRM (SAVSAVFBRM)

- Save System using BRM (SAVSYSBRM)
- Start Backup using BRM (STRBKUBRM)

Your media inventory is now managed through BRMS/400, set by the Media monitor parameter in the system policy. Although you can still use the native save commands, such as SAVDLO, SAVLIB, SAVOBJ, and so on, we recommend that you perform all of your save operations using BRMS/400 commands at all times unless there are exceptions. For example, you can use the native save commands to save objects for distribution using SNADS. You can also use the ObjectConnect commands to perform concurrent save and restore operations on your target system. The ObjectConnect method can be faster and requires less setup time. See *Upgrading to Advanced Series PowerPC AS*, SG24-4600, or *Backup and Recovery - Basic*, SC41-4304, for V3R7, for more information on ObjectConnect.

Another important factor to saving your system using BRMS/400 is the availability of media in the right class. You must ensure that you have enough save media (also sometimes known as *scratch volumes*) before you begin the save operation. Beginning with V3R2 and V3R6, you can use the Check Expired Media for BRM (CHKEXPBRM) command to check that you have sufficient media for your backups based on the media class or media location. You can run the STRBKUBRM command for a particular backup control group. In our example, we used the backup control group of SETUPTEST that contains some user libraries for test purposes (Figure 32). We recommend that you perform a total system save using BRMS/400.

```
                    Start Backup using BRM (STRBKUBRM)

 Type choices, press Enter.

 Control group  . . . . . . . . . > SETUPTEST     *BKUGRP, *SYSGRP, DEREKTEST
 Schedule time  . . . . . . . . .   *IMMED        hhmm, *IMMED
 Submit to batch  . . . . . . . .   *YES          *CONSOLE, *YES, *NO
 Starting sequence:
   Number . . . . . . . . . . . .   *FIRST        1-9999, *FIRST
   Library  . . . . . . . . . . .   *FIRST        Name, *FIRST
 Append to media  . . . . . . . .   *CTLGRPATR    *CTLGRPATR, *BKUPCY, *YES...
 Job description  . . . . . . . .   *USRPRF       Name, *USRPRF
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
 Job queue  . . . . . . . . . . .   *JOBD         Name, *JOBD
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
```

Figure 32. Backing up the SETUPTEST control group

3.15 Reviewing BRMS/400 log and media status

With the Display Log using BRM (DSPLOGBRM) command, you can see BRMS/400 activity and the details of your save. You can find additional information about saved objects with option 9 on the Work with Media Information (WRKMEDIBRM) display, or by selecting option 13 on the Work with Media (WRKMEDBRM) display. A sample output is shown in Figure 33 for your reference.

```
10
  6/08/00  15:52:18                                     Position to . . . . 6/08/00

  ----------------------------------------------------------------------------
  Volume D09002 expired.
  Begin processing for control group SETUPTEST type *BKU.
  Selecting devices with density *QIC120 for control group SETUPTEST type *BKU.
  Devices TAP01 will be used for control group SETUPTEST type *BKU.
  Interactive users are allowed to stay active.
  Starting SAVSECDTA to device TAP01.
  All security objects saved.
  Save security data (SAVSECDTA) complete.
  Starting save of library A960103D to devices TAP01.
  8 objects saved from library A960103D.
  Control group SETUPTEST bypassed automatic save of media information.
  SETUPTEST *BKU 0030 *EXIT SNDMSG MSG('Backup SETUPTEST ENDED') TOUSR(*SYSOPR)
  Control group SETUPTEST type *BKU processing is complete.
  Last run date for BRM maintenance was 06/05/00.
```

Figure 33. BRMS/400 log information

Hint

A PTF is provided to include all CPF37xx messages in the BRMS/400 log.
These messages provide information on objects that are not saved. Without
these PTFs, you either have to retain object-level information on the backup
control group, or review the system job log. The PTFs, which were correct at
the time this redbook was published, include:

```
    V3R1      SF33794
    V3R2      SF33795
    V3R6      SF33797
    V3R7      SF33798
```

Note: Providing this information may affect system performance. If you want to
disable this function, you may do so by typing a `1` in position 213 of the
Q1APRM data area in the QUSRBRM library. You can re-enable this function
by changing position 213 of the data area back to ` ` (blank) as shown in the
following example:

```
          Backup
  Seq     Items         Exit command


   10     *EXIT         CHGDTAARA DTAARA(QUSRBRM/Q1APRM (213 1)) VALUE('1')
   20     QUSRSYS
   30     *EXIT          CHGDTAARA DTAARA(QUSRBRM/Q1APRM (213 1)) VALUE(' ')
```

3.16 BRMS/400 reports and maintenance

Normally, you can display which objects are saved and where they are saved
through the BRMS/400 displays. You can also use the BRMS/400 displays to
assist in the restore.

On a single system, if the QUSRBRM library is lost as in a complete system
failure, you cannot do this. For this reason, you should always have a printed
Recovery Analysis report available. If you have systems in a network with OS/400

V3R6 or later, you can use the Receive Media Information function to maintain media content information at a central site. You can print the recovery report from this central site.

The Recovery Analysis report is printed by default with the Start Maintenance for BRM (STRMNTBRM) command. The recovery analysis report can also be generated by the Start Recovery using BRM (STRRCYBRM) command. It is good practice to run these reports at the end of the daily save and to include the most up-to-date recovery analysis report with the media when you move your system backup off-site. See 10.1.1, "Synchronizing maintenance, movement, and recovery reports" on page 193, for additional information.

Maintenance should be run regularly for BRMS/400 using the STRMNTBRM command. One of the ways you can ensure that the maintenance task is run is to add an exit routine in the control group. Apart from its housekeeping tasks, the maintenance job also produces reports for recovery analysis, backup activity, and expired media. These reports can also be separately produced, if required. See 4.1.4, "Performing daily checks" on page 58, for additional information.

It is also possible to run media movement using the Run media movement parameter during the maintenance. However, for several reasons, particularly in a networking situation, you should avoid setting this parameter to *YES. The media movement is done separately using the Move Media (MOVMEDBRM) command. In a complex BRMS/400 environment with many daily changes, performing the STRMNTBRM command with MOVMED(*YES) can also take some time to complete (Figure 34). See 4.1.5, "Moving media" on page 60, for more information on media movement.

```
                   Start Maintenance for BRM (STRMNTBRM)

 Type choices, press Enter.

 Expire media . . . . . . . . . .    *YES          *YES, *NO
 Remove media information:
   Media contents . . . . . . . .    *EXP          *EXP, *REUSE, *NONE
   Object level detail  . . . . .    *MEDCON       1-9999, *MEDCON
 Run media movement . . . . . . .    *yes          *NO, *YES
 Remove log entries:
   Type . . . . . . . . . . . . .    *ALL          *ALL, *NONE, *ARC, *BKU...
   From date  . . . . . . . . . .    *BEGIN        Date, *CURRENT, *BEGIN, nnnnn
   To date  . . . . . . . . . . .    90            Date, *CURRENT, *END, nnnnn
 Change BRM journal receivers . .    *YES          *YES, *NO
 Print expired media report . . .    *YES          *YES, *NO
 Print backup activity report . .    *YES          *YES, *NO
 Print recovery reports . . . . .    *ALL          *ALL, *NONE, *RCYANL...
```

Figure 34. Start Maintenance for BRM example

Unless circumstances dictate otherwise, you should use the RMVHST(*REUSE) option to preserve the media content information until the media is reused. You may want to use Change Command Default (CHGCMDDFT) command to permanently make this change.

If you decide to manually verify media movement by setting the Verify moves parameter to *YES in your move policies, you should use the Verify Media Moves (VFYMOVBRM) command (Figure 35).

Note: A tape volume only appears on the Verify Media Moves display *after* the MOVMEDBRM command is run.

```
                          Verify Media Moves                          SYSTEM09


    Type options, press Enter.  Press F16 to verify all.
       1=Verify   4=Cancel move   9=Verify and work with media


          Volume  Creation  Expiration                Move
    Opt   Serial   Date       Date      Location      Date      Container
          D09R01   6/07/00    6/07/00   COMPROOM     6/08/00    *NONE
          D09R45   5/29/00   *VER 002   VAULT        6/08/00    *NONE
     1    D09002   6/08/00   *VER 002   COMPROOM    *VER 002    *NONE
          D09003   5/29/00   *VER 002   VAULT        6/08/00    *NONE
          D09004   5/29/00   *VER 002   VAULT        6/08/00    *NONE
```

Figure 35. Verify Media Moves

An important BRMS/400 report called "Recovering your Entire System" can be found in the spooled file, QP1ARCY, if you chose to print recovery reports. You should *always* produce two copies. The first copy should be kept on-site, for assistance with your recovery from media that is stored on-site. The second copy should be sent off-site, along with your media to protect against disasters. See 10.2, "Recovering an entire system (starting with lIcensed Internal Code)" on page 195, for more information on recovery.

3.17 Current status of media and save activity

Once you save the various libraries, you can use the Work with Media Information (WRKMEDIBRM) command to review your save activity as shown in Figure 36 on page 54. This display can also be used as a starting point for restoring objects or working with media on which the objects are saved.

```
                        Work with Media Information                    SYSTEM09

     Position to Date . . . . .

     Type options, press Enter.
       2=Change    4=Remove    5=Display    6=Work with media    7=Restore
       9=Work with saved objects

          Saved                          Save    Volume    File   Expiration

   Opt   Item          Date      Time     Type    Serial    Seq      Date

         FLR          5/29/00   18:48:08  *FULL   D09003      5    *VER 002
         LINKLIST     5/29/00   18:49:03  *FULL   D09003 +    6    *VER 002
         QDOC         6/03/00    9:16:38  *FULL   *SAVF             6/04/00
         QDOC         6/03/00    9:16:50  *FULL   *SAVF             6/04/0
         MCBRYDC      6/06/00   15:12:17  *FULL   *SAVF             7/11/00
         QUSRBRM      6/06/00   15:12:36  *QBRM   *SAVF             7/11/00
         MCBRYDC      6/07/00   16:38:12  *FULL   D09R01      1     6/07/00
         QUSRBRM      6/07/00   16:38:48  *QBRM   D09R01      2     6/07/00
         *SAVSECDTA   6/08/00   15:49:31  *FULL   D09002      1    *VER 002
         A960103D     6/08/00   15:51:24  *FULL   D09002      2    *VER 002
```

Figure 36. Work with Media Information example

It is worth noting that the WRKMEDIBRM display shows the most recent entries by save date and time on the display. That is, it positions itself at the bottom of the list. You must page back to see earlier backup activity. You can also produce a report by specifying OUTPUT(*PRINT) for the WRKMEDIBRM command.

Note

If your backup control group processing ends abnormally, you may find that some of the entries for the Type value in the Work with Media Information display is set to *FILE. When you display these entries, they will have a value of zero for the number of objects saved. At present, BRMS/400 does not allow for *FILE entries to be recovered, and you media volumes will not appear on the Recoverying Your Entire System report. We recommend that you restart the control group save again. See 3.13.3.1, "The ADDMEDIBRM command" on page 45, for more information on recovering from control groups that have terminated abnormally.

You can also use the WRKMEDBRM command to display or print the current status of your media inventory as shown in Figure 37. You can selectively display or print volumes that are active, expired, or both. You can use this display to change the media class of your tapes or display the contents of your tapes. This display can also be used to list the tapes that have expired and are available for re-use.

```
                        Work with Media                        SYSTEM09

Position to . . . . . .          Starting characters

Type options, press Enter.
  1=Add       2=Change      4=Remove      5=Display
  6=Work with media set     7=Expire      8=Move    10=Reinitialize ...

     Volume          Creation Expiration                 Move    Media    Dup
Opt Serial  Expired    Date      Date     Location       Date    Class    Sts

    D09003 +          5/29/00  *VER 002   VAULT         6/09/00  QIC120     *
    D09004 +          5/29/00  *VER 002   VAULT         6/09/00  QIC120     *
    D09098   *YES     5/31/00   5/31/00   COMPROOM      6/07/00  QIC120     *
    D09099           5/29/00  *VER 002   VAULT         6/05/00  QIC120     *
    D99999   *YES     5/31/00  *NONE      *HOME         *NONE    QIC120
    SYSM05   *YES     6/04/00  *NONE      *HOME         *NONE    NETCHK
    SYSM09   *YES     6/04/00  *NONE      *HOME         *NONE    NETCHK
```

Figure 37. Work with Media example

You should also use the Display Backup Plan (DSPBKUBRM) command to display a
summary of all of your backup control groups that you set up and the backup
items that you specified for each of your backup control groups as shown in
Figure 38.

```
                        Review Backup Plan                     SYSTEM09


                                 Weekly   Incremental Full      Retain
Control      Save       List    Activity  Media       Media     Object
Group        Item       Type    SMIWTFS   Policy      Policy    Detail
*BKUGRP      *SAVSECDTA         FFFFFFF   FULL        FULL      *NO
             *SAVCFG            FFFFFFF   FULL        FULL      *NO
             *ALLUSR           FFFFFFF   FULL        FULL      *NO
             *ALLDLO           FFFFFFF   FULL        FULL      *NO
             *EXIT             FFFFFFF   FULL        FULL
*SYSGRP      *SAVSYS           FFFFFFF   SAVSYS      SAVSYS
             *IBM              FFFFFFF   SAVSYS      SAVSYS    *NO
RHAHN        RHAHN      *OBJ   FFFFFFF   DAILY       DAILY     *NO
             RHAHN2     *OBJ   FFFFFFF   DAILY       DAILY     *NO
             BRMTEST    *OBJ   FFFFFFF   DAILY       DAILY     *NO
A960103A     A960103B          FFFFFFF   REEL        REEL      *YES
             A960103C          FFFFFFF   REEL        REEL      *YES
             A960103D          FFFFFFF   REEL        REEL      *YES
                                                                More...
```

Figure 38. Display Backup Plan example

3.18 Restoring data using BRMS/400

Finally, you should test whether you can restore information that you have saved
using BRMS/400. We recommend that you test a full restore. See 10.2,
"Recovering an entire system (starting with IIcensed Internal Code)" on page 195,
for additional information.

Chapter 4. Managing BRMS/400

This chapter contains information to help you carry out the daily activities of BRMS/400. It begins with the BRMS/400 setup functions that most influence your day-to-day operations. Then, it outlines some of the basic tasks that operations carries out on a daily basis and finishes by looking at some aspects of job scheduling, using the save-while-active function with BRMS/400, and saving spooled files with BRMS/400.

We recommend that you review the functional enhancements between various releases of BRMS/400. These are covered in Appendix A, "Summary of changes" on page 289.

4.1 BRMS/400 operational tasks

The following tasks are some of the recommended daily tasks that you should perform when using BRMS/400 to ensure consistent operation.

4.1.1 Checking for media availability

Use the Media Report (showing only expired volumes) as a selection list to choose tapes to be used for the saves. This report can be created as part of the maintenance procedure, or it can be created on any machine in the BRMS/400 network. For example, the following command produces a list of expired 3490 cartridges in creation date sequence:

```
WRKMEDBRM TYPE(*EXP) MEDCLS(CART3490E) SORT(*CRT) OUTPUT(*PRINT)
```

This report should be produced after the daily movement procedures are completed.

With libraries, such as the 3494 Automated Tape Library Data Server, you depend on scratch media being inside the library when BRMS/400 requests it. If moves are being performed correctly, this should always be the case. However, sometimes cartridges are manually ejected, and the BRMS/400 records are not updated to reflect this move. When this happens, the Library Manager and BRMS/400 become out of synchronization. It is worth checking before each backup to see that the two databases agree. You can do this by running the WRKMEDBRM and WRKMLMBRM commands and comparing the outputs. However, this can be quite a task if you have a large library. See Appendix E, "Media missing from the 3494" on page 309, for a sample program and query that you can use to more easily highlight the differences.

4.1.2 Performing BRMS/400 backups

You should perform BRMS/400 backups on each of your AS/400 systems. If you have a BRMS/400 network, you must perform backups on all of the systems in the network.

For attended saves, you can use the Start Backup using BRM (STRBKUBRM) command and select the backup control groups that you want saved. For saves that are submitted to a job scheduler, check to ensure that the save job has been submitted and that it is in an active state.

If the Save-while-active parameter is being used, a message is sent when the library or libraries have reached a synchronization checkpoint. The Monitor Save While Active (MONSWABRM) command is used to take action when the synchronization point is reached. You should run this command through an *EXIT in the backup or archive control group. If you have a group of libraries with the *SYNCLIB parameter, you should code the first library as the LIB parameter on the MONSWABRM command. See 4.3, "Save-while-active and BRMS/400" on page 72, for more information.

4.1.3 Saving save files

If you have processed any backups to save files, you must run the Save Save Files using BRM (`SAVSAVFBRM`) command with the appropriate control group. Be aware that when you use the SAVSAVFBRM command, BRMS/400 recovery data is *not* saved automatically, as with control groups. This is similar to performing saves using the SAVLIBBRM command and the SAVOBJBRM command.

QA1AMM is updated during a SAVSAVFBRM to reflect the new media. Therefore, if you create a new recovery report at this point, it reflects the true location of the information because it is taken from the online QA1AMM in QUSRBRM.

However, since SAVSAVFBRM did not save the recovery information, if you perform a recovery using BRMS/400, BRMS/400 prompts you for save files or for different tapes than those in your recovery report. That is because BRMS/400 is using the older version to recover. Also, if you did not create a new recovery report after you ran the SAVSAVFBRM command, your recovery report indicates that certain objects were in save files (now gone), and you have to find the objects on the tape.

You must always run the `SAVMEDIBRM` command after you perform the SAVSAVFBRM command and produce a new recovery report. See 10.1, "Overview of BRMS/400 recovery" on page 191, for additional information.

4.1.4 Performing daily checks

The following tasks should be included in the daily operations procedures:

- **Log**: The BRMS/400 log shows all BRMS/400 activity and is the central logging point for all BRMS/400 related messages. Use the `DSPLOGBRM` command to display a copy of the BRMS/400 job log.

  Check daily on *each* system that:

  – All save activity completed successfully on each scheduled control group.
  – There are no unusual errors or messages.
  – Maintenance has completed successfully.

    Note: It is vital that any unusual entries observed, especially unsaved BRMS/400 recovery objects, are investigated.

- **Maintenance**: BRMS/400 maintenance performs all BRMS/400 housekeeping activities. It should be run on *each* system in the BRMS/400 network after the individual save processes complete. There should be a manual check every morning for the message `BRMS/400 maintenance procedure completed` in the BRMS/400 job log. This message indicates that the BRMS/400 maintenance run (STRMNTBRM) completed successfully.

BRMS/400 maintenance job performs various clean up tasks and produces important reports based on your media information. The tasks that are performed by this single command are:

- Journal receivers are cleaned up. BRMS/400 journals are changed, and new ones are attached. The old journal receivers are deleted based on the information in the Q1APRM data area. The default is to keep the information for five days. It is important to know that BRMS/400 implements journaling and commitment control to ensure data integrity and that the files are always at a transaction boundary.

- The EXPMEDBRM command is processed to expire any media.

- History records are removed for expired media. BRMS/400 re-uses deleted records in the physical files so you do not have to schedule to run the Reorganize Physical File (RGZPFM) command.

- A media synchronization audit is performed to ensure that the media files on all BRMS/400 systems in the network are at the same level.

- Media movement is performed (if requested).

- Volume error statistics are collected, and the volume error logs are updated.

- A report on expired media is produced using the WRKMEDBRM command.

- A report on backup activity report is produced using the WRKMEDIBRM command.

- Library analysis is run to determine which libraries were not saved.

- Recovery analysis report is produced for *all* locations.

- A report on recovery activity (contact information) is produced.

- Various work files are cleaned up such as DLOs that might have been left over by the spooled file backup.

- Media inventory registration is reconciled.

- Disk storage space is freed for any archived objects that were retrieved. Beginning with V3R6, you can specify the number of days you want to keep the object on the system after you have retrieved it. If the object has not been updated for this period, the maintenance job performs a save to a temporary file using the STG(*FREE) option. If the object has been changed, you have to archive it again.

If the BRMS/400 maintenance task is not started or executed through using an exit program in the control group, you must start it manually by issuing the BRMS/400 STRMNTBRM command.

- **Reports**: Check for:

  - *Centralized Media Audit Report* (on each system): This is automatically produced as part of the STRMNTBRM command for systems that are in a network. It is not produced when you are in a single system environment. You should understand why any errors are found and what updates BRMS/400 has made to correct them.

  - *Backup Activity Report*: This is automatically produced by the BRMS/400 maintenance task. You should look for errors in save operations. You should look under the *Not Saved* report column to identify the objects or libraries that were not saved and then take the appropriate actions.

– *Save Strategy Exceptions Report*: This report is automatically produced when the BRMS/400 maintenance task has completed. You should review the libraries that are not saved with their owners to ensure that an appropriate save strategy is in place for those libraries. You can add the libraries to the appropriate backup control group.

If you have some libraries that are shown in the report as not saved but are already in the backup control group, investigate why the control group has not saved these libraries.

You can also gather information about libraries that are not being saved by running the `WRKMEDIBRM SAVTYPE(*NONE)` command. If you do this online, remember to page up and look at all entries in the list.

– *Tape Volume Report, Volume Threshold Report*, and the *Volume Statistics Report*: These reports are automatically produced as part of a BRMS/400 maintenance run. They can also be produced using the Print Media Exceptions for BRM (PRTMEDBRM) command.

The reports show volumes that equal or exceed the usage or read/write threshold limits set for the media class. You should check these error thresholds and take the appropriate action to replace volumes with errors. You can do this with the Duplicate Media using BRM (DUPMEDBRM) command by using the following technique:

1. Attempt to recover data using the `DUPMEDBRM` command.

2. Perform a manual move of the volume in error (for example, to a location called DISPOSED).

You should also check the number of free media volumes in each of the media classes. Use the `WRKMEDBRM` command as in producing the preceding media picking list. Or, with V3R2 and V3R6 and V3R7, you can use the `CHKEXPBRM` command:

1. Enroll or order new tapes if necessary.
2. Expire old tapes if necessary.

4.1.5 Moving media

Moving media correctly is important. Apart from knowing exactly where your information is, it is vital to ensure that recovery data is moved to a secure location and that there is sufficient media in your scratch pool for backup or archive.

The rules for moving media are defined in the move policy. The instructions for moving media are produced when the Move Media using BRM (MOVMEDBRM) command is performed, either as part of maintenance or on its own. Each time media movement is run, BRMS/400 calculates in which location the media should be (according to the move policy), checks the location where it actually is, and if the two are different, issues a move request to move the media to the correct location.

Media can be moved using option 8 on the Work with Media using BRM (WRKMEDBRM) command. However, if the media is under control of a move policy, the next time the MOVMEDBRM command is run, an instruction may be issued to move it back. This sort of situation can occur if media is retrieved from another location to restore objects from it.

If you want to retain the media and not return it, you must break the link with the move policy. You can do this from the Change Media using BRM (CHGMEDBRM) command and entering *NONE in the Move Policy field.

If you are confident that media moves scheduled by the MOVMEDBRM command are *always* physically carried out, you can choose to have the media location updated when the MOVMEDBRM command is run. However, we recommend that you choose the option to Verify Media Movement before you update the BRMS/400 records. This can be done by running the Verify Moves using BRM (VFYMOVBRM) command and confirming that the media has actually been moved.

If you have a media library, running the MOVMEDBRM command causes the RMVTAPCTG command to be issued to the library to eject the cartridge. Depending on the library type, and whether the system is a CISC or a RISC system, this may physically eject the cartridge or merely change its category to *EJECT.

If you prefer the RMVTAPCTG action to be issued during the VFYMOVBRM command, rather than during the MOVMEDBRM command, change byte 210 in the Q1APRM data area to '1' using the following command:

```
CHGDTAARA DTAARA(QUSRBRM/Q1APRM (210 1)) VALUE('1')
```

BRMS/400 is shipped with this value set to blank. To find out which value you are currently using, use the command:

```
DSPDTAARA DTAARA(QUSRBRM/Q1APRM)
```

This data area has no effect when volumes are inserted.

Using the data area and Verify Moves *YES/*NO provides four setups:

- **Q1APRM blank, verify moves *NO**: Volumes that are scheduled to leave the MLB are ejected when the MOVMEDBRM command is run and they are "moved" in the BRMS/400 database. Volumes that are scheduled to return need to be physically placed into the library prior to the move being run. Once inserted, they have a category of *INSERT and when MOVMEDBRM is run, they are changed to *NOSHARE or *SHARE400 depending on the value in the Shared media parameter on the media class.

- **Q1APRM blank, verify moves *YES**: Volumes that are scheduled to leave the MLB are ejected when the MOVMEDBRM command is run. However, they are not *moved* in the BRMS/400 database until the Verify Moves using BRM (VFYMOVBRM) command is run. For volumes that are scheduled to return, the MOVMEDBRM command is run first. The volumes need to be physically placed into the library. Once inserted, they have a category of *INSERT. When the VFYMOVBRM command is run, they are changed to *NOSHARE or *SHARE400 depending on the value in the Shared media parameter on the media class.

- **Q1APRM '1', verify moves *NO**: This setup operates in exactly the same way as the first setup in this list.

- **Q1APRM '1', verify moves *YES**: The MOVMEDBRM command is run first, which sets the volumes that are scheduled to leave the MLB up for verification. When the VFYMOVBRM command is run, the volumes are ejected and moved in the BRMS/400 database. For volumes that are

scheduled to return, the MOVMEDBRM command is run first. The volumes need to be physically placed into the library. Once they are inserted, they have a category of *INSERT. When the VFYMOVBRM command is run, they are changed to *NOSHARE or *SHARE400 depending on the value in the Shared media parameter on the media class.

The MOVMEDBRM command can be run on any system in a network, and the resulting database updates are propagated around the network. It is clearly not desirable to have all systems moving media for all systems so either movement is run on each system for that system's media only, or movement is run on one system in the network for all systems.

We recommend that you run the Move Media using BRM (MOVMEDBRM) command separately on each system. This is accomplished by specifying *LCL in the SYSNAME parameter of the MOVMEDBRM command.

You can run the MOVMEDBRM command on a "central" BRMS/400 system for all systems. This is a practical solution for many enterprises. However, if you have more than one tape library, and they are attached to different systems, you must run the command separately. The reason for this is that although the MOVMEDBRM command updates the BRMS/400 files for all systems, the associated RMVTAPCTG command only ejects cartridges on the library attached to the "central" system.

The operations tasks associated with moving media include printing reports, physically moving the media, and if required, verifying that the media has been moved. These tasks may be summarized as follows:

- **Reports**: Prior to performing any physical tape movement, direct the required reports (some of which may have been produced earlier) to an appropriate output queue and print them.

  In a networked environment where the individual processes can be scheduled and controlled as a single procedure, the controlling job should distribute the Recovery Volume Summary Report and the Disaster Recovery Report directly to the central system for printing. This is achieved using the Send Network Spooled File (SNDNETSPLF) command over SNA distribution services (SNADS). This way, each system also keeps copies of the two recovery reports for possible reference during an emergency.

```
REPORT NAME                      CONTEXT   SPLF NAME   PRODUCED BY


Media Location report            CENTRAL   QP1AMM      WRKMEDBRM
Media Movement Report            CENTRAL   QP1APVMS    PRTMOVBRM
Recovery Volume Summary Report   UNIQUE    QP1A2RCY    STRMNTBRM
Disaster Recovery Report         UNIQUE    QP1ARCY     STRMNTBRM
```

  On the "central" system, print the Media Movement Reports using the following command:

```
PRTMOVBRM PERIOD(*CURRENT) TYPE(*VFY)
```

  This command is used to print the report for the current day's media movements.

  If you cycle media off-site, you probably want the expired media to be returned at the same time that the current media is being collected. Use the following command to print the Media Movement Report:

```
PRTMOVBRM PERIOD(*BEGIN dddddd) TYPE(*NEXT) LOC(OFFSITE)
```
Here, *dddddd* is the next day's date.

- **Move**: Once the preceding reports are printed, the media can be physically moved. The Media Movement Report indicates which tapes should be moved.

  Note: It is essential that the Recovery Analysis Report and the Volume Summary sReport for each BRMS/400 system are sent to the remote site (for example, "VAULT") with the tapes.

- **Verify**: Verify Media Movement to confirm to BRMS/400 that all pending movements have been performed by the operator. The VFYMOVBRM command should be run on the "central" system. From the list of media pending movement, enter option 1 next to those media volumes that are physically being moved.

4.1.6 Media management

Ensuring that there are enough expired media of the required type in the required location to complete a save is one of the prime tasks of operations.

For media libraries, such as the 3494 Automated Tape Library Data Server or where the home location is convenient to the tape drive, this is a question of having sufficient quantities of usable media. Where the media is stored elsewhere (for example, in a fireproof safe or off-site), it is also a question of selecting and moving the media.

In V3R6, V3R7, and V3R2, two new parameters on the Media Policy influence media management. The Required volumes parameter ensures that the save does not start if there are fewer media available than indicated. The Mark volumes for duplication parameter causes media to be duplicated when the DUPMEDBRM command is run with the VOL(SEARCH) option.

To be certain that you have sufficient media, the value can also be checked by user jobs using the Check Expired Media for BRM (CHKEXPBRM) command. For example, the CHKEXPBRM command can be incorporated into a job scheduler to determine, at various times, if there are enough expired media volumes available for a save operation. Figure 39 shows how the CHKEXPBRM command checks for a specific number of volumes.

```
                      Check Expired Media for BRM (CHKEXPBRM)

 Type choices, press Enter.

 Required volumes . . . . . . . . > 5             1-9999, *MEDPCY
 Media class  . . . . . . . . . . > QIC120        NETCHK, QIC1000, QIC120...
 Location . . . . . . . . . . .    *ANY           *ANY, *HOME, COMPROOM...
```

Figure 39. Checking for expired media

If sufficient volumes are available, the display shown in Figure 40 on page 64 appears.

```
                         Additional Message Information

Message ID . . . . . . . :   BRM1933        Severity . . . . . . . . :   00
Message type . . . . . :   Completion
Date sent  . . . . . . :   06/14/00        Time sent  . . . . . . :   20:14:26


Message . . . . :   Request for 5 expired volumes successful.
Cause . . . . . :    The check expired media command requested 5 volumes. 24
  expired volumes are available for media class QIC120 at location *ANY.
```

Figure 40. The message indicating that the request was successful

Although you should always monitor for the availability of media volumes, there may be times when additional volumes need to be introduced to complete the save.

Automatic enrollment of media allows you to automatically add new media used in output operations to the media inventory if the request has been done using a BRMS media class and is on this device.

To enable this function, set the Auto enroll media parameter to *SYSPCY or *YES in the BRMS/400 device description. If you are enabling this globally, you should set the Auto enroll media parameter in the system policy to *YES.

You should also ensure that you have enough licenses to allow for any additional media.

Note: If you are using a media library, such as the 3494 Automated Tape Library Data Server, automatic enrollment of media during a save operation does *not* occur because BRMS/400 has to specify a volume to be mounted.

4.1.7 Daily housekeeping

You should perform the following tasks on a daily basis:

- All of the reports that were printed should be filed.

- Check all of the BRMS/400 spooled files and delete any that are older than the specified retention period.

- If you implemented BRMS/400 archiving, use the Start Archive using BRM (STRARCBRM) command to produce the Archive Candidate Report. This should be repeated for each archive control group.

- Use the Add Media to BRM (ADDMEDBRM) command or the Add Media Library Media to BRM (ADDMLMBRM) command to enroll and initialize new media that you may have.

4.2 Setting up your own control groups

Although BRMS/400 provides default control groups to backup and restore your entire system, it is probable that you will define your own control groups.

One reason is to provide the flexibility to start and stop various subsystems, hold job queues, save spooled files, or even use the save-while-active function to perform some of your backups. Another reason is to satisfy requirements to perform different tasks at different times (daily, weekly, at period end, and so on).

Depending on your recovery plans, you may need to recover a critical application and resume processing before you recover the remainder of your system. You can easily separate the application from your other backups using control groups.

We recommend that you do not change the default BRMS/400 control groups. You should first copy them and change the new control groups, rather than making changes to the original control groups.

4.2.1 Considerations for libraries that affect BRMS/400

When setting up a backup control group, you should carefully plan how you will save your BRMS and other critical libraries. Besides the BRMS/400 libraries QBRM and QUSRBRM, if you have a 3494 Automated Tape Library Data Server installed on CISC-based AS/400 systems, you have QMLD and QUSRMLD. QMLD contains commands and programs; QUSRMLD contains user system configuration. The QUSRSYS library also affects your BRMS/400 save operation when you are using a 3494 Automated Tape Library Data Server. This library contains three important files that are using during a save operation:

- QATADEV contains a list of automated tape libraries.
- QATAMID contains a list of volume identifiers used during a save operation.
- QATACFG contains a list of media categories.

There are also logical files and out files used for communications to the 3494 Automated Tape Library Data Server.

When planning to save libraries QUSRSYS and QUSRBRM, it is *extremely important* to understand the implications of the seize locks when saving in a non-restricted state. For example, assume that you are saving library QUSRSYS to a volume that is already mounted. The system is unable to save all the data on the mounted tape and requires another volume to be mounted. Because the QUSRSYS is locked, the save operation is unable to read and update the required files. The save is in a deadlock condition and fails with a message identifier of CPA37A0.

To minimize the chances of spanning QUSRSYS and QUSRBRM across multiple volumes and to avoid lock conflicts, we *strongly* recommend that you create a separate control group to save BRMS/400 data before you save *ALLUSR data. You *must* ensure that these libraries are omitted from the backup policy; otherwise, you save them twice. These recommendations assume that you can fit QUSRSYS and QUSRBRM libraries in the mounted volume and that you are performing the save operation in a non-restricted state. See Appendix D, "Performing restricted saves to a 3494 on CISC" on page 305, for an example of saving them in a restricted state.

4.2.2 Control group to save QGPL, QUSRSYS, and QUSRBRM

Figure 41 on page 66 contains a sample backup control group based on a V3R2 AS/400 system to perform a weekly save of all user data to a media library. The example is for saving *all user* data from the system, including security information, configuration information, document library objects, and directory information from the integrated file system. Prior to starting the backup, ensure that you have varied off the Integrated PC Server (FSIOP), if you have one installed.

For setting up a control group to save IBM data, see 4.2.5, "Control group to save QMLD and QUSRMLD" on page 68.

Use the WRKCTLGBRM command to create a backup control group called WKLIBM09 as shown in Figure 41.

```
             Display Backup Control Group Entries              SYSTEM09

  Group . . . . . . . . . . . : WKLIBM09
  Default activity  . . . . : *BKUPCY
  Text  . . . . . . . . . . : M09: Weekly Save Control Group

                                 Weekly   Retain   Save      SWA

             Backup         List  Activity Object   While     Message

   Seq       Items          Type  SMTWTFS  Detail   Active    Queue

    10       QGPL                 *DFTACT  *NO      *SYNCLIB  *LIB
    20       QUSRSYS              *DFTACT  *NO      *SYNCLIB  *LIB
    30       QUSRBRM              *DFTACT  *NO      *SYNCLIB  *LIB
    40       *SAVSECDTA           *DFTACT  *NO
    50       *SAVCFG              *DFTACT  *NO
    60       *IBM                 *DFTACT  *NO      *NO
    70       *ALLUSR              *DFTACT  *NO      *NO
    80       *ALLDLO              *DFTACT  *NO      *NO
    90       LINKLIST       *LNK  *DFTACT  *NO      *NO
   100       SAVEOUTQ       *SPL  *DFTACT
   110       *EXIT                *DFTACT
   120       *EXIT                *DFTACT
   130       *EXIT                *DFTACT
   140       *EXIT                *DFTACT
   150       *EXIT                *DFTACT
```

Figure 41. Sample backup control group

When performing saves using *ALLUSR, or *ALLPROD, ensure that you understand which "Q" libraries are saved. See Table 2 on page 40 for more information.

It is also important to ensure that you *omit* libraries that are saved as part of *ALLUSR, when you are planning to save them outside the *ALLUSR control group entry.

In the example in Figure 41, notice that sequence number 100 is added to save spooled files. In our example, we used a backup list called SAVEOUTQ that contains a list of output queues that are specified as sequence numbers, which is the same as the exit programs. You can have multiple output queues within one backup list item. For additional details on how to use BRMS/400 for spooled file saves, see 4.4, "Saving spooled files using BRMS/400" on page 84.

> **Important**
>
> It is extremely important that you understand the recovery implications when setting up your own backup control groups. For example, say that you are planning to perform an *ALLUSR save in your control group. Before you perform this *ALLUSR save, you want to save libraries QGPL, QUSRSYS, and QUSRBRM ahead of other libraries. You have set up the backup control group as shown in Figure 41, and you have defined the libraries to omit in your backup policy.
>
> If you plan to perform the restore using BRMS/400, the restore is seamless. However, if you plan to perform the restore operation outside BRMS/400, such as using the OS/400 native RSTLIB LIB(*ALLUSR) command, you do not recover libraries QGPL, QUSRSYS, and QUSRBRM. These libraries were saved separately so you *must* restore them separately.

4.2.3 User exits and control groups

You can create a backup control group entry of *EXIT to perform user command processing. Select F10 (Change item) for each *EXIT to go into the User Exit Maintenance display, and enter the command you want to process. This can be done on the Create Backup Control Group Entries display, or you can go back afterwards and change the item on the Edit Backup Control Group Entries display. Figure 42 is provided for user exit in sequence 110.

```
                          User Exit Maintenance                      SYSTEM09


   Type command, press Enter.

      Sequence number . . . . . . . :  110
      Where used  . . . . . . . . . :  *EXIT
      Weekly activity . . . . . . . :  *DFTACT   SMTWTFS
      Command . . . . . . . . . . .    SNDMSG MSG('Weekly Backups are Complete')

 TOUSER(*SYSOPR)
```
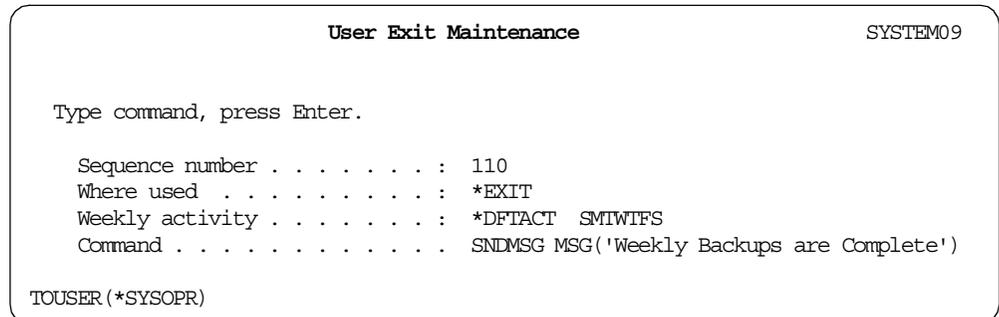
Figure 42. User Exit Maintenance

Tab down to each user exit sequence number that you have specified, and use F10 to assign a command that you want to process. The commands that are executed by the remaining sequence numbers in our WKLIBM09 backup control group are:

```
Seq No.      Command
-------      ------------------------------------------------------
120          SBMJOB CMD(STRMNTBRM) JOB(STRMNTBRM) JOBQ(BRMSJOBQ) OUTQ(BRMSOUTQ)
130          SBMJOB CMD(DSPLOGBRM OUTPUT(*PRINT)) JOB(DSPLOGBRM) JOBQ(BRMSJOBQ)
                                                                 OUTQ(BRMSOUTQ)
140          SBMJOB CMD(PRTMEDBRM VOL(*EXCP))     JOB(PRTMEDBRM) JOBQ(PRTMEDBRM)
                                                                   OUTQ(BRMSOUTQ)
```

The above example includes various exits that make up a series of commands that are executed after the saves have completed. Rather than specifying a series of user exits, you may want to create a simple CL program that includes all of the commands that you want to process and include this CL program as a single user exit.

Note: There is no command for *EXIT 150. This exit is used to perform some post-processing tasks before the control group has finished processing. This means that the subsystems are restarted and the job queues are released. The subsystems that require ending and the job queues that require holding are set up as part of the control group set up. In our example, we use *EXIT 120, *EXIT 130, and *EXIT 140 to submit jobs to the BRMSJOBQ job queue. Since the last executable entry is *EXIT 140, and we want this to be processed within the control group, we have to add an extra *EXIT to allow for post-processing.

The same as a post-processing exit, you can also add a preprocessing exit. See Figure 45 on page 76 for an example.

4.2.4 Omitting libraries from a control group

If you need to back up all libraries with the exception of one or two, it is more convenient to specify *ALLUSR or *IBM and omit the libraries, rather than to specify all of the required libraries individually.

For example, if you have a 3494 Automated Tape Library Data Server installed on a CISC system, you probably have made a special provision for backing up critical QMLD and QUSRMLD libraries together with the QGPL, QUSRSYS, and QUSRBRM libraries. See 4.2.5, "Control group to save QMLD and QUSRMLD" on page 68, and Appendix D, "Performing restricted saves to a 3494 on CISC" on page 305, for more information on this. It is not necessary to back them up a second time as part of *ALLUSR, so they should be omitted.

Use F10 from the Work with Backup Control Groups display to go directly into Work with Libraries to Omit from Backups display shown in Figure 43.

```
                 Work with Libraries to Omit from Backups          SYSTEM09


   Type options, press Enter.
      1=Add    4=Remove

  Opt  Type          Library

       *ALLUSR       QGPL
       *ALLUSR       QUSRBRM
       *ALLUSR       QUSRSYS
       *IBM          QMLD
       *IBM          QUSRMLD
```
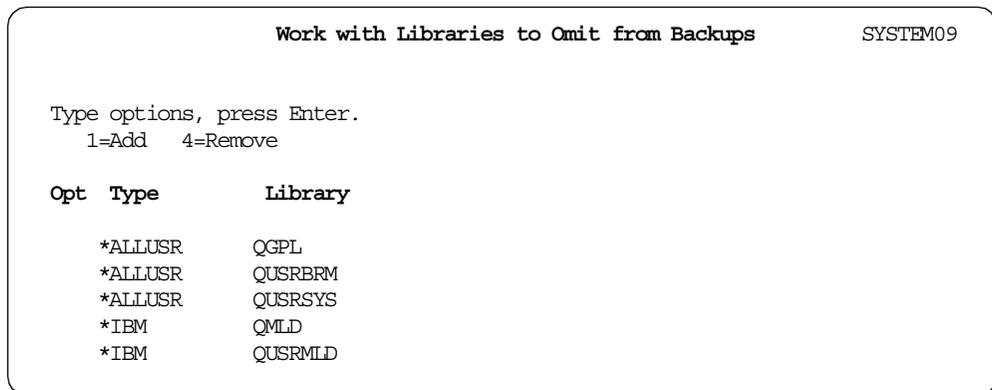
Figure 43. Omitting libraries from backups

4.2.5 Control group to save QMLD and QUSRMLD

On CISC systems, the 3494 Automated Tape Library Data Server still requires MLDD software. Appendix A, "Summary of changes" on page 289, suggests a way to back up the QMLD and QUSRMLD libraries when the system is in a restricted state. You may want to back up these libraries at other times. We strongly recommend that you do not save them with the *IBM backup list. IBM Informational APAR (II08968) contains information on the possibility of the save job failing due to the loss of a communications link between the AS/400 system and the 3494. You can access the Informational APAR through the home page at:
`http://as400service.rochester.ibm.com/`

The recommended steps are as follows:

1. Omit the QMLD and QUSRMLD libraries from the backup policy as shown in Figure 43.

2. Add the libraries to the backup control group that does the *SAVSYS as follows:

```
                                   Weekly      Retain    Save
                 Backup     List   Activity    Object    While
        Seq      Items      Type   SMTWTFS     Detail    Active
        ____     _____    ____   _____    _____    _____
        10       *SAVSYS           *DFTACT
        20       QMLD              *DFTACT      *NO       *NO
        30       QUSRMLD           *DFTACT      *NO       *NO
        40       *EXIT      *DFTACT
```

The *EXIT does not have anything in it. It is there in case you want to specify other libraries after QUSRMLD. In that case, the *EXIT causes BRMS/400 to start a new SAVLIB, and locks on key files are minimized. When *SAVSYS has completed, BRMS/400 starts QMLDSBS. This may cause some object locks in QMLD and QUSRMLD, but the significant objects are saved. See Appendix D, "Performing restricted saves to a 3494 on CISC" on page 305, for information on how to save using the 3494 Automated Tape Library Data Server while the system is in a restricted state.

If the BRM commands are used in a CL program, use the following commands (use the DEV and MEDPCY parameters as appropriate):

```
SAVSYSBRM DEV(xxxxx) MEDPCY(xxxxxx) STRCTLSBS(*NO)
          STRCTLSBS(*NO)
SAVLIBBRM LIB(QMLD QUSRMLD) DEV(XXXXX) MEDPCY(XXXXX)
          SEQNBR(*END)
```

4.2.6 Backup control group attributes

After creating a backup control group, you should always set the attributes for the control group by selecting option 8 for the control group name.

The backup control group attributes allow you to add backup information (for example, media policies and devices to use) and to override the default backup policy settings based on your overall backup and recovery strategy. Some of the attributes require careful planning before they are changed either in the backup control group attributes or in the backup policy. The key attributes are:

- **Media Policy**: Enter here the media policies, full and incremental, that you want to use for this control group.

- **Backup devices**: Backup devices specify the name of the backup device you want to use for this control group. You can specify up to four backup devices. If more than one device is specified, they must have the same characteristics. This feature is less widely used now that tapes are written in both directions (no rewind time) and when successive tapes can be automatically loaded by a tape drive in sequential or random mode, or by an automated tape library. The *MEDCLS special value specifies that any available device that supports the media class specified in the media policy may be selected. BRMS/400 searches for a device alphabetically according to the BRMS/400 Device Table.

- **Sign-off interactive users**: This is useful to advise users that a backup is about to take place and to sign them off. You can specify exceptions to this, either devices or users, in the system policy. Messages can be issued at five

minute intervals to warn the users. However, there is no check if users sign back on again. If this is likely to be a problem, you should consider stopping subsystems.

- **Automatically backup media information**: BRMS/400 records media information when objects are saved to volumes or save files. You can control how much media information BRMS/400 records when objects are saved, as well as how much media information is saved. Your decision here has an impact on the performance of your save operation and the amount of media used to process the backup. Additionally, the amount of recovery data recorded during backup affects at what level of detail (library or object) you can ask BRMS/400 to prompt for recovery.

  The default is to save library-level (*LIB) information after every backup operation using that policy or control group. The other alternatives are *OBJ, which retain object-level detail, or *NONE, which does not save any information for recovery purposes.

  The value of *NONE should be used with caution. If you are performing multiple saves, you may not want to save the recovery information after every save, but save it once at the end. Alternatively, if you keep a large database of recovery information, you may not want to save this after every single file or object save. Caution is advised because your recovery may be compromised until you save the recovery information.

  With object-level information, you can also retain member (*MBR) information for members associated with *FILE type objects.

  Note

  If you select the *OBJ parameter for the Automatically backup media information field, you should ensure that you are saving objects at the object level in your control groups. To verify whether you are saving at the object level, go to the Edit Backup Control Group display for the control group, and review the Retain object detail field for each backup item. Those backup items that show *YES, *OBJ, or *MBR in the Retain object detail field keep object detail. Additionally, those items that do not display a Retain object detail field indicate that object-level detail is automatically kept.

  We recommend that you be selective with retaining object-level information because it increases your disk storage considerably and affects your save and restore times. Unless you are constantly restoring individual objects from a library, there is no need to keep object-level information. Remember that you can *always* restore an individual object even without keeping object-level information as long as you *know* the library in which the object was stored. You can search your save history for the library using the Work with Media Information (WRKMEDIBRM) command. You select the library you want to restore. Then, on the Select Recovery Items display, you select the option to restore specific objects (option 7) rather than selecting the entire library (option 1).

> **Note**
>
> If your library spans multiple save volumes, you must mount the first volume even though you may know that the actual object is, for example, in the third volume. This is an OS/400 limitation, and BRMS/400 uses the same underlying code for save and restore operations as the native OS/400 commands.

BRMS/400 recovery information consists of multiple files that are appended at the end of your last tape volume or to a save file associated with the save files containing your saved data. The files required for library-level information are:

```
QA1A1DV    Device record:  By type
QA1A1MD    MLB Device record:  By location
QA1ACN     Container status
QA1ADV     Device record:  By name
QA1AHS     Save history (library level)
QA1ALR     Save history:  Save statistics by library
QA1AMD     MLB Device record:  By name
QA1AMM     Media status
QA1ASP     System policy
QA1AMT     Media class attributes
QA1AOQ     Backup spooled file entries
```

The following files are also saved if you save object-level information:

```
QA1ADI     IFS directory information
QA1ALI     IFS object link information
QA1AOD     Object detail
```

See the Start Maintenance for BRM (STRMNTBRM) command parameters in *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) for a discussion on using BRMS/400 maintenance to remove object-level detail while retaining library-level detail.

- **Append to media**: You may want to use APPEND(*YES), particularly with 3590 cartridges. BRMS/400 normally chooses an expired volume for output operations, unless you specify APPEND(*YES) on the backup policy or control group attributes. When selecting an active volume for APPEND(*YES), BRMS/400 tries to choose a volume with the same media class, same expiration date, same system name, same move policy, and same expiration date. If no volume is available that matches these criteria, BRMS looks for a volume with the earliest expiration date. This selection method ensures that the oldest volumes are chosen for appending. See 3.13.1, "Appending to media rules" on page 44, for information on append selection rules.

  In some cases, this selection method is appropriate, but if the customer wants to continue filling the last used volume, this does not work. For example, if you are doing a non-cumulative (incremental) save, you may want all of the incremental saves to be on the same volume to minimize reloading volumes when restoring.

  Other customers may want to alternate the volumes, so that, for example, a full save is done on Sunday. Monday, Wednesday, and Friday saves are incremental and should be to a different tape. Tuesday and Thursday saves are also incremental, but should be to another different volume, ensuring that if one of the incremental volumes is lost or damaged, a maximum of one day's backups are lost.

There may also be a requirement to manually control whether a volume is appended, similar to the way in which you can manually expire and move a volume.

The current rules of expiring when the last file (library) on the tape expire mean that you progressively create empty space at the beginning of a volume. This is unusable space until the volume is expired.

- **Text**: When you are adding a backup control group, you can assign text to describe the control group. The text that you specify is assigned to media created as a result of saving the control group. This can be extremely useful. For example, if you prompt on the WRKMEDBRM command, you can enter text related to the media with which you want to work. You can search for any string of characters, and only those media inventory entries that contain the string of characters in the text are included in the display or print.

  There can be instances where you want to preserve the text assigned to the volume name. In this situation, blank out the text field for the control group. This indicates to BRMS/400 that you want to preserve the text currently associated with the volume in the media inventory and not use the control group text.

  There can also be cases where you do not want text from the backup control group or the current text assigned to the volume. In this case, specify *NONE as the text for this control group. Media that is created as a result of saving this control group has *NONE as the descriptive text.

4.3 Save-while-active and BRMS/400

The save-while-active function allows you to modify objects while they are being saved. It is possible to save while active without stopping the users. However, this type of usage requires you to implement commitment control to ensure that save and restore operations are always at a transaction boundary.

If your application does not use journaling or commitment control, and for ease of recovery, we recommend that you shut down your application until a save-while-active *synchronization* (also known as *checkpoint*) is reached. Once synchronization is reached, the system releases the exclusive locks on the library you are saving, and users can resume normal activity. The system continues to save the data to a tape device as a background task. This is where you benefit most from the save-while-active function. The data in your library can be used by your users without having to wait until the entire library is saved on a tape device. The gain is the time it takes to write your data to the tape device from the point of reaching synchronization.

In general, if you have large libraries with single member physical files, the time to establish the checkpoint can be small compared to the time to write to the tape. For example, assume that the entire save takes one hour at present, and the library contains single member physical files. Without the save-while-active function, the entire library is locked for one hour and users are not allowed to use any file in that library until the save is complete. With the save-while-active function, you may find that the checkpoint is established within 20 minutes, for example.

You can monitor for the checkpoint message and allow users to continue using the files in the library. This increases your application availability by 40 minutes.

Backup and Recovery - Advanced, SC41-4305, contains a detailed explanation on the save-while-active function. It also includes information on performance considerations, object locks, and the limitations of the save-while-active function. We strongly recommend that you review this book before you implement the save-while-active functions in BRMS/400.

4.3.1 Save-while-active implementation in BRMS/400

Within BRMS/400, the save-while-active function is implemented through the backup control groups.

BRMS/400 also provides the Monitor Save While Active for BRM (MONSWABRM) command that can be used through an exit in the control group. This command monitors for checkpoint messages and allows you to process another command, once the checkpoint message has been monitored. For example, you can restart a subsystem or an application or send a message to your users indicating that activity related to the application can be restarted. See 4.3.3, "Using the MONSWABRM command" on page 75, for more information. Figure 44 shows an example of creating an *EXIT on the Edit Backup Control Group Entries display.

```
                    Edit Backup Control Group Entries

    Group . . . . . . . . . . . : SWA
    Default activity  . . . . . *BKUPCY
    Text  . . . . . . . . . . . Save While Active Control Group


    Type information, press Enter.

                                 Weekly    Retain   Save      SWA ▌1▐
                 Backup    List  Activity  Object   While     Message
    Seq          Items     Type  SMTWTFS   Detail   Active    Queue


    10     *EXIT                 *DFTACT ▌2▐
    20     *EXIT                 *DFTACT ▌3▐
    30     LIBA                  FFFFFFF   *NO      *SYNCLIB  *LIB
    40     LIBB                  FFFFFFF   *NO      *SYNCLIB  *LIB
    50     *EXIT
```

*Figure 44. Edit Backup Control Group Entries display: Creating an *EXIT*

The numbers in revers bold in Figure 44 are explained here:

▌1▐ Beginning with V3R6 and V3R2, the control group contains a new SWA Message Queue field as shown in Figure 44. This function is not available in V3R1.

With the SWA Message Queue value in the control group, you can specify the name of the message queue where you want the checkpoint messages to go. By default, the value is set to *LIB, which means the messages are sent to the message queue of the library name specified in the sequence number of the control group. In later examples, we discuss the implications of using *LIB or a message queue name for this value.

▌2▐ Sequence number 10 in the control group is used for any preprocessing that needs to be done before starting the control activities. For example, you may want to ensure that the subsystems defined in the control group have ended, job queues have been held, or users have signed off prior to starting the next

exit. In our example, the next exit is the MONSWABRM command. The advantage here is that the MONSWABRM command does not lose any time from its default 60 minutes for the preprocessing tasks to complete.

3 This exit is used for MONSWABRM command processing as part of your backup control group. See Figure 45 on page 76 for additional information.

Refer to 4.3.5, "Examples of using save while active with BRMS/400" on page 78, for more information. This section addresses several examples of using the save-while-active function with BRMS/400, including the use of the MONSWABRM command.

4.3.2 Save-while-active parameters

For each backup item in a control group, you may elect to save them while active. See Figure 44 on page 73 for an example of this option. There are a number of alternatives that are described in the help text.

The possible values are:

- ***NO**: Objects that are in use are not saved. Objects cannot be updated while they are being saved. Data integrity is preserved with maximum save performance.

- ***YES**: Document library objects can be changed during the save request. Objects that are in use but are not using application recovery are not saved. See *Backup and Recovery - Advanced*, SC41-4305, for more information on DLOs, saving while an object is in use, and application recovery. If you use *YES with a non-document library object, *YES functions the same as the *LIB parameter.

- ***LIB**: Objects in a library can be saved while they are in use by another job. All of the objects in a library reach a checkpoint together and are saved in a consistent state in relationship to each other. If multiple libraries are specified on the backup control group, the checkpoint processing is performed individually for the objects within each specified library. For example, if you are planning to save LIBA and LIBB, the system performs two separate SAVLIB commands and establishes two checkpoints.

> **Note**
>
> Only physical files with members have the same save active date (and time) time stamp. Libraries with thousands of objects may be too large for this option.

- ***SYNCLIB**: Objects in a library can be saved while they are in use by another job. All of the objects and *all* of the libraries specified within a backup control group reach a checkpoint together and are saved in a consistent state in relationship to each other.

  If you use *SYNCLIB for saves within a BRMS/400 control group, and the media policy specifies that the saves are to be done to save files, you need to understand the following points:

  - When saving to save files, OS/400 restricts you to save a single library to save files. BRMS/400 adopts the same restrictions.

  - The control group uses *LIB level synchronization instead of *SYNCLIB.

- If you are using the MONSWABRM command to monitor for save-while-active messages, you receive one message from the first library that is saved. After this, the MONSWABRM command is ended.

- If you specify a message queue in the SWA Message Queue field in the Edit Control Group Entries display, BRMS/400 sends the synchronization message for every library. Until a PTF for APAR SA61101 is available, the message queue must exist in the QUSRBRM library.

- BRMS/400 completes the save processing without any warning or error messages. It does not warn you that the save process has adopted an *LIB level of synchronization.

Notes

Different items (libraries or backup lists) to be saved-while-active in your control group, interspersed special operations, such as *EXIT or *LOAD, or different activities have an effect on your save-while-active processing. See 4.3.4, "Synchronizing blocks of libraries" on page 76, for more information.

- ***SYSDFN**: Objects in a library can be saved while they are in use by another job. Objects in a library may reach checkpoints at different times and may not be in a consistent state in relationship to each other. If you are going to use the Monitor Save While Active for BRM (MONSWABRM) command to perform operations when a checkpoint has been reached, the *SYSDFN option may not be convenient to use. You cannot be sure which database network within a library has reached a checkpoint. This makes it difficult to release the library to users for normal work.

  Note: Specifying this value eliminates some size restrictions and can allow a library to be saved that cannot be saved with SAVACT(*LIB). However, there is a concern with the ability to recover to a known state.

See *Backup and Recovery - Advanced*, SC41-4305, for additional information.

4.3.3 Using the MONSWABRM command

The MONSWABRM command can be used through an *EXIT in your backup or archive control group. The MONSWABRM command monitors for system messages CPI3710 and CPI3712. These messages indicate that the libraries specified in your backup control group are synchronized.

Figure 45 on page 76 shows you an example of how you can use the MONSWABRM command through an exit from the control group.

```
                              User Exit Maintenance


 Type command, press Enter.

    Sequence number . . . . . . . . :   20
    Where used  . . . . . . . . . . :   *EXIT
    Weekly activity . . . . . . . . :   *DFTACT   SMTWTFS
    Command . . . . . . . . . . . .    MONSWABRM LIB(LIBA) CMD(STRSBSBRM GROUP(SWA

))


                F4
```

Figure 45. User Exit Maintenance display: Completed MONSWABRM command

You can use the LIB parameter to specify the message queue that you are monitoring for synchronization messages to arrive. You can also specify a value of *MSGQ, followed by specifying the name of the message queue in the MSGQ parameter. The *MSGQ value and the MSGQ parameter are *not* available in V3R1.

You can use the CMD parameter to execute a command, once the synchronization message has arrived. In the preceding example, we chose to run the Start Subsystem using BRM (STRSBSBRM) command after synchronization occurred for the libraries we are saving. This makes it possible to quiesce an application only until synchronization has occurred. It also makes it available to end users while the save process continues writing data to tape.

> **Note**
>
> Instead of the STRSBSBRM command, you can use the native STRSBS command, in which case you specify the name of the sybsystem to be started. The advantage of the STRSBSBRM command over STRSBS is that you do not need to remember which subsystems need to be restarted. BRMS/400 automatically restarts those subsystems that it had ended prior to starting the control group processing. These subsystems are specified as part of the control group setup.

4.3.4 Synchronizing blocks of libraries

To synchronize a set of libraries together at the set level, rather than for every item in the control group, you must ensure that the libraries are listed in sequence without any special operations such as *EXIT or *LOAD. You must also ensure that the values for the Retain object detail, Weekly Activity, or the Save While Active fields are also the same for the list of libraries that you specified in your control group. BRMS/400 uses a single save command to process these libraries for identical fields in the control group.

If you split the library by using special operations, such as an *EXIT or a *LOAD, BRMS/400 processes the sets separately as shown in Figure 46.

```
                      Weekly    Retain   Save      SWA
         Backup    List  Activity  Object   While     Message
    Seq   Items    Type  SMIWTFS   Detail   Active    Queue

    10   *EXIT           *DFTACT
    20   LIBA            FFFFFFF   *NO      *SYNCLIB  *LIB
    30   LIBB            FFFFFFF   *NO      *SYNCLIB  *LIB
    40   *EXIT
    50   LIBC            *DFTACT   *YES     *SYNCLIB  *LIB
    60   LIBD            *DFTACT   *YES     *SYNCLIB  *LIB
```

Figure 46. Synchronizing multiple libraries with save while active

In the example in Figure 46, libraries LIBA and LIBB are synchronized together. Libraries LIBC and LIBD are synchronized later. The *EXITs each perform a MONSWABRM command, which monitors for the synchronization point. LIBA is used for the first set, and LIBC is used for the second set for save-while-active synchronization point messages.

Important

In this example, the SWA Message Queue value in the control group is left as `*LIB`. Because of this, it is important that you use the name of the *first* library in the LIB value for the MONSWABRM command. If you use a name other than the first library name, the MONSWABRM command cannot monitor for the save-while-active synchronization message. In the meantime, your control group has already finished processing, and you do not benefit by using the save-while-active message queue function.

One of the advantages of splitting the libraries into two sets is that it allows you to specify different weekly activity or retain object detail information for LIBA and LIBB compared to LIBC and LIBD.

If you use generic names for the libraries, such as A*, B*, and C*, and you specify *SYNCLIB, BRMS/400 groups all of the libraries together and performs a single save operation. You receive a single synchronization message. A single save command supports up to 300 libraries to be entered as a list. This is an OS/400 restriction. If you have more than 300 libraries, BRMS/400 issues another save command to process the remaining libraries.

Note

By default, the MONSWABRM command waits for 3600 seconds (one hour) for the synchronization message issued by the system. You must ensure that you increase the save-while-active wait time in the MONSWABRM command if your libraries require over one hour to reach synchronization. Remember that, in the release covered in this redbook, OS/400 has a restriction of up to 300 libraries that can be specified in the list of libraries to be saved. If your list of libraries is *ALLPROD or *ALLTEST, or if the number of generic libraries exceeds 300, BRMS/400 issues another save command to save the remaining libraries.

4.3.5 Examples of using save while active with BRMS/400

This section contains various examples of using the save-while-active function with BRMS/400. It also contains examples of using the MONSWABRM command. We assume that you are already familiar with how to set up control group entries and use exits within the control groups.

4.3.5.1 Example 1

This example is for V3R1 of BRMS/400. It does not contain the SWA Message Queue field on the control group, and the MONSWABRM command does not have the MSGQ parameter or *MSGQ value for the LIB parameter. Figure 47 shows you how to save all of the libraries specified within your backup control group with a single save command. The synchronization point is monitored by the MONSWABRM command.

```
                                 Weekly      Retain    Save
                 Backup    List   Activity    Object   While
        Seq      Items     Type   SMTWTFS     Detail   Active
        ___      _____    ____   _____     _____   _____
         10      *EXIT      ____   *DFTACT
         20      *EXIT      ____   *DFTACT
         30      LIBA       ____   *DFTACT     *NO      *SYNCLIB  1
         30      LIBB       ____   *DFTACT     *NO      *SYNCLIB
         30      LIBC       ____   *DFTACT     *NO      *SYNCLIB
         30      LIBD       ____   *DFTACT     *NO      *SYNCLIB


      MONSWABRM LIB(LIBA) CMD (STRSBSBRM CTLGRP(MONDAY01))  2
```

Figure 47. Save-while-active example 1

When you submit the save of the preceding control group, BRMS/400 first acquires a volume and begins control group processing. It submits the MONSWABRM job in QBATCH subsystem. The MONSWABRM command creates a message queue of LIBA **2** in library QUSRBRM and waits for the system to send a message when the synchronization point is established by the libraries in the control group. It waits for a default of one hour for a message to arrive. The job goes into a MSGW status.

BRMS/400 checks the control group entries and sees that they are all identical for **1** *SYNCLIB processing. It builds a list of libraries to be submitted internally to the save process. In this example, a single synchronization point is established. The system sends the synchronization message to LIBA message queue. The MONSWABRM command receives this message queue and processes the command specified in the CMD value. The MONSWABRM command *deletes* the message queue it created in QUSRBRM and ends the job.

When you perform a full save, BRMS/400 always uses the *first* library name as the message queue that receives the synchronization message. Therefore, it is important that you use the first library name in the **2** MONSWABRM command.

> **Important**
>
> The MONSWABRM command creates a message queue in the QUSRBRM library, using the same name as the value you specified in the LIB parameter. This message queue waits to receive the synchronization message from OS/400. As soon as the message is received, the MONSWABRM command processes the command specified in the CMD parameter. It deletes the message queue that it created in library QUSRBRM and ends the job.
>
> The MONSWABRM waits for a default of one hour to receive the synchronization message from OS/400. If no messages are received, the command processing is ended. The MONSWABRM command also deletes any user created message queue in the QUSRBRM library that matches the message queue name specified in the LIB parameter.

4.3.5.2 Example 2

This example shows you how to obtain synchronization messages for every library that you save in your control group. This example assumes that you are performing a full save. The MONSWABRM command is used for monitoring synchronization messages (Figure 48).

```
                                     Weekly   Retain   Save     SWA
                   Backup     List   Activity Object   While    Message
          Seq      Items      Type   SMIWTFS  Detail   Active   Queue

          10       *EXIT             *DFTACT
          20       *EXIT             *DFTACT
          30       LIBA              *DFTACT  *NO      *LIB     ACCOUNTS
          40       *EXIT             *DFTACT
          50       LIBB              *DFTACT  *NO      *LIB     SALES
          60       *EXIT             *DFTACT
          70       LIBC              *DFTACT  *NO      *LIB     PAYROLL
          80       *EXIT             *DFTACT
          90       LIBD              *DFTACT  *NO       *LIB     MFG
```

Figure 48. Save-while-active example 2

The exits have the following settings for the MONSWABRM command:

```
20 - MONSWABRM LIB(ACCOUNTS)
        CMD(SNDMSG MSG('Account Libraries have been synchronized.')
        TOUSR(*SYSOPR))

40 - MONSWABRM LIB(SALES)
        CMD(SNDMSG MSG('Sales Libraries have been synchronized.')
        TOUSR(*SYSOPR))

60 - MONSWABRM LIB(PAYROLL)
        CMD(SNDMSG MSG('Payroll Libraries have been synchronized.')
        TOUSR(*SYSOPR))

80 - MONSWABRM LIB(MFG)
        CMD(SNDMSG MSG('Manufacturing libraries have been synchronized.')
         TOUSR(*SYSOPR))
```

In this example, BRMS/400 issues four saves. Each save establishes a synchronization point at the *LIB level, and a message is sent to the message queue specified in the SWA Message Queue field in the control group.

In this example, we specified the name of the message queue in the SWA Message Queue value rather than using the default of *LIB. The message queue name specified in the control group entry *must* match the message queue name in the LIB parameter of the MONSWABRM command. The MONSWABRM automatically creates and deletes the message queue for you.

For example, when the LIBB is synchronized, OS/400 sends the synchronization message to message queue SALES. The SALES message queue is monitored by the MONSWABRM command and is created in the QUSRBRM library when the control group processing is started. This message queue is automatically deleted when the SNDMSG command defined in the MONSWABRM command is processed. The SNDMSG command sends a message to QSYSOPR informing you that the application can be used.

Instead of invoking the SNDMSG command, you can start another process such as release a job queue, start a subsystem, or call a program. You may *not* want to use the STRSBSBRM command until the last exit, because this starts all of the subsystems that were ended by the control group. This assumes that you defined the subsystems to end in your control group.

The preceding example allows you to release applications to the users as and when they are available. The disadvantage here is that BRMS/400 has to perform four separate save commands to save the four libraries.

> **Note**
>
> By default, the backup control group job and all of the MONSWABRM jobs are submitted to QBATCH subsystem. You must ensure that you have enough activity levels to perform your control group save and process all of the MONSWABRM commands. If you prefer, you can use another subsystem by specifying the job queue name or the job description name in the STRBKUBRM or the MONSWABRM commands.

4.3.5.3 Example 3

In this example, the MONSWABRM command is not used at all. This is only possible if you are at V3R6 or later or at V3R2. If all you want from the save-while-active function is the message when the libraries reach synchronization point, you can use SWA Message Queue as shown in Figure 49.

```
                                  Weekly    Retain   Save       SWA
                 Backup     List  Activity  Object   While      Message
          Seq    Items      Type  SMTWTFS   Detail   Active     Queue

          10     LIBA             *DFTACT   *NO      *SYNCLIB   OPER01
          20     LIBB             *DFTACT   *NO      *SYNCLIB   *LIB
          40     LIBC             *DFTACT   *NO      *SYNCLIB   *LIB
          50     LIBD             *DFTACT   *NO      *SYNCLIB   *LIB
```

Figure 49. Save-while-active example 3

The OPER01 message queue is used by the system to log the following messages:

```
0 of 4 libraries processed. Started LIBA at 02/03/01 10:20:06.
1 of 4 libraries processed. Started LIBA at 02/03/01 10:20:07.
```

```
2 of 4 libraries processed. Started LIBC at 02/03/01 10:20:07.
3 of 4 libraries processed. Started LIBD at 02/03/01 10:20:08.
Now completing save-while-active checkpoint processing.
Save-while-active checkpoint processing complete.
```

BRMS/400 uses the first message queue to monitor for the synchronization. Even if you were to specify OPER02, OPER03, and OPER04 as the message queues for LIBB, LIBC, and LIBD, the save-while-active synchronization goes to message queue OPER01 as previously shown.

If you require synchronization messages to go to different message queues, you must separate your control group entries for libraries by using operations such as *EXIT or *LOAD. BRMS/400 also separates the library groups if it detects a change of value in the Retain Object Detail, Weekly Activity, or the Save While Active field.

Important

At the time this redbook was written, BRMS/400 required the message queue to exist in QUSRBRM when processing the save.

If you are using the MONSWABRM command, you do not have to create any message queues. If you are *not* using the MONSWABRM command, you must ensure that you create a message queue in the QUSRBRM library with the same name as that value you specified in the SWA Message Queue field.

This implementation is being enhanced so that BRMS/400 now looks at the QUSRBRM library first for the message queue. If it cannot find the message queue in the QUSRBRM library, it searches your library list. With these enhancements, you can specify QSYSOPR as the message queue for receiving synchronization messages.

The availability for this functional enhancement can be tracked by reviewing APAR SA61101. This APAR is updated with the PTF information when the PTFs are released.

Until the PTF is available and applied, you *must* create a message queue in the QUSRBRM library to match the message queue value you used in the control group. Use the Create Message Queue (CRTMSGQ) command to create a message queue such as SWAMSGQ.

4.3.5.4 Example 4
The MONSWABRM command is not used in this example. The objective here is to use multiple message queues to monitor for save-while-active synchronization. See Figure 50 on page 82.

```
                               Weekly   Retain   Save     SWA
               Backup    List  Activity Object   While    Message
         Seq   Items     Type  SMIWTFS  Detail   Active   Queue

         10    LIBA            *DFTACT  *NO      *SYNCLIB OPER01
         20    LIBB            *DFTACT  *NO      *SYNCLIB *LIB
         30    LIBC            *DFTACT  *NO      *LIB     OPER02
         40    LIBD            *DFTACT  *NO      *SYNCLIB OPER03
         50    LIBE            *DFTACT  *NO      *SYNCLIB *LIB
```

Figure 50. Save-while-active example 4

In the example in Figure 50, BRMS/400 performs three save operations. The first save operation saves LIBA and LIBB and sends the synchronization message to OPER01 message queue. BRMS/400 processes LIBC and sends the synchronization message to OPER02 message queue. LIBD and LIBE libraries are processed last and a single synchronization message is sent to the OPER03 message queue. In all, BRMS/400 performs three separate save operations for this control group.

You see that in the preceding example, we did not use an *EXIT or a *LOAD operation to separate the saves in the control group. BRMS/400 automatically issues another save operation when it detects a change in the way you want to perform your save-while-active operation. In this example, it detected a change in the Save-while-active field.

4.3.5.5 Example 5

In the example shown in Figure 51, we use special values, such as *ALLPROD or *ALLTEST, in the MONSWABRM command with the save-while-active function.

```
                               Weekly   Retain   Save     SWA
               Backup    List  Activity Object   While    Message
         Seq   Items     Type  SMIWTFS  Detail   Active   Queue

         10    *EXIT           *DFTACT
         20    *EXIT           *DFTACT
         30    *ALLPROD        *DFTACT  *NO      *SYNCLIB PRODMSGQ
         40    *EXIT           *DFTACT
         50    *ALLTEST        *DFTACT  *NO      *SYNCLIB  TESTMSGQ
```

Figure 51. Save-while-active example 5

The exits have the following settings for the MONSWABRM command:

```
20 - MONSWABRM LIB(PRODMSGQ)
       CMD(SNDMSG MSG('All production libraries are synchronized.')
       TOUSR(*SYSOPR))

40 - MONSWABRM LIB(TESTMSGQ)
       CMD(SNDMSG MSG('All test libraries are been synchronized.')
        TOUSR(*SYSOPR))
```

When the *ALLPROD set of libraries reaches a synchronization point, the system sends the message to PRODMSGQ. PRODMSGQ is monitored by the MONSWABRM command. As soon as it receives the message from the system, it processes the command specified in the CMD value. The control group goes on to process the *ALLTEST libraries and performs similar tasks as for *ALLPROD processing.

The advantage of using this approach, where the SWA Message Queue value matches with the LIB value on the MONSWABRM command, is that you do not have to remember the name of the first library that appears in your list. You also do not need to know how BRMS/400 builds the list of libraries for save processing. This list may *not* always appear in alphabetical sequence when BRMS/400 is performing an *incremental* save.

For example, you have libraries APROD, BPROD, and CPROD as your production libraries. You know that BRMS/400 always uses the first library in sequence to check for save-while-active messages. Your MONSWABRM command contains APROD for the LIB value, and the control group defaults to *LIB for SWA Message Queue. You already performed a full save on Sunday. Between the full save and the next incremental save, you created a new library called AAPROD and have not updated the exit for the MONSWABRM command.

When you process the control group on Monday for incremental saves, BRMS/400 looks at the last save date and time for all of the libraries and builds a list of libraries for the save operation. This list has AAPROD ahead of APROD library. Thus, your MONSWABRM command does not receive any save-while-active messages to libraries reaching synchronization. Therefore, we recommend that you specify a name of a message queue in the SWA Message Queue field and use the same name for the LIB value in the MONSWABRM command. This always ensures that you get synchronization messages, regardless of how BRMS/400 builds a list of libraries for save processing.

> **Note**
>
> We strongly recommend that you avoid using the *ALLUSR value for
> save-while-active processing because of the additional performance impact.
> OS/400 does not allow SAVLIB LIB(*ALLUSR) or SAVLIB(*IBM) when using
> the *SYNCLIB function. The *ALLUSR value is only supported when you use
> the SAVCHGOBJ command. See *Backup and Recovery - Advanced*,
> SC41-4305, for additional information.
>
> These OS/400 restrictions also apply to BRMS/400.

4.4 Saving spooled files using BRMS/400

Within BRMS/400, you create a backup list to specify the output queues that you
want to save using the backup control groups. Figure 52 shows how you can
create a spooled file backup list.

```
                        Change Spooled File List                SYSTEM09

Use . . . . . . . . . :  *BKU
List name . . . . . . :  SAVESPLF
Text  . . . . . . . .    Output Queue to be Saved by BRMS

Type choices, press Enter.
                                                              *INC/
  Seq Library    Outq      File      Job       User     User data  *EXC
  ___ _____  _____  _____  _____  _____  _____  ____
   10 QGPL       SAVEOUTQ  *ALL      *ALL      *ALL      *ALL       *INC
```

Figure 52. Including and excluding spooled file entries in backup list

Within a single spooled file list, you can add multiple output queues that you want
to save by selecting multiple sequence numbers. When you add the output
queues, you can select the type of spooled file names, job names, or user names
that you want to save. For example, if you only want to save spooled files that
belong to USERA, you can specify the name of this user in the User field. You
can also select generic names or job names.

This example saves output queue SAVEOUTQ from library QGPL. You can leave
the OUTQ default to *ALL. In this case, BRMS/400 saves all spooled files from all
output queues from the QGPL library.

If you want to omit an output queue, you can use the *EXC value to exclude it.

> **Note**
>
> Incremental saves of spooled files are not supported. If you specify an incremental save for an *SPL list type, all spooled files in the list are saved. When the spooled files are successfully saved to a save file or to a tape media, BRMS/400 does not automatically clear the output queue. You have to manage how you want to clear data from your output queues. We recommend that you obtain a hardcopy of your output queue immediately after the BRMS/400 save is completed for audit purposes. Use the Work with Output Queue (WRKOUTQ) command with the OUTPUT(*PRINT) option.

Once you have set up a backup list, you can add this list to your daily, weekly, or monthly backup control group as a backup item and a list type of *SPL. BRMS/400 automatically saves the spooled files whenever the control group is processed for backups. Figure 53 shows a backup control group especially created to save spooled files using the backup list that was created earlier.

```
                    Edit Backup Control Group Entries            SYSTEM09

    Group . . . . . . . . . . : BKUSPLF
    Default activity  . . . . . FFFFFFF
    Text  . . . . . . . . . . . Control Group to Backup Spooled Files

    Type information, press Enter.

                                   Weekly    Retain   Save      SWA
               Backup      List    Activity  Object   While     Message
      Seq      Items       Type    SMTWTFS   Detail   Active    Queue

       10      SAVESPLF    *SPL    *DFTACT
```

Figure 53. Backup list SAVESPLF

Once you have successfully saved the spooled files, you can use the Work with Spooled Files for BRM (WRKSPLFBRM) command to display the status of your saves. You see that your spooled files are organized in the date and time order in which they were created on the system (Figure 54).

```
                    Work with Saved Spooled Files              SYSTEM09

    Position to date . . . .

    Type options, press Enter.
      4=Remove    5=Display    6=Work with media    7=Restore spooled file

    Opt Library     Outq       File        Job        User        Date      Time
        QGPL        SAVEOUTQ   QP1AVER     DSP08      USER103D    5/30/00 13:15:55
        QGPL        SAVEOUTQ   QP1AEP      DSP08      USER103D    5/30/00 13:16:01
        QGPL        SAVEOUTQ   QP1AVMS     DSP08      USER103D    5/30/00 13:16:19
        QGPL        SAVEOUTQ   QP1AMM      DSP08      USER103D    5/30/00 13:16:40
        QGPL        SAVEOUTQ   QP1AHS      DSP08      USER103D    5/30/00 13:16:46
        QGPL        SAVEOUTQ   QP1ALE      DSP08      USER103D    5/30/00 13:16:49
        QGPL        SAVEOUTQ   QP1ARCY     DSP08      USER103D    5/30/00 13:19:23
```

Figure 54. Work with Saved Spooled Files (WRKSPLFBRM)

You need to use the WRKSPLFBRM command or the WRKMEDIBRM command to restore the spooled files.

Important

BRMS/400 does not automatically create the spooled files that you saved when you restore your user data on your system. You have to recover your spooled files using the WRKSPLFBRM command and perform the appropriate actions to restore the spooled files.

From the Work with Saved Spooled Files display, select option 7 to restore the spooled files that you want to recover. This takes you to the Select Recovery Items display (Figure 55).

```
                            Select Recovery Items                         SYSTEM09

Type options, press Enter.  Press F16 to select all.
  1=Select    4=Remove    5=Display


  ....................................................................
  :                                                                  :
  :                     Restore Command Defaults                 :   :
  :                                                                  :
  : Type information, press Enter.                                   :
  :  Device . . . . . . . . . . . . . . *MEDCLS     Name, *MEDCLS    :
  :  End of tape option  . . . . . . . . *REWIND     *REWIND, *LEAVE, *UNLOAD :
  :  Restore to output queue . . . . . . *SAVOUTQ    Name, *SAVOUTQ  :
  :    Library . . . . . . . . . . . . .  _____   Name, *LIBL     :
  :                                                                  :
  :  F12=Cancel                                                      :
  :                                                                  :
  :                                                                  :
  :                                                                  :
  :..................................................................:

1  QGPL        SAVEOUTQ    QP1ALE      DSP08       USER103D    *SAVF
1  QGPL        SAVEOUTQ    QP1ARCY     DSP08       USER103D    *SAVF
                                                                  More....

F3=Exit    F5=Refresh    F9=Recovery defaults    F12=Cancel
F14=Submit to batch      F16=Select all
```

Figure 55. Select Recovery Items

By default, BRMS/400 restores your spooled data into the output queue from which it was saved. You may override the defaults by selecting function key F9 from the Select Recovery Items display to change the recovery defaults.

During the save and restore, BRMS/400 retains the spooled file attributes, file name, user name, user data field, and, in most cases, the job name. OS/400 assigns new job numbers, a system date, and a time of the restore operation. The original date and time cannot be restored. Once you restore the output queue, you can use the WRKOUTQ command with OPTION(*PRINT) to spool the contents of the output queue. You can use this report to compare with the original report that you produced after saving the output queue.

> **Note**
>
> Internally, BRMS/400 saves the spooled files as a single folder, with multiple documents (spooled members) within that folder. During restore, it reads the tape label for the folder and restores all of the documents. If your spooled file save happens to span multiple tape volumes, you will be prompted to load the first tape to read the label information, before you restore the documents in the subsequent tapes. Therefore, we recommend that you plan to save your spooled files on a separate tape using the *LOAD exit in the control group, or split your spooled file saves so that you are only using one tape at a time. This approach will help you during your spooled file recovery.

4.5 BRMS/400 console monitor

In BRMS/400 V3R2 and later, a SAVSYS can be done in unattended mode from the system console using the console monitor. Console monitor puts the system console in a monitored state, but you can suspend the console to enter OS/400 commands and put the console back to a monitor state.

4.5.1 Console monitor function

The goal of console monitoring is to allow the users to submit the SAVSYS job to batch instead of doing it interactively. Previously, SAVSYS, SAVSYSBRM, or STRBKUBRM with *SAVSYS required interactive processing. Now, there is a new option in the STRBKUBRM command. The Submit to Batch option allows you to enter *CONSOLE as a parameter. It also allows you to perform your saves in batch mode. You no longer need to be in the machine room or have an attended environment to perform a system save. However, you *must* start the console monitoring function on the system console prior to leaving the machine to operate in unattended mode. You can do this by selecting option 2 (Backup) from the BRMS main menu and selecting option 4 (Start Console monitor) from the BRMBKU menu. See Figure 56 on page 88 for details on the STRBKUBRM command and the optional parameters.

For example, if you schedule the STRBKUBRM SUBMIT(*CONSOLE) command to run on Sunday at 2:00 a.m., you have to start the console monitor on the system console before you leave your office. You *must* perform this on the system console because it requires the job to run in the QCTL subsystem. If you attempt to start the console monitor from your workstation, you receive the BRMS/400 BRM1947 error message: `Not in a correct environment to start the console monitor`.

```
┌─ Hint ──────────────────────────────────────────────────────────────────────┐
│                                                                              │
│   • Once you start console monitoring, the console waits for a BRMS/400      │
│     command to process. You can suspend the console to process commands.     │
│     However, during this period, if BRMS/400 tries to start a backup using   │
│     *CONSOLE, it is delayed until you finish your command and return to the  │
│     monitoring status.                                                       │
│                                                                              │
│     If you forget to exit from the command line, BRMS/400 cannot process any │
│     backup group using the SUBMIT(*CONSOLE) parameter. If this situation     │
│     occurs and you realize it the next day, do not end the command line      │
│     immediately. If you do, your nightly BRMS/400 backup using *CONSOLE is   │
│     processed. Since this is probably a SAVSYS (since console monitoring is  │
│     mainly designed for SAVSYS backups), it ends all of your subsystems which│
│     is not what you may want the system to do. Therefore, before you end the │
│     command line entry on the console monitoring, you should invoke system   │
│     request <SYST REQUEST> on DSP01 (in console monitoring mode) and         │
│     select option 2 to cancel the previous request.                          │
│                                                                              │
│     This stops console monitoring. Once you restart the console monitoring, all│
│     of the previous requests are cleared so your previous SAVSYS does not    │
│     restart.                                                                 │
│                                                                              │
│   • In V3R6, there is nothing (other than physical access security) to stop a │
│     person from going to the console display and selecting PF3 to end console │
│     monitoring. Once ended, the console is still signed on with your user    │
│     authority. You can prevent this from happening by securing the console   │
│     monitor. See 4.5.2, "Securing the console monitor" on page 90.           │
│                                                                              │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌──────────────────────────────────────────────────────────────────────────────┐
│  BRMBKU                             Backup                                     │
│                                                         System:    SYSTEM05    │
│  Select one of the following:                                                  │
│                                                                                │
│       1. Backup planning                                                       │
│       2. Perform backup                                                        │
│       3. Display backup activity                                               │
│       4. Start console monitor                                                 │
│                                                                                │
└──────────────────────────────────────────────────────────────────────────────┘
```
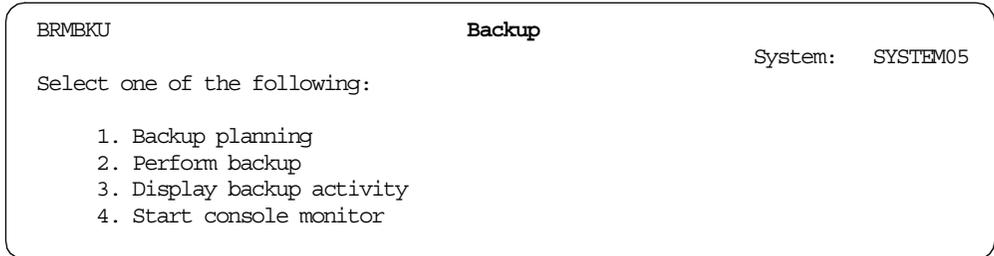
Figure 56. Start console monitor option on the Backup menu

If you are on the system console, you can start the console mode with option 4
from the BRMBKU menu. Once you start the console monitor, the console waits
for a BRMS/400 command to be processed (Figure 57).

```
┌──────────────────────────────────────────────────────────────────────────────┐
│                             Console Monitor                                    │
│                                                                                │
│                                                                                │
│  Press F12 to cancel the monitor operation.                                    │
│  Press F9 to access command line. Control must return to this display          │
│     for BRMS activity to be monitored.                                         │
│                                                                                │
└──────────────────────────────────────────────────────────────────────────────┘
```
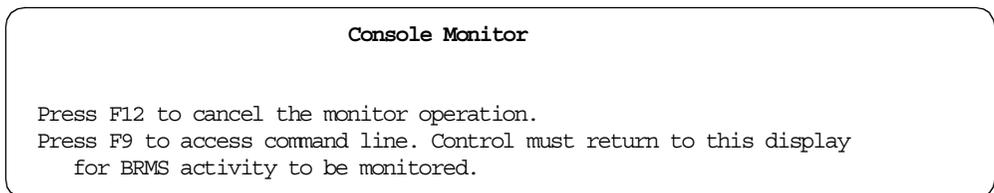
Figure 57. Console Monitor active

The use of the console monitor is provided by the special value *CONSOLE on the Submit Job (SBMJOB) parameter of the STRBKUBRM command (Figure 58).

```
                    Start Backup using BRM (STRBKUBRM)

 Type choices, press Enter.

 Control group  . . . . . . . . . >  SAVSYS       *BKUGRP, *SYSGRP, SAVSYS...
 Schedule time  . . . . . . . . .    *IMMED       hhmm, *IMMED
 Submit to batch  . . . . . . . .    *CONSOLE     *CONSOLE, *YES, *NO
 Starting sequence:
   Number . . . . . . . . . . .      *FIRST       1-9999, *FIRST
   Library  . . . . . . . . . .      *FIRST       Name, *FIRST
 Append to media  . . . . . . . .    *CTLGRPATR   *CTLGRPATR, *BKUPCY, *YES...
 Job description  . . . . . . . .    *USRPRF      Name, *USRPRF
   Library  . . . . . . . . . .                   Name, *LIBL, *CURLIB
 Job queue  . . . . . . . . . .      *JOBD        Name, *JOBD
   Library  . . . . . . . . . .                   Name, *LIBL, *CURLIB
```

Figure 58. Submitting a system save to batch using the console monitor

If you want to interrupt the console monitor, press F9 and enter your password. If you entered the correct password, a pop-up window is shown where you can enter OS/400 commands (Figure 59).

```
                        Console Monitor Security


 Press F12 to cancel the access command line function.

 Type choice, press Enter.

 Current user ID  . . . . . . . . . . . . . CONSOLE
 Enter password to verify . . . . . . . . .                 Current password






 ...........................................................................
 :                             Command                                     :
 :                                                                         :
 :  ===>_____   :
 :  F4=Prompt   F9=Retrieve   F12=Cancel                                   :
 :                                                                         :
 :.........................................................................:
```

Figure 59. Command line access from the console monitor

When the console monitor is interrupted, any requests submitted through the console monitor are queued and not processed until you complete your command and *return* to the console monitoring status. If you forget to return from the command line, BRMS/400 does not process any queued backups that were submitted.

4.5.2 Securing the console monitor

Once you start the console monitor, your password is required before the monitor suspends itself to provide a command line. In V3R6, there is no password to end the console monitor. Once it is ended, the console is again fully available just as it was before you selected the console monitor option from the BRMS/400 backup menu.

To avoid this security exposure, you should create a new user profile (for example, CONSOLE) that has QBRM as the current library, calls the console monitor program (Q1ACCON) as its initial program, and uses the *SIGNOFF menu as its initial menu (Figure 60).

```
                      Create User Profile (CRTUSRPRF)

 Type choices, press Enter.

 User profile . . . . . . . . . > CONSOLE        Name
 User password  . . . . . . . .                  Name, *USRPRF, *NONE
 Set password to expired  . . . .     *NO         *NO, *YES
 Status . . . . . . . . . . . .     *ENABLED      *ENABLED, *DISABLED
 User class . . . . . . . . . .     *SECOFR       *USER, *SYSOPR, *PGMR...
 Assistance level . . . . . . .     *SYSVAL       *SYSVAL, *BASIC, *INTERMED...
 Current library  . . . . . . .     QBRM          Name, *CRTDFT
 Initial program to call  . . . .    Q1ACCON      Name, *NONE
   Library  . . . . . . . . . .       QBRM        Name, *LIBL, *CURLIB
 Initial menu . . . . . . . . .     *SIGNOFF      Name, *SIGNOFF
   Library  . . . . . . . . . .       *LIBL       Name, *LIBL, *CURLIB
 Limit capabilities . . . . . . .    *NO          *NO, *PARTIAL, *YES
 Text 'description' . . . . . . . .  BRMS/400     Console Monitor Profile
```

Figure 60. Initial program to secure the console monitor

Signing on at the system console with this user profile starts the console monitor. You can use F9 to enter commands on this display only if you enter the CONSOLE profile password. Any attempt to end the console monitor results in a sign off.

4.5.3 Monitoring the console monitor

BRMS/400 logs the following messages that help monitor the console monitor:

```
BRM1948 'BRMS Console monitoring is now started'
        when you start the console monitoring
BRM1950 'BRMS Console monitoring is inactive'
        when you use the command line entry (PF9)
BRM1954 'BRMS Console monitoring is now ending'
         when you quit the console monitoring (PF3)
```

4.5.4 Canceling the console monitor

If you want to end the console monitor, use the F3 or F12 key. In V3R6, there is no password required to end this function. You return to where you were before you selected the console monitor.

In V3R2, if you exit the console monitor with F3 or F12, the Console Monitor Exit display is shown to enter a password (Figure 61).

```
                        Console Monitor Exit


    Press F12 to cancel the exit console monitor function.

    Type choice, press Enter.

    Current user ID . . . . . . . . . . . .        CONSOLE
    Enter password to verify . . . . . . . .       Current password
```

Figure 61. Console Monitor Exit

4.6 Job scheduling and BRMS/400

Many of the functions performed by BRMS/400 are well suited to run under the
control of a job scheduler (for example, scheduling a backup when nightly
processing has completed, or scheduling the MOVMEDBRM and STRMNTBRM
commands across a network). With the Console Monitor function, you can now
also schedule an unattended system save.

4.6.1 Using the OS/400 job scheduler

BRMS/400 provides a direct interface to the OS/400 job scheduler to process
both backup and archive control groups (Figure 62).

```
                      Work with Backup Control Groups                SYSTEM01

    Position to . . . . . .                Starting characters


    Type options, press Enter
      1=Create    2=Edit entries   3=Copy      4=Delete    5=Display
      6=Add to schedule   8=Change attributes   9=Subsystems to process ...
                      Full       Incr       Weekly
            Control   Media      Media      Activity
    Opt Group         Policy     Policy     SMTWTFS   Text
  2 6 SAVFIFS
      *BKUGRP     *BKUPCY    *BKUPCY    *BKUPCY   Entry created by BRM configura
      *SYSGRP     SAVSYS     SAVSYS     *BKUPCY   Entry created by BRM configura
      DUPTAP01    FULLR      FULLR      FFFFFFF   DUPTAP01 SAVE  to REEL 6250
      EDELM09     FULL       INCR       FFFFFFF   Edelgard's SAVE
      DEREK       FULL       FULL       FFFFFFF
      RDARS1      RDARS      RDARS      FFFFFFF   DUPTAP01 SAVE  to REEL 6250
  1 6 SAVFIFS     SAVFP      SAVFP      FFFFFFF   Backup FSIOP with SAVF / SWA=*
      SAVFIFS2    SAVFP      SAVFP      FFFFFFF   Backup FSIOP with SAVF / SWA=*
```

Figure 62. Work with Backup Control Groups display

You can add a control group to the schedule by entering 6 in the Opt column for
the relevant control group **1**. You may also enter 6 in the option column of the first
line of the display and the name of the control group in the **2** Control Group field.

This takes you to the OS/400 Add Job Schedule Entry display as shown in Figure
63 on page 92, where BRMS/400 automatically completes the job name and
command to run fields. You should enter scheduling details in the lower half of the
display and any additional parameters (F10=Additional parameters) not shown on
the initial display.

```
               Add Job Schedule Entry (ADDJOBSCDE)

 Type choices, press Enter.

 Job name . . . . . . . . . . . . > QBRMBKUP      Name, *JOBD
 Command to run . . . . . . . . . > STRBKUBRM CTLGRP(SAVFIFS) SBMJOB(*NO)
 _____
 _____
 _____
 _____
 _____
 _____

 Frequency  . . . . . . . . . . . > *WEEKLY      *ONCE, *WEEKLY, *MONTHLY
 Schedule date, or  . . . . . . . > *NONE        Date, *CURRENT, *MONTHSTR...
 Schedule day . . . . . . . . . . > *ALL         *NONE, *ALL, *MON, *TUE...
              + for more values
 Schedule time  . . . . . . . . . > '00:01'      Time, *CURRENT
```

Figure 63. Add Job Schedule Entry display

4.6.2 Submitting jobs to the OS/400 job scheduler

You can choose to add your own BRMS/400 jobs to the OS/400 scheduler using the ADDJOBSCDE command. BRMS/400 searches the Command to run character string for "BRM" for jobs to include in the Work with BRM Job Schedule Entries display. Although most BRMS/400 commands have "BRM" as a suffix, some do not, and these do *not* appear unless you use the QBRM library qualification.

Only those jobs that do not generate an interactive display can be submitted to a job scheduler. This precludes scheduling recovery with the STRRCYBRM command, but allows you to schedule the recovery report.

4.6.3 Working with scheduled jobs

To work with the BRMS/400 jobs that have already been added to the scheduler, press F7 on the Work with Backup Control Groups display (see Figure 62 on page 91). This takes you to the Work with BRM Job Schedule Entries display shown in Figure 64.

```
                 Work with BRM Job Schedule Entries            SYSTEM01



 Type options, press Enter.
   2=Change   3=Hold   4=Remove 5=Work with   6=Release

                                                          Next
                         -----Schedule------        Recovery  Submit
 Opt  Job          Status Date      Time     Frequency Action  Date
      BRMSAVE      SCD    *NONE     23:30:00  *WEEKLY   *SBMRLS 05/06/00
      QBRMBKU      SCD    *ALL      22:00:00  *ONCE     *NOSBM  06/06/00
```

Figure 64. Work with BRM Job Schedule Entries

The Work with BRM Job Schedule Entries display allows you to change, hold, remove, work with, or release scheduled jobs. It is similar to the OS/400 Work

with Job Schedule Entries display, but does not allow all options. You may, however, add a new job to the schedule by using F6 (Add).

If you choose option 4 (Remove) in the Work with BRM Job Schedule Entries display (Figure 64), a confirmation display is *not* shown. Your selected entries are removed immediately.

You can also access scheduled jobs from the BRMS/400 Scheduling menu. Option 1 on the BRMS Scheduling menu shows all BRMS/400 scheduled jobs (including those added manually to the scheduler) as shown in Figure 64. Option 2 shows all scheduled jobs.

4.6.4 Using BRMS/400 commands in job scheduler for OS/400

An alternative job scheduler can easily be used with BRMS/400 commands. You are responsible for adding the BRMS/400 commands to your chosen job scheduler. Appendix A in *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) has a full list of BRMS/400 commands. Remember, only those commands that do not generate an interactive display can be submitted to a job scheduler.

Job scheduler for OS/400 already works with BRMS/400, and BRMS/400 allows you to tailor its functions so that job scheduler for OS/400 commands are automatically invoked when certain BRMS/400 options are selected. Use option 3 (Change Job Scheduler) from the BRMS scheduling menu or the Change Job Scheduler (CHGSCDBRM) command with a prompt. You are prompted with the display shown in Figure 65.

```
                    Change Job Scheduler (CHGSCDBRM)

 Type choices, press Enter.

 Scheduler type . . . . . . . .    *USRDFN       *SYSTEM, *IJS, *USRDFN
```
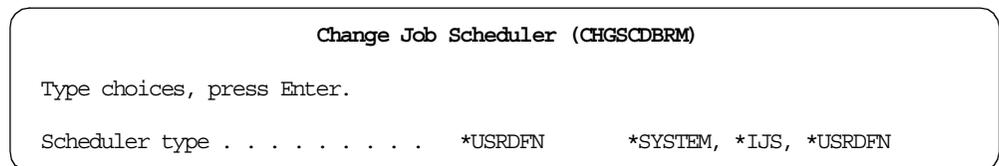
Figure 65. Changing job scheduler in BRMS/400

In V3R2 and V3R7, the *IJS option was added for the Scheduler type parameter on the CHGSCDBRM command. If you are using job scheduler for OS/400 and are happy with the BRMS/400 defaults, you should choose this option. No further options are shown.

If you are using a release other than V3R2 or V3R7, or if you are using a non-IBM scheduler, you should use the *USRDFN value. There are three parameters where you can define non-IBM scheduler CL commands to be executed. For each parameter, you can also specify whether you want to be prompted for the command at execution time.

The following three parameters correspond to the BRMS/400 functions:

- **Add a job**: Option 6, Add to schedule from the Work with Control Groups displays.
- **List jobs**: Option 2, Work with all scheduled jobs from the BRMS/400 Scheduling menu.
- **Select jobs**: Option 1, Work with all BRM scheduled jobs from the BRMS/400 Scheduling menu or F7 from the Work with Control Groups displays.

There are four substitution variables that can be specified in any of the command strings used on the parameters of the CHGSCDBRM command as previously described. BRMS/400 passes information to these four substitution variables depending on what BRMS/400 function is being used. The four variables are:

- **&JOBNAME**: A BRMS/400 identifier assigned to every job: QBRMBKUP.

- **&REQUEST**: The full BRMS/400 command to be submitted to the scheduler: STRBKUBRM or STRARCBRM with parameters (if applicable).

- **&APPL**: Always contains "BRMS". This can be used to assist a non-IBM scheduler locate jobs by an application code if they support this function.

- **&GROUP**: Control group name (if applicable).

Not all variables apply in each case. If the variable name is not relevant, an asterisk (*) is placed in the variable (Figure 66).

```
                    Change Job Scheduler (CHGSCDBRM)

 Type choices, press Enter.

 Scheduler type . . . . . . . . .    *USRDFN       *SYSTEM, *IJS, *USRDFN
 Add a job command  . . . . . . .    'ADDJOBJS JOB(&JOBNAME) APP(&APPL) SCDCDE(*D

AILY) TIME(2400) CMD(&REQUEST)'
 _____
 _____
 _____
 _____
 _____

 Command prompt for add . . . . .    *YES          *NO, *YES
 List jobs command  . . . . . . .    'WRKJOBJS'
 _____
 _____
 _____
 _____
 _____
 _____

 Command prompt for list  . . . .    *NO           *NO, *YES
 Select jobs command  . . . . . .    'WRKJOBJS APP(&APPL)'
 _____
 _____
 _____
 _____
 _____

 Command prompt for select  . . .    *NO           *NO, *YES
```

Figure 66. Change Job Scheduler

Before you can use &APPL, which contains "BRMS", you need to set up the application in job scheduler for OS/400. You do this by selecting option 4 (Job Controls) from the main job scheduler for OS/400 menu and option 6 (Work with Applications).

Figure 67 and Figure 68 show the prompts for creating the application BRMS. You are asked for contact names and other information, but you can create these by drilling down (the same as with BRMS/400).

```
                        Work with Applications                      SYSTEM01

Position to . . . . . .              Starting characters

Type options, press Enter.
  1=Add   2=Change   3=Copy   4=Remove   5=Display   6=Work with jobs
  7=Hold application jobs      8=Release application jobs
  9=Change application information

Opt   Application     Text
 1    BRMS
```

Figure 67. Work with Applications

```
                          Add Application                           SYSTEM01

Type information, press Enter.

Application . . . . . . . . . . . .    BRMS
Application contact one . . . . . .
Application contact two . . . . . .
Application contact three . . .....................................
Application contact four  . . :     Select Application Contact       :
Application contact five  . . :                                      :
Text . . . . . . . . . . . . :  Type options, press Enter.           :
                              :                                      :
                              :     1=Select                         :
                              : Opt  Application contact             :
                              : 1  Derek McBryde                     :
                              :    Sejal Dave                        :
                              :    Genyphyr Novak                    :
                              :    Debbie Saugen                     :
                              :                                      :
                              :                            Bottom :
                              : F9=Work with application contacts    :
                              : F12=Cancel                           :
                              :                                      :
F3=Exit    F4=Prompt    F12=Ca :.....................................:
```

Figure 68. Adding a BRMS application to job scheduler for OS/400

4.6.5 Weekly activity and job scheduling

You should be careful when specifying control groups if you intend to schedule backup and archiving. In a control group, you can specify an action to happen on specific days of the week. However, if there is a delay that causes your job to run later than expected, the control group may take a different action.

Consider the example shown in Figure 69.

```
                        Weekly      Retain    Save
             Backup      List    Activity    Object    While
      Seq    Items       Type    SMIWTFS     Detail    Active

       10    PGMLIB                  F        *NO       *NO
       20    FILELIB*             FIIIIII     *NO       *NO
```

Figure 69. Sample backup control group entries

Suppose the control group shown in Figure 69 on page 95 is scheduled to run each evening at 23:00. The job scheduler submits the backup job at 23:00 to the same job queue as the month-end batch job.

On Saturday, the month-end job overruns and does not complete before midnight. The backup job, therefore, does not run until after midnight, which is *on Sunday* in our scenario.

BRMS/400 looks at the weekly activity and can:

- Do a *full* backup of the FILELIB* libraries.
- *Not save* PGMLIB.

To add to this, when the scheduler submits the control group to run again at 23:00 on Sunday evening, another full backup of the FILELIB* libraries is taken. If these saves are to save files, you can experience space problems. If you are saving to tape, you can run out of tapes.

Chapter 5. BRMS/400 networking

This chapter looks at how AS/400 systems with BRMS/400 can participate in a BRMS/400 network. It only covers networking AS/400 systems that have V3R2, V3R6, or V3R7 of BRMS/400 installed. Where appropriate, it includes information on the BRMS/400 V3R1 release.

5.1 Overview of BRMS/400 network

By grouping multiple AS/400 systems in a BRMS/400 network group, you can share BRMS/400 policies, media information, devices, and storage locations across the network group. This allows you to manage the backup and archiving of all your AS/400 systems in a consistent manner, as well as optimizing the use of your media and media devices.

Each AS/400 system that is a member of a network group receives updates to the media inventory, regardless of which network member makes the change. Therefore, if you have a network of four AS/400 systems (SYSTEM01, SYSTEM02, SYSTEM03, and SYSTEM04), and you add a media volume (A001) on SYSTEM01, the information about this new volume is propagated on all other systems. Information shared between systems in the shared media inventory environment includes:

- Media inventory
- Media class
- Media policy
- Container inventory
- Container class
- Move policy
- Network group
- Storage location
- Duplication cross reference

Before you set up your network, it is *extremely* important that you have installed on your system the PTF related to the enhancements made to the Copy Media Information using BRM (CPYMEDIBRM) command. The CPYMEDIBRM command copies media inventory information to a work file or copies the contents of the work file to the media inventory. The actual usage of this command in a BRMS/400 network group is discussed later in this chapter. Based on the version and release you are using, you should have the following PTF installed for your version and release:

- V3R1 - SF34449
- V3R2 - SF34452
- V3R6 - SF34453
- V3R7 - SF34454

With the PTF applied, the CPYMEDIBRM command saves the following information:

- Containers, container classes, move policies, move policy rules, and locations are now included in the *TOFILE function.

- If they do not already exist, containers, container classes, move policies, move policy rules, and locations are added to the *FROMFILE functions. This

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97

allows volumes to be added in the media file that were rejected in the past due to this information not being available.

- Volumes are now stamped with "CPYMEDIBRM" as the job name when they are added to the media file.
- All time stamps are updated for all records written so that additions are synchronized in a network environment.
- All added volumes are registered to the new system, if available.
- History information is no longer deleted from the CPYMEDIBRM file.
- History information is added for any volumes added by a CPYMEDIBRM command.
- Files created with the CPYMEDIBRM OPTION(*TOFILE) command prior to applying this PTF are supported as before.

Note

Media and history records that are added have the system name changed to the new system name with the *FROMFILE function.

The *TOFILE function copies the media and history records owned by the current system.

You should also ensure that you have the latest BRMS/400 PTFs applied on your system.

5.2 How shared media inventory synchronization works

Assume that you have SYSTEM01, SYSTEM02, and SYSTEM03 in your network (independent of whether the link is APPC or APPN). When your BRMS/400 network is set up, you see that the Q1ABRMNET subsystem is started on all of the AS/400 systems that are participating in the BRMS/400 network. See Figure 70.

Note: The subsystem descriptions, job descriptions, and the job queue that BRMS/400 uses are stored in the QBRM library.

On SYSTEM01
CHGMEDBRM VOL(A001)

|
updates
↓

QA1AMM file — Creates a new record → QJ1ACM journal

Q1ACNETI

Submits | Writes | Reads

QBRMSYNC job in Q1ABRMNET sbs

Reads then deletes if successful

Q1A1ARMT file contents:
SYSTEM02 A001
SYSTEM03 A001

Q1A1ARMT file contents:
SYSTEM01
SYSTEM02
SYSTEM03

DDM link with SYSTEM03

Job in SBS Q1ABRMNET (default)
Opens remote QA1AMM file
Checks A001 date/time stamp
Updates if SYSTEM01 record newer

Job in SBS Q1ABRMNET (default)
Opens remote QA1AMM file
Checks A001 date/time stamp
Updates if SYSTEM01 record newer

Figure 70. BRMS/400 synchronization process

BRMS/400 uses the following process to update data across the network.

BRMS/400 journals the files containing the shared resources. These files are QA1AMM for the media and QA1A1RMT for the systems in the network group. When SYSTEM01 updates media, a policy, or any shared resources, an entry is logged in a BRMS/400 journal QJ1ACM in the QUSRBRM library. BRMS/400 captures both before images and after images in the journal receiver for any changes that are made related to media inventory on the systems in the network. However, only the after images are used to update the shared media inventory.

The Q1ABRMNET subsystem starts an autostart job called QBRMNET, which calls a CL program Q1ACNET. This job uses a job description of Q1ACNETJD in the QBRM library. The Q1ACNET program periodically monitors for journal entries that arrive in the QJ1ACM journal and performs the following tasks:

1. The Q1ACNET CL program calls Q1ARNET when the wait time has expired. The Q1ARNET program reads the QR1ANE data area in the QUSRBRM library for the last journal entry it processed and checks journal QJ1ACM to see if there are any new journal entries. If there are new journal entries, Q1ARNET pulls the journal entry, adds a system name and network identifier to it, and for each update in the journal receiver, it creates a new record for each system in the network group (except for the system where the update was made). This data is written in the QA1ANET file. BRMS/400 obtains information about the systems that are in the network group from the QA1A1RMT file in the QUSRBRM library. The Q1ARNET program updates the data areas after each record is processed. The Q1ARNET program also creates a record in the QA1A2NET file in the QUSRBRM library for each file and system reflected in the journal entries.

In our example shown in Figure 70 on page 99, there are three systems in the network group. When we make updates to SYSTEM01, the Q1ACNET program creates two entries in the QA1ANET file referring to the updates that need to be sent to the remaining two systems (SYSTEM02 and SYSTEM03) that are participating in the BRMS/400 network.

2. At regular intervals, the Q1ACNET program in subsystem Q1ABRMNET checks to determine if media activity has occurred that should be transferred to other systems in the network group.

Hint

The interval (or delay) value used to synchronize media information within a BRMS/400 netowk can be set between 30 and 9999 seconds using the Shared Inventory Delay parameter in the System Policy for V3R2, V3R6, or V3R7 systems. For V3R1 systems, this delay is fixed at 60 seconds and *cannot* be changed.

When there is data in the QA1ANET file, it submits the QBRMSYNC job through the Q1ABRMNET job queue. The QBRMSYNC job uses a job description of QBRMSYNC and calls the Q1ACSYN program.

Using QA1A2NET as a key, records are read from the QA1ANET file. A Distributed Data Management (DDM) link is established with the remote system to update the corresponding file on the remote system. The DDM files can be recognized in the QTEMP library because they have the name `QA1A--D`, where "`--`" refers to the file name such as QA1AMMD for media inventory. The suffix of "D" indicates that it is a DDM file.

 – Before performing the update, it first checks the date and time stamp of the record to be updated with the date and time stamp of the update itself.

 – If the update has an older time stamp, the update request is rejected.

Once this update is done, Q1ACSYN deletes the record from the QA1ANET file and reads the next record until all of the records have been processed. The QBRMSYNC job ends when the QA1ANET file is empty.

If you have any doubt that this process is not working satisfactorily, you can display the QA1ANET file to see if it contains any records. If the number of records is not zero, or is not decreasing, you may have a problem with the network.

Check that there are no messages on the QSYSOPR message queue on all of the networked systems. You also need to check that:

 • Subsystem Q1ABRMNET is started.
 • Job queue Q1ABRMNET is released.
 • APPC controllers are varied on.
 • QBRMS user profile is not in the *DISABLED state.

Note: BRMS/400 always attempts to go through the Q1ABRMNET subsystem first for network synchronization tasks. This subsystem has a default communications entry using the QBRM mode. We recommend that you do not create your own subsystem descriptions for synchronizing the BRMS/400 network. See 5.3.1, "Network security considerations" on page 101, for additional information.

5.3 Network communications for BRMS/400

As with many communication products, BRMS/400 also uses the default local location name LCLLOCNAME and not the system name SYSNAME. In most cases, the AS/400 systems have the same value specified in the LCLLOCNAME as in the SYSNAME. BRMS/400 also uses the local network identifier LCLNETID. Other network attributes have no effect on BRMS/400. These network values are defined in the network attributes and can be changed using the Change Network Attribute (CHGNETA) command. You can display the values using the Display Network Attribute (DSPNETA) command.

If you are using APPN with auto configuration, communications between AS/400 systems should be relatively simple. If display station pass through works fine and you can use SNA distribution services (SNADS) successfully, there is every chance that BRMS/400 networking will also work.

Also with APPN, and auto configuration enabled, you do not have to manually re-create the APPC controller and APPC device descriptions if you decide to change your system name or your network identifier. You can simply vary off and delete the old controller and device descriptions and allow APPN to automatically re-create the definitions for you.

If you use APPC communications, you have to create your own APPC controllers and devices. You must ensure that you specify correct information regarding the remote system when creating the controller description. For example, the Remote network identifier, Remote Control point, and Remote System Name values relate to the remote system. You also need to ensure that you are using the QBRM mode for the Mode parameter on the APPC device description. The default for this value is *NETATR, which uses the BLANK mode description, and your BRMS/400 network will not work.

With APPC, you also need to ensure that you change your APPC controller device descriptions if you decide to change the name of your network or the local location name at a future date. The reason you have to do this is because you cannot delete and allow the system to automatically re-create your definitions as in APPN.

5.3.1 Network security considerations

Beginning with V3R2 and V3R7, the OS/400 security implementation has been significantly enhanced. One of the enhancements that affects BRMS/400 is the change to *PUBLIC authority for IBM-supplied libraries from *CHANGE to *USE. A new user profile called QBRMS is now created at OS/400 installation time for V3R2 and V3R7. BRMS/400 objects are now owned by this user profile.

You need to understand the following information when you have a mixture of V3R1, V3R6, V3R2, and V3R7 in a BRMS/400 network:

- For APPN networks, check to see whether you are using secured locations or non-secured locations for your network. You can do this by using the Work with Configuration List (WRKCFGL *APPNRMT) command.

  Check the Secure Loc value. Figure 71 on page 102 shows an example. If the secure location is set to *NO, you are using a non-secured network. If the secured location is set to *YES, you are using secured location network. For

additional information on APPN security, see *AS/400 APPN Support*, SC41-5407.

```
              Work with Configuration Lists

Configuration list . . . . . . . . :   QAPPNRMT
Configuration list type  . . . . . :   *APPNRMT
Text . . . . . . . . . . . . . . . :

------------------APPN Remote Locations-------------------
          Remote            Remote    Control
Remote    Network  Local    Control   Point     Secure
Location  ID       Location Point     Net ID    Loc
SYSTEM01  APPN     SYSTEM02 SYSTEM01  APPN      *YES
SYSTEM06  APPN     SYSTEM02 SYSTEM06  APPN      *YES
SYSTEM07  APPN     SYSTEM02 SYSTEM07  APPN      *YES
```

Figure 71. Work with Configuration Lists

- If you have a non-secured network, you do not need to do anything on your systems. All you need to ensure is that the QBRMS (for V3R2 and V3R7), QUSER, and QPGMR user profiles are not disabled.

- If you are using a secured APPN network, ensure that the new system you are adding to the network is also configured as a secured location. At the same time, if you have a V3R1 or a V3R6 system already in the BRMS/400 network and you have now added a V3R2 or a V3R7 system to the network, you need to carry out some simple tasks to enable the media synchronization between V3R1/V3R6 to V3R2/V3R7. This is because you do not have a QBRMS profile on a V3R1 or a V3R6 system. If you do nothing when you change media information on a V3R1 or a V3R6 system, you will have a problem and will notice that the updates are not sent to the target system.

5.3.1.1 Problem description

Let us first look at what happens and define the solution. For example, assume that you have a source system (SYSTEM01) that is on V3R1. You also have a target system (SYSTEM02) that is on V3R2. When any updates are made on SYSTEM01, you notice that they are not synchronized on the SYSTEM02. Observe the status of the QBRMSYNC job under the Q1ABRMNET subsystem using the Work with Active Jobs (WRKACTJOB) command as shown in Figure 72.

```
Opt   Subsystem/Job  User      Type   CPU %  Function      Status
 __   Q1ABRMNET      QSYS      SBS     .0                  DEQW
 __     QBRMNET      QPGMR     ASJ     .0    PGM-Q1ACNET   TIMW
  7     QBRMSYNC     QPGMR     BCH     .0    PGM-Q1ACSYN   MSGW
```

Figure 72. WRKACTJOB display

The QBRMSYNC job is in MSGW (message wait) status, indicating that it is waiting for a message to be answered. Type option 7 next to the job to see the message. You see that Q1ARSYN (synchronizing program) is unable to perform a WRITE I/O operation on the target system through DDM. The message you see is shown in Figure 73.

```
                          Additional Message Information

Message ID . . . . . . :   RPG1299          Severity . . . . . . . :    99
Message type . . . . . :   Inquiry
Date sent  . . . . . . :   01/23/01         Time sent  . . . . . . :   12:26:51


Message . . . . :    CPF5134 I/O error was detected in QA1AMMFR (C G S D F).
Cause . . . . . :    The RPG program Q1ARSYN in library QBRM received the
  message CPF5134 at statement 35600 while doing WRITE I/O operation on file
  QA1AMMFR. Actual file is  QA1AMMD.QTEMP MEMBER - QA1AMM. See the job log for
  a complete description of message CPF5134.
```

Figure 73. Additional Message Information

On the target system (SYSTEM02), which is at V3R2, you can use the Work with Configuration Status (WRKCFGSTS) command to observe the status of your APPC device and controller. You notice that a mode is attached under the device. The mode that BRMS/400 uses is QBRM. You also notice that the mode uses the QPGMR user profile rather than QBRMS. From the Work with Configuration Status display, type option 5 next to the QBRM mode to work with the job, followed by option 10 to see the job log. You can see the error condition in Figure 74.

```
                          Additional Message Information

Message ID . . . . . . :   CPF5134          Severity . . . . . . . :    50
Message type . . . . . :   Escape
Date sent  . . . . . . :   01/23/01         Time sent  . . . . . . :   12:25:31


Message . . . . :    Not authorized to process request on member QA1AMM.
Cause . . . . . :    You do not have the correct authority to process your
  request on member QA1AMM file QA1AMM in library QUSRBRM.  To process your
  request, you need the following authority to either the member or to the
  physical members under the logical member:
    -- *READ authority to read the records in member QA1AMM.
    -- *ADD authority to add records to member QA1AMM.
    -- *UPD authority to update the records in member QA1AMM.
    -- *DLT authority to delete the records in member QA1AMM.
Recovery  . . . :    Get the necessary authority from either the security
  officer or the owner of the file.  Then try your request again.
```

Figure 74. Additional Message Information

As the message suggests, you must have the appropriate authority to access files in the QUSRBRM library on the target system.

5.3.1.2 Problem solution
To resolve the problem with authorities, use the following steps on a V3R1 or V3R6 system:

1. End the Q1ABRMNET subsystem.

2. Create a user profile called QBRMS as follows:

   CRTUSRPRF USRPRF(QBRMS) PASSWORD(*NONE) TEXT('User Profile for BRMS')

3. Change the job description Q1ACNETJD in the QBRM library as follows:

   CHGJOBD JOBD(QBRM/Q1ACNETJD) USER(QBRMS)

4. Start the Q1ABRMNET subsystem.

5.4 Adding systems to a network group

BRMS/400 is delivered with a predefined network group named *MEDINV. When it is delivered, *MEDINV contains no entries for systems participating in the network group. Setting up the BRMS/400 network group is simple as long as you follow the steps.

Although the steps are fairly easy, you should take every precaution to ensure that proper planning has taken place and that you fully understand the implications of adding and removing systems from the BRMS/400 network. Some of the planning considerations that you should be aware of are:

- Ensure that you have a *full backup* of the *QUSRBRM library* on all of your AS/400 systems that you plan to place in the network group. The BRMS/400 network setup modifies some critical files in the QUSRBRM library. You may have to restore the QUSRBRM libraries to their original state if things do not work out.

- Check with your Support Center to ensure that you are up-to-date with your PTFs for BRMS/400 and dependant PTFs for OS/400 and Licensed Internal Code.

- Ensure that there is no BRMS/400 activity on the systems that you are planning to network within the network group. All BRMS activity must be stopped prior to starting the network connection.

- If you already have BRMS/400 operational on individual systems, ensure that the operation is error free and that there are no outstanding issues with the normal operations. It is also important to sit down and think about volume names, media policies, containers, and classes. Duplicate volume names are *not* allowed within a shared media inventory. See 2.1.3, "Media naming convention" on page 8, for suggestions on how you should define a naming convention for your BRMS/400 volumes.

- If you are adding a new system to a network group, make sure your media license covers the additional media. See 2.2.1, "Updating BRMS/400 license information" on page 13, for additional information.

Figure 75 provides a high-level overview of the steps that you need to follow when setting up a BRMS/400 network. The example assumes that one system is at V3R6 (SYSTEM05), and the other system is at V3R2 (SYSTEM09). We want to add SYSTEM05 to the network using SYSTEM09 as the master system. Both systems currently have BRMS/400 fully operational and have their own media inventory. They both also have unique volume names. We also verified that the LCLLOCNAME is the same as the system name and that the LCLNETID on both systems is set to ITSCNET.

```
                Overview of steps required for setting up the BRMS network

         Steps for SYSTEM09                  Steps for SYSTEM05
         ===================                 ===================
1. Save the QUSRBRM library.
                                             2. Save library QUSRBM.
           ──────────▶
3. Vary on Line and Controller.
                                             4. Vary on Line and Controller.
           ──────────▶
5. SYSTEM09 designated as master system.

6. Ensure no BRMS activity is in progress.
                                             7. Ensure that no BRMS activity is in
           ──────────▶                           progress.

8. Type GO BRMSYSPCY and select the following options:
      4 - Change Network Group
      1 - Add SYSTEM05 to network group
                                             9. WRKMEDBRM - if entries exist, issue
           ──────────▶                           CPYMEDIBRM OPTION(*TOFILE)

                                             10. INZBRM OPTION(*NETSYS)
           ──────────▶                           FROMSYS(SYSTEM09)
                                                 Reply I for messages that appear.

           ──────────▶                       11. Check whether QDATE is correct.

12. Check whether QDATE is correct.

13. INZBRM OPTION(*NETTIME)

           ──────────▶                       14. CPYMEDBRM OPTION(FROMFILE)

           ──────────▶                       15. WRKMEDBRM to see results.

16. WRKMEDBRM to see the results.

   Notes:
   ──────────▶   = Execute the step on SYSTEM05.
```

Figure 75. Overview of establishing a BRMS/400 network

- For systems that are completely new, the process to add them into the existing BRMS/400 network group is extremely simple. This is because the new system does not yet have its own media inventory. This removes the requirement to run the CPYMEDIBRM command to save and later reload the media information.

5.4.1 Receiving media information

Every AS/400 system in a BRMS/400 network group receives media inventory updates, regardless of which system makes the change. Beginning with V3R6 and V3R2, you can select to have the media content information updated also. You can use the Receive media information option on the Change Network Group display. You can set this parameter to be *LIB. See the circled text in Figure 77 on page 107. The default for this field is *NONE, which indicates that only media information is to be shared with this system. This functional enhancement is *not* available on V3R1. This means that when you select the option to display the contents of a particular media on a V3R1 system, and the media is actually owned by another system, the V3R1 system has to use DDM to obtain the information you require. This requires a communications link to be active when

the DDM request is invoked. Beginning with V3R6 and V3R2, with the *LIB option, when you select option 13 (Display Contents) on the WRKMEDBRM display, the system *does not* use DDM to obtain this data from the owning system. If you have a failure on the owning system or in communications, you can use the media information that has been synchronized to build a recovery report for the system that failed. This local database can be used to recover objects belonging to another system.

You can change the Receive media information field at any time, and depending on the number of media information records you have, the synchronization process may take a long time.

Note: We, therefore, recommend that you *do not* change the Receive media information field frequently.

Be careful when adding systems to an existing network, especially if the system you are trying to add has been outside the network for a long time and contains media information. You definitely do not want to propagate media files from the system that has been down for weeks to a system that has been in the network the entire time. In other words, you *must not* run the INZBRM command with *NETSYS on the system that was operational at all times to place the "new" system back in the network. You have to run the INZBRM command with *NETSYS on the system that was down for a long time (for example, an upgrade) pointing to a system that was operational at all times using the FROMSYS parameter.

If you have a 3494 media library device attached to multiple AS/400 systems in a BRMS network, we recommend that you have the library names the same across all of the AS/400 systems.

Once you set up a BRMS/400 network, it is important that you verify on a regular basis that the network is working for you. See 5.9, "Verifying the BRMS/400 network" on page 120, for additional information.

Perform the following tasks to add SYSTEM05 to the BRMS/400 network:

1. Save the QUSRBRM library on SYSTEM09.

2. Save the QUSRBRM library on SYSTEM05.

3. Ensure that the communications link on SYSTEM09 for SYSTEM05 is active. Use the WRKCFGSTS command to determine the status for line, controller, and device description.

4. Ensure that the communications link on SYSTEM05 for SYSTEM09 is active. Use the WRKCFGSTS command to determine the status for line, controller, and device description.

5. Designate SYSTEM09 to be your "master" system.

6. Ensure that there is no BRMS/400 activity on SYSTEM09 when you are setting up a network group.

7. Ensure that there is no BRMS/400 activity on SYSTEM05.

8. On SYSTEM09, enter GO BRMSYSPCY to go to the System Policy menu.

   a. Select option 4 (Change Network Group). Press Enter.

b. Add SYSTEM05 on the Change Network Group display as shown in Figure 76.

```
                              Change Network Group              SYSTEM09 ITSCNET
Network group . . . . :   *MEDINV              Position to  . . . . .
Text  . . . . . . . . .   Centralized media network systems
Receive media info  . .   *NONE                *NONE, *LIB


Type options, press Enter.
  1=Add    4=Remove    8=Set time
      Remote Local     Remote      Receive
Opt Location Name   Network ID   Media Info    Status
  1    SYSTEM05      ITSCNET

    (No entries found)
```

Figure 76. Adding a new system to the network

c. Press Enter. BRMS/400 searches the network for the system name that you specified. Depending on your network configuration and the number of systems you have in the network, this can take a few minutes. When the system is found (in our example, SYSTEM05), it is added to *MEDINV (the BRMS/400 network group name). As shown in Figure 77, the display is refreshed with the entry for SYSTEM05 added to the network group. SYSTEM05 is shown as an inactive member of a network group and is not sharing media files with other active network systems in the group at present. To change the inactive status to active, media files must be copied to the system that is being added to the network group. The process to copy media files and media content information occurs in step 10 on page 108.

```
                              Change Network Group              SYSTEM09 ITSCNET
Network group . . . . :   *MEDINV              Position to  . . . . .
Text  . . . . . . . . .   Centralized media network systems
Receive media info  . .   *NONE                *NONE, *LIB

Type options, press Enter.
  1=Add    4=Remove    8=Set time
      Remote Local     Remote      Receive

Opt Location Name   Network ID   Media Info    Status

       SYSTEM05      ITSCNET      *NONE        Inactive




                                                                    Bottom
F3=Exit    F5=Refresh    F12=Cancel
System SYSTEM05 network group ITSCNET added.
```

Figure 77. SYSTEM05 added to the network group

9. On SYSTEM05, use the Work with Media (WRKMEDBRM) command to see if you have any media information. If media information is not present, go to step 10.

In our example on SYSTEM05, media information is already present since BRMS/400 is fully implemented.

Use the Copy Media Information BRM command (CPYMEDIBRM) to save your media information as follows:

```
CPYMEDIBRM OPTION(*TOFILE)
```

This copies the contents of the media inventory file to a temporary file (QA1AMED) or a file name that you can designate. This temporary file is created in your Current library. Using the CPYMEDI parameter, you can also choose if you want to copy media information. The default is *NO and should be used unless you are planning on restoring media information to a non-networked system.

Note: This step is not required if you have a new system with only BRMS/400 installed with no media information and you are planning to add the system to the BRMS/400 network.

10. You are now ready to synchronize SYSTEM09 with SYSTEM05. On SYSTEM05, enter the following command:

```
INZBRM OPTION(*NETSYS) FROMSYS(SYSTEM09)
```

The media management files on the inactive system (SYSTEM05) are cleared during the copy process and replaced with the network media management files. Before clearing the media management files, you are notified when the SYSTEM05 files are overwritten with files coming from SYSTEM09 as shown in Figure 78.

```
                       Display Program Messages

Job 047122/A960103D/QPADEV0001 started on 05/31/00 at 09:15:55 in subsystem
Entries exist for Media.  (R I C)
I
Entries exist for Media policy.  (R I C)
I
Entries exist for Media class.  (R I C)
I
Entries exist for Location.  (R I C)
I
Entries exist for Move policy.  (R I C)




Type reply, press Enter.
  Reply . . .   i



F3=Exit    F12=Cancel
```

*Figure 78. Running INZBRM *NETSYS on SYSTEM05*

The media management files that are copied to the inactive system are:

- QA1AMM: Media inventory
- QA1AMT: Media class attributes
- QA1ACN: Container status inventory

- QA1ACT: Container class
- QA1ASL: Storage locations
- QA1AMP: Move policies
- QA1A1MP: Move policy entries
- QA1AME: Media policy attributes
- QA1ARMT: Network group
- QA1A1RMT: Remote system name entries
- QA1ADXR: Media duplication cross reference

If you specified *LIB in the Receive media information field, media content information is synchronized to the system that you are adding. After the network media management files have been copied to the inactive system (SYSTEM05), the status of the inactive system is changed to active, and its media files are now the network media files.

On SYSTEM05, select the option to ignore *all* of the messages by replying with I. These messages indicate that you are about to overwrite files on SYSTEM05.

Hint

It is important to ensure that the user profile QBRMS is not in a *DISABLED state. Communication entries in the Q1ABRMNET subsystem use this user profile. If it is disabled, you cannot establish a DDM connection. During our tests, we noticed that the profile was disabled. A CPF4734 message was logged on the system operator's messge queue indicating that an evoke function for the QCNDDMF file in the QSYS library device DDMDEVICE was rejected. The SNA error code was X'080F6051, indicating that the security code specified by the source program or the default values supplied by the system are not correct.

Upon checking everything, we found that the QBRMS user profile was disabled. We enabled the profile and restarted the INZBRM process. The error was resolved.

When the system is added to the network, several things happen. First, the media inventory files from the network are copied to SYSTEM05.

Second, as shown in Figure 79 on page 110, an entry for SYSTEM09 is automatically created on SYSTEM05 with the status of *Active*. If you now check the entry for SYSTEM05 that was created on SYSTEM09, you see that this also has a status of *Active*.

```
                          Change Network Group                SYSTEM05 ITSCNET
   Network group . . . . :  *MEDINV           Position to  . . . . .
   Text  . . . . . . . . .  Centralized media network systems
   Receive media info  . .  *NONE             *NONE, *LIB


   Type options, press Enter.
     1=Add    4=Remove   8=Set time
                     Remote         Receive

 Opt     System      Network ID   Media Info    Status

         SYSTEM09    ITSCNET       *NONE         Active
```

Figure 79. Network group entry on SYSTEM05 for SYSTEM09

The process of networking the two systems automatically starts a new
subsystem, Q1ABRMNET, whose description is found in the QBRM library
(Figure 80). An autostart job entry for this subsystem is also added to
QSYSWRK on both systems.

```
                         Work with Subsystems
                                                       System:    SYSTEM05
   Type options, press Enter.
     4=End subsystem    5=Display subsystem description
     8=Work with subsystem jobs


                     Total     -----------Subsystem Pools------------
 Opt   Subsystem   Storage (K)  1   2   3   4   5   6   7   8   9  10


       QBATCH            0      2
       QCMN              0      2
       QCTL              0      2
       QINTER            0      2   4
       QSERVER       64000      2   5
       QSNADS            0      2
       QSPL              0      2   3
       QSYSWRK           0      2
       Q1ABRMNET         0      2
```

Figure 80. BRMS/400 networking subsystem: Q1ABRMNET

11. On SYSTEM05, check the system value QDATE, and make any corrections.

12. On SYSTEM09, check the system value QDATE, and make any corrections.

13. On SYSTEM09, issue the Initialize BRMS/400 (INZBRM) command as
    follows:

    INZBRM OPTION(*NETTIME)

    The time of the system that issues the INZBRM command is used to
    synchronize the rest of the systems in the network group.

    Alternatively, use option 8 (Set time) from the Change Network Group display
    to synchronize the times to selected systems within the network group. The
    selected systems use the time of the issuing system. This option is useful if
    you just want to synchronize the time of one system, rather than all of the
    systems. For example, you may want to synchronize the time of a system that
    was shutdown for maintenance. Usually, you need to reset the time when you
    perform a manual IPL, or where you are operating in different time zones, and

someone may have entered the "correct" time. You should always synchronize the time with a system operational in a network, rather than from a system that you are about to add to the network.

> **Note**
>
> It is important that network times remain in sychronization and the INZBRM command should be run periodically. Remember that a common media inventory update depends on the fact that a precise chronological sequence of media information is recorded across all systems in the network group. The `INZ OPTION(*NETTIME)` command ensures that the times match to within five seconds across the systems.
>
> Use care if times are synchronized near midnight because the command does not take date into account.

14. Go to SYSTEM05. You can now merge the media inventory data that was saved prior to adding the system to the network under step 9. Enter the following command on SYSTEM05:

`CPYMEDIBRM OPTION(*FROMFILE)`

Note: This step is only necessary on systems that previously had BRMS/400 media inventory. Make sure you *change* the *default* from *TOFILE to `*FROMFILE`.

Any media information that is inconsistent with the new network level media information is ignored. All entries that are not duplicates are added to the network media inventory. If duplicate media contains active files, you must keep track of the information. If no active files are present, you should re-initialize the tape with a new volume ID.

> **Note**
>
> When the media inventory has been copied back from the temporary file (QA1AMED or a file name that you designate), you need to review common classes for inconsistencies. For example, it is possible that Media Class SAVSYS on one system uses a media density of *QIC120, while the same media class on the other uses *FMT3490E. All media density now belongs to the network class SAVSYS.

15. Enter the WRKMEDBRM command on SYSTEM05. You see the media inventory of SYSTEM09 and SYSTEM05.

16. Enter the WRKMEDBRM command on SYSTEM09. You see the media inventory for SYSTEM05 and SYSTEM09.

We *strongly* recommend that you check on a daily basis to see if your network is operational and that the media information is moving across it. See 5.9, "Verifying the BRMS/400 network" on page 120, for additional information.

5.5 Removing a system from the network group

AS/400 systems can be removed from the network group by using the following steps:

1. On the system being removed from the network group, select option 4 (Remove) for all network entries on the Change Network Group display. This removes all entries from the network group table on the system that is being removed from the network group. When selecting option 4 (Remove), you are transferred to the Confirm Remove of Network Systems display. On this display, you are given the opportunity to remove media entries from this system's media inventory for media belonging to the other systems in the network group. By selecting the value *YES for the Remove media information field, you remove all media entries from this system's media inventory belonging to all systems remaining in the network group. If you select *NO, media entries are not removed from the systems that you are removing.

   Note: If a system name is displayed as inactive, you should use caution in using the *YES parameter, since it removes all media entries associated with that system name, even if the system name was never an active member of the network group.

   Another option that you can select is to rename (*RENAME) the media for the systems that you are removing. The media is renamed to the system name of the system that you are currently using. In the following example, shown in Figure 81 and Figure 82, SYSTEM01 and SYSTEM02 are renamed to SYSTEM03, which is the system that you are currently using.

```
                     Change Network Group              SYSTEM03 ITSCNET

  Network group . . . . :   *MEDINV          Position to  . . . . .

  Text  . . . . . . . . .  Centralized media network systems
  Receive media info  . .  *LIB                  *NONE, *LIB

  Type options, press Enter.
    1=Add    4=Remove    8=Set time
                      Remote        Receive
  Opt     System    Network ID    Media Info    Status

   4      SYSTEM01   ITSCNET       *NONE         Active
   4      SYSTEM02   ITSCNET       *NONE         Active
          SYSTEM04   ITSCNET       *NONE         Active
```

Figure 81. Change Network Group

```
             Confirm Remove of Network Systems           SYSTEM03 ITSCNET

  Press Enter to confirm your choices for 4=Remove.
  Press F12 to return to change your choices.
     Remove media . . . . . . . . . .   *RENAME       *YES, *NO, *RENAME

                  Remote       Receive
  Opt    System    Network ID   Media Inf   Status
   4     SYSTEM01   ITSCNET      *NONE       Active
   4     SYSTEM02   ITSCNET      *NONE       Active
```

Figure 82. Removing systems from a network group

2. On any system remaining in the network group, select option 4 (Remove) for the system name being removed from the network group on the Change Network Group display. This removes the system name from all systems

remaining in the network group. When selecting option 4 (Remove), you are transferred to the Confirm Remove of Network systems display. You should select *YES for the Remove media field. The system is removed completely from the network.

5.6 Changing the system name

Renaming a system is not a task that is undertaken lightly. Many definitions may depend on the system name, not the least of which are PC networking definitions and the system directory. You must consult your network support personnel to resolve issues related to configuration objects.

Implied in a system name change is a default local location, LCLLOCNAME, name change and, therefore, a change for BRMS/400. When this happens, BRMS/400 needs to perform the following actions:

- Update the network to remove the old system name, and add the new system name.
- Transfer all of the media previously owned by the old system name to the new system name.

When changing the system name using BRMS/400, you need to check two items:

- Is your system running under V3R1?
- Is your system running under V3R2, V3R6, or later?

Information on changing system names for systems that are at V2R3 or V3R0.5 is documented in *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) for V3R7. Please note that the V2R3 and V3R0.5 releases are *no longer supported* by IBM.

5.6.1 Changing the system name on V3R1

If you decide to change the system name that is currently operating at a V3R1 level, you need to perform the tasks that are listed in this section. In our discussion of the following example, we assume that the system name and local location name identical and you are planning to change the system name and local location name from OLDSYSN to NEWSYSN. We discuss other options at the end of these steps.

Note: You may need to perform additional steps when you change your system name or network ID. The steps described here are required for BRMS/400 only.

1. Save library QUSRBRM on OLDSYSN.

2. If OLDSYSN is part of the BRMS/400 network, remove all the networked systems from OLDSYSN using the following steps. Otherwise, go to step 3.

   a. On OLDSYSN, enter:

      GO BRMSYSPCY

   b. Select option 4 (Change Network Group).

   c. Enter option 4 next to all network systems from the Change Network Group display.

   d. On the Confirm Remove of Network display, select *YES to remove media information.

e. Go to *any* other system that was in the network.

   f. Enter: `GO BRMSYSPCY`

   g. Select option `4` (Change Network Group).

   h. Select option `4` to remove OLDSYSN from the Change Network Group display.

   i. On the Confirm Remove of Network display, select `*YES` to remove media information.

3. Change the system name on OLDSYSN to NEWSYSN. This keeps the new system name in "pending" status until an IPL is performed.

   ```
   CHGNETA SYSNAME(NEWSYSN) LCLCPNAME(NEWSYSN)
   LCLLOCNAME(NEWSYSN)
   ```

4. Enter `INZBRM OPTION(*DATA)` on OLDSYSN. This changes the system name for each volume in the media management file (QA1AMM) from OLDSYSN to NEWSYSN according to the following logic:

   ```
   If BRMSYSNAME < or > LCLLOCNAME, and BRMSYSNAME = SYSNAME
      Then  BRMSYSNAME = LCLLOCNAME
   ```

5. IPL the system. This changes the system name to NEWSYSN.

6. On NEWSYSN, enter `CPYMEDIBRM OPTION(*TOFILE)` to protect the media information that is unique to NEWSYSN. You need to add this later.

7. Add NEWSYSN back to the BRMS/400 network. See 5.4, "Adding systems to a network group" on page 104, for additional information. You should *not* treat NEWSYSN as your master system.

8. On NEWSYSN, enter:

   ```
   INZBRM OPTION(*NETSYS) FROMSYS(name of another system)
   ```

   This copies all of the media information from another system to NEWSYSN. You are prompted to answer several messages (BRM1519). Enter `I` for all of these messages.

9. From one of the other systems in the network, enter `INZBRM OPTION(*NETTIME)` to synchronize all the clocks within the network. The reason for selecting another system rather than the one for which you just changed the name is to avoid errors that relate to different time zones. For example, if the system that you are changing the name is in New York and the participating network of other AS/400 systems is in Rochester, Minnesota, you need to be careful when you synchronize the clocks. If you synchronize the clocks from the New York system, all Rochester systems are set to one hour early. You need to decide which time zone you want to use. Then, issue the `INZBRM` command from the system that is in the time zone you want.

10. On NEWSYSN, enter:

    ```
    CPYMEDIBRM OPTION(*FROMFILE)
    ```

    This appends the media information that was unique to NEWSYSN and synchronizes the information with other systems participating in the BRMS/400 network.

11. Use the `WRKMEDBRM` command to check media information.

If you have a system name different than your local location name (such as SYSTEM01, LOCA), and you want to change both of these to new values (such

as SYSTEM02, LOCB), you must first change the system name alone (SYSTEM01 to SYSTEM02) and IPL the system. After the IPL, you should follow all of the steps starting at step 3 in this example.

5.6.2 Changing the system name on V3R2, V3R6, or V3R7

Beginning with V3R2 and V3R6, renaming a system name or network ID can be done automatically.

> **Important**
>
> After you change the system name and IPL the system, you must ensure that you change the BRMS/400 network immediately. The BRMS/400 media files still have not been updated to reflect the system name change. The BRMS/400 media volumes are still owned by the old system name. In addition, the other systems in BRMS/400 network still try to communicate with the old system name because they are not yet aware of the rename.
>
> To avoid any missing information in the shared media inventory data, you *must change* the BRMS/400 network immediately after the system IPL. Also, make sure that no BRMS/400 activity occurs between the IPL and adding your system to the BRMS/400 network.

Use the following steps to change the system name:

1. Change the system name and IPL.
2. Ensure that there is no BRMS/400 activity and that you have a latest save of QUSRBRM library.
3. On the system where you just changed the name, enter:

   `GO BRMSYSPCY`

4. Select option 4 (Change Network Group). On the top right corner of the Change Network Group display, you see your new system name as shown in Figure 83.

```
                        Change Network Group              NEWSYSN   APPN

Network group . . . . :  *MEDINV           Position to  . . . . .
Text  . . . . . . . . .  Centralized media network systems
Receive media info  . .  *LIB              *NONE, *LIB


Type options, press Enter.
  1=Add    4=Remove   8=Set time
                   Remote      Receive
Opt     System    Network ID   Media Info    Status


  _     SYSTEM01   APPN         *NONE         Active
  4     OLDSYSN    APPN         *NONE         Inactive
  _     SYSTEM03   *LOC         *NONE         Active
```

Figure 83. Removing the old system name from the network

5. Select option 4 to remove the old entry (OLDSYSN).

6. On the Confirm Remove of Network Systems display, specify `*RENAME` on the Remove media field so that ownership of the media inventory is transferred from OLDSYSN to NEWSYSN as shown in Figure 84.

```
                    Confirm Remove of Network Systems           NEWSYSN  APPN

   Press Enter to confirm your choices for 4=Remove.
   Press F12 to return to change your choices.

      Remove media . . . . . . . . .  *RENAME      *YES, *NO, *RENAME


                    Remote      Receive
 Opt    System    Network ID   Media Inf   Status
  4     OLDSYSN   APPN         *NONE       Inactive
```
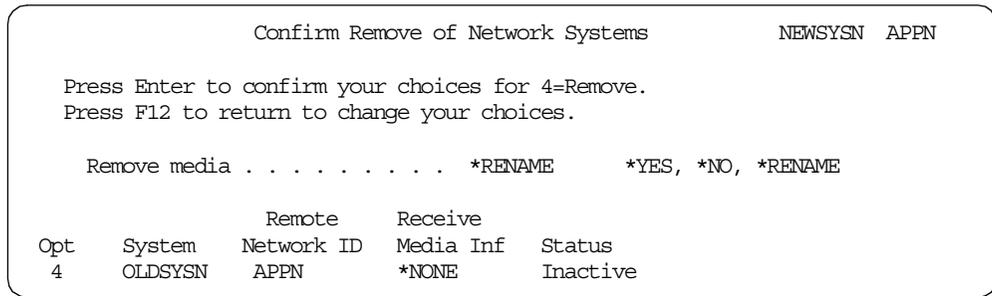
Figure 84. Confirm Remove of Network Systems

5.6.3 Other scenarios that involve a system name change

Besides changing the system names when you have a system in the BRMS/400 network, there are other scenarios that also require similar steps as those previously described.

We look at two example scenarios in the following sections.

5.6.3.1 Example 1

You have a system that is at V3R1 or later. You are going to move to a new system that has a new name. Let us assume that you are going from a V3R1 to a V3R2 system. The steps outlined here relate to BRMS/400 only, and not for a complete migration to V3R2.

1. On your V3R1 system, save the QUSRBRM library.

2. On your V3R2 system, complete these steps:

   a. Delete the BRMS/400 (5763BR1) licensed program. You do not need to do this if you are not changing an OS/400 release.

   b. Restore QUSRBRM.

   c. Use the `RSTLICPGM` command to restore the BRMS/400 licensed program if it is not already installed. The RSTLICPGM process performs any file conversions that may be required in the QUSRBRM library. File conversions generally involve adding new fields to database files or adding new files or data areas. File conversions *can only* happen when you are installing a licensed program. A restore operation does not perform any file conversions.

   d. You see that the old system name is still shown on the Change Network Group display.

   e. Select option `4` to remove the old system name from the network (although you really do not have a network).

   f. On the Confirm Remove of Network Systems display, select the option to `*RENAME` the media. This renames all your media information from your old system name to the new system name.

   g. Use the `WRKMEDBRM` command to check your media information.

5.6.3.2 Example 2

Another example is where you have two CISC processors and you want to merge them to a single RISC processor. Assume that you have SYSTEM01 and SYSTEM02 as your CISC processors. Your RISC processor is called SYSTEM01. You can also have two CISC processors merging to a single CISC processor. The following steps are outlined for the tasks that need to be carried out on the CISC processors and the RISC processors.

Steps for your CISC processors

Follow these steps for the CISC processors:

1. Ensure you have a full save of QUSRBRM for SYSTEM01 and SYSTEM02.

2. Break up the network group. Remove SYSTEM01 in the network from SYSTEM02 along with the media information.

3. Remove SYSTEM02 from SYSTEM01 along with the media information. This way, both systems now have their own media information.

4. Save library QUSRBRM and QBRM on SYSTEM01.

5. Use the following command to copy to a database file on SYSTEM02 and save this file separately to a tape:

   `CPYMEDIBRM OPTION(*TOFILE) CPYMEDI(*YES)`

   If you use the defaults, the data is saved in the QA1AMED file in the QGPL library. Save this object to a tape.

Steps for your RISC processors

Complete these steps for your RISC processors:

1. Follow the instructions in *AS/400 Road Map for Changing to PowerPC Technology*, SA41-4150, to install your new RISC processor. This is called SYSTEM01.

2. If BRMS/400 is already installed, use the `DLTLICPGM` command to delete BRMS/400.

3. Restore the QUSRBRM and QBRM libraries from your SYSTEM01 (CISC) backups.

4. Run the Start Object Conversion (`STROBJCVN`) command for the QUSRBRM and QBRM libraries. This step is required as part of your upgrade from CISC to RISC. The STROBJCVN command is part of your RISC operating system.

5. Restore (RSTLICPGM) 5716BR1 from your distribution tapes. This performs any conversions for file layouts that are required in library QUSRBRM when going to the RISC operating system.

6. Apply the latest BRMS/400 PTFs on your RISC system.

7. At this point, you already have media information for your original SYSTEM01 (CISC processor). You need to add the media information from SYSTEM02. Restore the QA1AMED file from the QGPL library that you saved earlier.

8. Append the media information of SYSTEM02 to SYSTEM01 by using the command:

   `CPYMEDIBRM OPTION(*FROMFILE) FILE(QGPL/QA1AMED)`

   Ensure that you change the defaults for the CPYMEDIBRM command to `*FROMFILE`.

9. Use the WRKMEDBRM command to check your media inventory.

5.7 Joining two BRMS/400 networks

When you have more than one BRMS/400 network group and you want to create a single network group, you must carefully plan how to do this. When you plan to join two networks, you must not do this by adding one system from one network to another network. Figure 85 has two BRMS/400 networks called NETWORK1 and NETWORK2. It illustrates the *wrong* way to join two BRMS/400 networks.
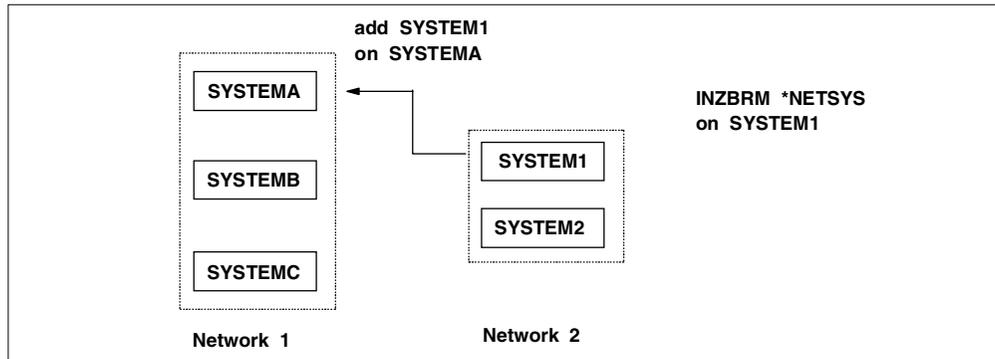
Figure 85. Incorrect way of joining two BRMS/400 networks

As shown in the example in Figure 85, SYSTEM1 from NETWORK2 is networked to SYSTEMA in NETWORK1. With this approach, SYSTEM2 remains unknown to all of the systems in NETWORK1. This is because SYSTEM1's knowledge of SYSTEM2's existence is erased when you run the INZBRM OPTION(*NETSYS) command on SYSTEM1. Therefore, you *must* split one of the networks before joining them so that all of the systems in the network have knowledge of each other. Figure 86 illustrates the *correct* way to join two BRMS/400 networks.
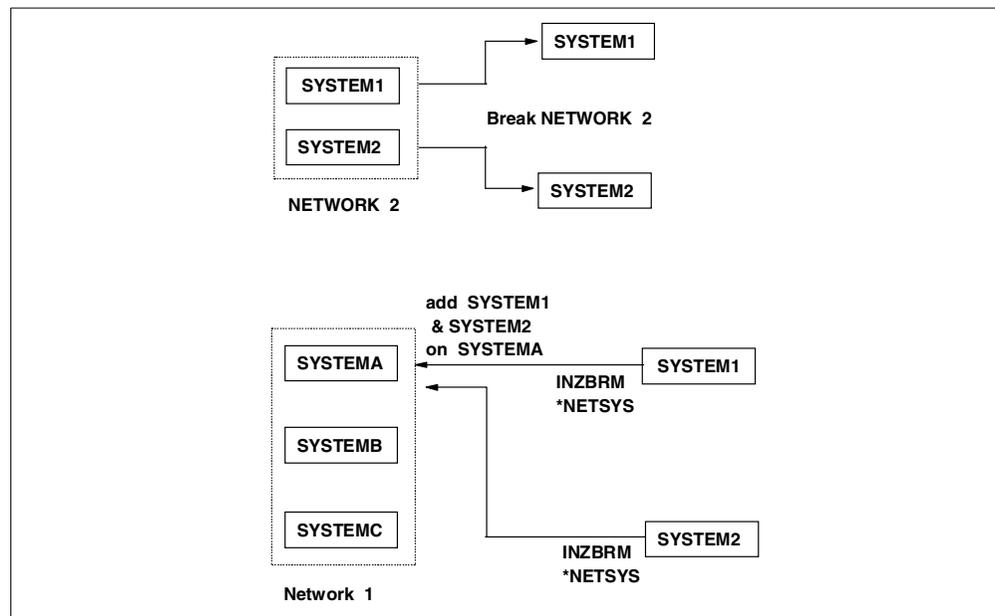
Figure 86. Correct way to join the BRMS/400 network

As illustrated in Figure 86, the first step is to break the two systems apart and add them in the network. Here is an overview of what you need to do:

1. Remove all of the entries on the Change Network Group display on SYSTEM1 for SYSTEM2, including its media information.

2. Remove all of the entries on the Change Network Group display on SYSTEM2 for SYSTEM1, including its media information.

3. To save the media information for both systems, on SYSTEM1 and SYSTEM2, enter:

   `CPYMEDIBRM OPTION(*TOFILE) CPYMEDI(*YES)`

4. Add SYSTEM1 on any system in NETWORK1 using the Change Network Group option. In our example, we used SYSTEMA to add SYSTEM1.

5. On SYST_1, enter:

   `INZBRM OPTION(*NETSYS) FROMSYS(SYSTEMA)`

   This overwrites the media information files on SYSTEM1 from SYSTEMA.

6. On SYSTEM1, to synchronize the clocks for both systems based on the time on SYSTEMA, enter:

   `INZBRM OPTION(*NETTIME) FROMSYS(SYSTEMA)`

7. On SYSTEM1, to append SYSTEM1's media information, enter:

   `CPYMEDIBRM OPTION(*FROMFILE)`

   This synchronizes the media information of SYSTEM1 on all other AS/400 systems within the same network. You receive several messages when the files are overwritten. Reply with an `I`.

8. On SYSTEM1, use the `WRKMEDBRM` command to check the media information.

9. Repeat steps 4, 5, 6, 7, and 8 for SYSTEM2 by substituting the name of SYSTEM1 with SYSTEM2 in these steps.

5.8 Copying control groups between networked AS/400 systems

Beginning with V3R1, you have the opportunity to specify whether you want to copy the control groups on your own system or send the information to other systems in the BRMS/400 network. The default when you copy the control group is *LCL, which means you are copying the control group to another name on your local system. You can specify a remote system name and the network identifier for the remote system. This copies the control group to the target system that you specified. BRMS/400 uses DDM to copy the information across to the QA1ACM file. You may find this facility useful, but be aware of some of the limitations.

```
┌─ Watch out for: ─────────────────────────────────────────────────┐
│                                                                   │
│  • Control group attributes are not copied across to the target system. These │
│    attributes revert to the system defaults.                      │
│                                                                   │
│    With V3R7, the subsystems to process and the job queues that you want to │
│    process as part of the control group are copied across provided that the │
│    copy command is issued from a V3R7 system. This support is not available │
│    on releases prior to V3R7.                                     │
│                                                                   │
│  • The entries in the control group are copied across, but lists are not. If the │
│    entry in the control group is a list, you have to manually create the backup │
│    list on the target system in order for the control group to work successfully. │
│    Use the WRKLBRM command to create any missing backup lists.    │
│                                                                   │
│  • You are not provided with a warning message at the time of the copy to │
│    inform you that your control group has invalid data if it is run on the new │
│    system (for example, unknown library).                         │
│                                                                   │
│    You may have to remove some backup items that are not supported on the │
│    target system. For example, V3R7 supports the save of integrated file │
│    system through using *LINK value for the backup items. When you copy the │
│    control group to a V3R1 system, the *LINK value is not supported. You have │
│    to edit the control group to make the changes.                 │
│                                                                   │
│  • The control group text is not copied across. You have to manually add the │
│    text on the target system.                                     │
│                                                                   │
└───────────────────────────────────────────────────────────────────┘
```

We, therefore, recommend that you always review the control group even after the copy. You may need to tailor the values based on the operational requirements for that particular system.

5.9 Verifying the BRMS/400 network

It is *vital* that you check the accuracy of the shared data and, as a consequence, to check that the data exchange is working properly. Checking for the communications link between systems (line descriptions, control descriptions) alone is *not* enough. This does not guarantee that the BRMS/400 media inventory between all of your AS/400 systems is synchronized. You must check daily on the Change Network Group display that the participating AS/400 systems are in an `Active` status. Another easy way to check for media synchronization is to implement the following steps:

1. On a system in the BRMS/400 network, create a dummy media class NETCHK (for Network Checking). Because it is never used for real backups, there are no particular parameters to specify. You can use the defaults.

2. On each system (SYSTEMxx, where *xx* is the name of the system), type:

   ```
   ADDMEDBRM VOL(SYSxx) MEDCLS(NETCHK)
   ```

3. Every morning, on each system in your BRMS/400 network, use the job scheduler to run the CL command:

   ```
   RMVMEDBRM VOL(SYSxx) MEDCLS(NETCHK)
   DLYJOB DLY(300)
   ADDMEDBRM VOL(SYSxx) MEDCLS(NETCHK)
   ```

Once the CL command is submitted, your media should have a creation date equal to the current date. This should be true on the system that has run the command. If not, it means that the CL command has not been submitted and you should check the job log. The other systems in the BRMS/400 network should also have the current date as the creation date for this media. If not, it means that the update has not been correctly sent between the systems.

We created a small CL program with the CL command and submitted this as a remote job on each of the AS/400 systems using OS/400 job scheduler. If you use this method, you should also check the activities of the job scheduler.

Assuming that today's date is 06 July 2000, the WRKMEDBRM command for each system should display the information shown in Figure 87.

```
                         Work with Media                      SYSTEM01

 Position to . . . . . .              Starting characters

 Type options, press Enter.
   1=Add        2=Change       4=Remove      5=Display
   6=Work with media set       7=Expire      8=Move     10=Reinitialize ...

      Volume              Creation  Expiration              Move     Media      Dup
 Opt  Serial    Expired   Date      Date      Location      Date     Class      Sts

      xxxxxx              xx/xx/xx  *NONE     xxxxxxxx      xx/xx/xx  xxxxxxx
      xxxxxx              xx/xx/xx  *NONE     xxxxxxxx      xx/xx/xx  xxxxxxx
      SYS01     *YES      07/06/00  *NONE     *HOME         *NONE     NETCHK
      SYS02     *YES      07/06/00  *NONE     *HOME         *NONE     NETCHK
      SYS03     *YES      07/06/00  *NONE     *HOME         *NONE     NETCHK
      SYS04     *YES      07/06/00  *NONE     *HOME         *NONE     NETCHK
      xxxxxx              xx/xx/xx  *NONE     xxxxxxxx      xx/xx/xx  xxxxxxx
```

Figure 87. Media update to check the network

If you see the information shown in Figure 88, you can conclude that SYSTEM01 did not receive the SYS04 media update.

```
                         Work with Media                  >>>> SYSTEM01

 Position to . . . . . .              Starting characters

 Type options, press Enter.
   1=Add        2=Change       4=Remove      5=Display
   6=Work with media set       7=Expire      8=Move     10=Reinitialize ...

      Volume              Creation  Expiration              Move     Media      Dup
 Opt  Serial    Expired   Date      Date      Location      Date     Class      Sts
      xxxxxx              xx/xx/xx  *NONE     xxxxxxxx      xx/xx/xx  xxxxxxx
      xxxxxx              xx/xx/xx  *NONE     xxxxxxxx      xx/xx/xx  xxxxxxx
      SYS01     *YES      07/06/00  *NONE     *HOME         *NONE     NETCHK
      SYS02     *YES      07/06/00  *NONE     *HOME         *NONE     NETCHK
      SYS03     *YES      07/06/00  *NONE     *HOME         *NONE     NETCHK
 >>>> SYS04     *YES      07/04/00  *NONE     *HOME         *NONE     NETCHK
      xxxxxx              xx/xx/xx  *NONE     xxxxxxxx      xx/xx/xx  xxxxxxx
```

Figure 88. No update for SYS04

A possible explanation is that communications worked on July 4, but a subsequent problem occurred.

Note: Because communications are often subject to failure or disruption, it is worth using one media per system to have a safe BRMS/400 network. This ensures consistent data between the systems at least once during the day (since a network failure may occur after the successful updates). Check the BRM log since messages are sent to the log if BRMS/400 encounters update problems.

Chapter 6. Saving and restoring the integrated file system

This chapter discusses the commands and procedures that are necessary to set up when saving the integrated file system (IFS) with BRMS/400. It provides examples to help you develop and carry out your backup strategy. We chose the LAN Server/400 environment as our base to discuss the integrated file system concepts and the additional steps that you need to consider when defining your overall save and restore strategy. Other environments, such as the Integration of Lotus Notes on AS/400 and the Integration of Novell NetWare on AS/400, are not discussed in any detail in this chapter. However, the concept of saving these solutions using the integrated file system remains the same.

The Integration of Lotus Notes on AS/400 uses a separate approach to perform the overall saves. For the server data, it uses the ADSTAR Distributed Storage Management (ADSM) product for backup and recovery purposes. This allows the Lotus Notes Administrator to perform a save and restore operation on individual documents and folders within the Lotus Notes database. For additional information, see the following list of publications that address the save and restore requirements for the Integration of Lotus Notes on the AS/400 system:

- *OS/400 Integration of Lotus Notes*, SC41-3431
- *Setting Up and Implementing ADSTAR Distributed Storage Manager/400*, GG24-4460
- *Using ADSM to Back Up Lotus Notes*, SG24-4534
- *Backup and Recovery - Basic*, SC41-4304

The Integration of Novell NetWare on AS/400 requires an approach that is similar to saving and restoring the LAN Server/400 environment. Novell NetWare has its own backup and recovery solution that is widely used and popular among their users, such as the solutions offered by ARCserve and SBackup. These solutions save and restore Novell NetWare server data only. The licensed program library, network server descriptions, and storage spaces are still saved by OS/400 using the appropriate commands. For additional information on save and restore for Novell NetWare, see *Integrating AS/400 with Novell NetWare*, SC41-4124.

We recommend that you obtain the appropriate Informational APARs related to Lotus Notes and Novell NetWare integration for important information.

6.1 Overview of IFS

The integrated file system (IFS) design allows you to save files from:

- Other Integrated PC Servers
- OS/2 LAN server systems

The files can reside on the local Integrated PC Server (formerly known as the FSIOP) or on a remote server. This ability makes the AS/400 system a powerful part of the domain. You can use the AS/400 system to save the server data from any server system in the domain such as LAN Server/400.

To save or restore the IFS data, you have to use the Save Object (SAV) command and the Restore Object (RST) command on the AS/400 system. Using these commands, you can save or restore the entire integrated file system. As such,

OS/400 is now part of the integrated file system (QSYS.LIB) along with folders and documents (QDLS). Because these two file systems and their associated objects are saved by native OS/400 commands, they have to be omitted from the IFS save and restore process. For example, the QSYS file system is saved by such commands as SAVSYS and SAVLIB. The QDLS file system is saved by the SAVDLO command.

For additional information on how to save and restore using the SAV and RST commands, see the *Backup and Recovery - Basic*, SC41-4304. For information on IFS, see *Integrated File System Introduction*, SC41-5711.

A major benefit of the Integrated PC Server and LAN Server/400 is the ability to include your LAN Server/400 backup procedure into your AS/400 backup procedure. However, when you use the Integrated PC Server, you create additional objects on the AS/400 system that need to be saved outside the control of the SAV and RST command. They are:

- Configuration objects associated with the Integrated PC Server
- Licensed program product libraries
- Network server storage space associated with the network description
- Storage spaces shared by all Integrated PC Servers on the AS/400 system

When you design a solution to save IFS, especially when you have the Integrated PC Server, you need to consider how you back up the objects in the above list.

We use the LAN Server/400 environment as an example to define the save and restore strategy for IFS using BRMS/400. The rest of this chapter is divided into two parts. The first part contains an overview of the different components that are created when you use the Integrated PC Server for LAN Server/400. It discusses the importance of ensuring that you have proper authority to save and restore information. It also discusses the performance implications on your save and restore operation when you use the Integrated PC Server.

The second part of this chapter addresses how you can use BRMS/400 to save and restore various objects that are created when you have the Integrated PC Server installed and configured on your system to be used by LAN Server/400.

6.2 Planning for saving IFS directories

To develop a save and restore strategy, you must decide what to save and how often to save. Before you decide on a strategy, you must understand the LAN Server/400 objects and their contents.

6.2.1 Storage spaces

The Integrated PC Server does not have its own disks. It uses AS/400 storage space for storing client data and sharing network files. A *storage space* is the AS/400 storage allocated for use by the Integrated PC Server. You can allocate up to 8000 MB of storage for each storage space you create. You then link the storage space as a PC drive to the server that runs on the Integrated PC Server.

Storage spaces contain your LAN data. You may decide to create two or more storages spaces for each network server description. In this way, you can store data, such as PC programs, that does not change often in one storage space. And you can store user data that changes often in another storage space. Now,

you can save the user data more often and possibly save the PC program data only when you save the entire AS/400 system.

When we discuss backup and restore procedures, we have to make a distinction between the two kinds of storage spaces that the Integrated PC Server uses.

6.2.1.1 Server storage space

These storage spaces are in file allocation table (FAT) format. They are created when you create a network server description. They contain licensed programs and system files such as OS/2 code, LAN Server code, Integrated PC Server device drivers, Integrated PC Server administration applications, CONFIG.SYS, NET.ACC, SWAPPER.DAT, and dump files. This server storage space takes about 80 MB of disk storage per configured Integrated PC Server.

Save and restore for the server storage spaces can be done using the SAVOBJBRM command and the RSTOBJBRM command, or through the SAVLICPGM command and the RSTLICPGM command. These storage spaces are stored in library QUSRSYS and QXZ1.

6.2.1.2 Network server storage space (storage spaces)

These storage spaces are created and used by the LAN Server/400 administrator (usually, but can be created by users). They hold the directories and files that make up the entire High Performance File System (386 HPFS) disk volume.

Network server storage spaces are often simply called "storage spaces". The server storage spaces are often referred to as the C: drive, D: drive, and E: drive. Throughout this chapter, the term "storage space" refers to network server storage spaces unless indicated otherwise.

6.2.2 LAN Server/400 structure

You can find pieces of LAN Server/400 in several parts of the AS/400 system. They are explained in the following sections.

Library QXZ1

QXZ1 holds a number of objects, three of which are the base from which the AS/400 system creates network server descriptions when the CRTNWSD command is used. These storage spaces are:

- QFPHSYS1
- QFPHSYS2
- QFPHSYS3

Library QUSRSYS

This is where the disk images for each network server description are stored. You find that there are two "server storage" areas for each network server description that is created.

For the network server description "SRVLS40A" shown in our example in Figure 89 on page 126, the two server storage spaces are called SRVLS40A1.SVRSTG (also referred to as your C: drive) and SRVLS40A3.SVRSTG (also referred to as your E: drive). The names consist of the server name followed by a suffix of 1 or 3. SRVLS40A1 holds the files and programs to boot the Integrated PC Server. SRVLS40A3 holds the domain control database information.

/ (Root)
QSYS.LIB
QXZ1.LIB — QFPHSYS1.SVRSTG / QFPHSYS2.SVRSTG (D drive read only) / QFPHSYS3.SVRSTG
QSYS.29nn — Secondary language version
QUSRSYS.LIB — SRVLS40A1. SVRSTG (C drive read only) / SRVLS40A3. SVRSTG (E drive)
QFPNWSSTG — disk1 (storage space, currently linked to SRVLS40A as K:) / disk2 (storage space, currently linked to SRVLS40A as L:) / disk3 (storage space, currently linked to SRVLS40A as M:)
QLANSrvSR — Directory for temporary copies of LS/400 files during a SAV/RST command
QLANSrv
  KDRIVE (Permanent alias)
    APPL
    FILE
    MYFILE
  NWS
    SRVLS40A
      KDRIVE (Temporary alias)
      DSK
        X — APPL / FILE / MYFILE
        L
        M
    SRV0S2A — DSK — A / B / C / D (Drives on remote server)

Figure 89. LAN Server/400 Integrated PC Server objects

Library QSYS29nn (29nn is a language number)
This library contains licensed system code for secondary languages. This library holds the national language versions of the code that is stored in QXZ1. It contains two objects: QFPHSYS2.SVRSTG and QFPHSYS3.SVRSTG (note that QFPHSYS1.SVRSTG does not have an NLS version).

Integrated File System directory /QFPNWSSTG
/QFPNWSSTG holds the storage spaces that you link to the network server descriptions. In this view, the storage spaces are seen as solid blocks of data; there is no way to see individual files or directories.

Integrated File System directory /QLANSrv file system
This directory contains the LAN Server/400 file system as a hierarchical structure of directories and files that can be saved and restored individually or in groups.

Integrated File System directory /QLANSrvSR (V3R1)
This directory is a temporary storage area for files that are in the process of being saved to AS/400 tapes. The QLANSrvSR directory exists on an AS/400 system running V3R6 or later, or V3R2 only if you upgraded your AS/400 system from V3R1. OS/400 does not use the directory in either V3R6, V3R7, or V3R2.

6.2.3 Memory requirements for save and restore

The QLANSrv is sensitive to the size of the AS/400 memory pool. To achieve acceptable save performance, you must have at least 15 MB of main storage in the pool that your save and restore job is running. For additional information on how to calculate memory pool, see *LAN Server/400 Administration* (part of the IBM Online Library SK2T-2171) or Informational APAR II09313.

Please ensure that you are not affecting other operations on the system by taking memory for the save operation. Other factors, such as the size of your files, tape speed, disk arms, and your processor feature also influence the speed at which the AS/400 system can save or restore your data. For more information on managing system activities, see *Work Management*, SC21-8078.

If less than the recommended memory is allocated to the pool where the save is running, the save operation may take significantly longer. Also, if there is other work being run in the pool, you may have to increase the pool size.

6.2.4 Authority to save IFS directories

Many organizations allow users to back up the system (or certain components of it) and give those users *SAVSYS authority. The LAN Server/400 environment works differently from the standard AS/400 system, so users performing the backup and restore operation for LAN Server/400 may need additional authority. To properly back up LAN Server/400, three types of data should be saved, and each type has authority requirements. The three types are:

- **AS/400 configuration information**: AS/400 configuration information may be saved using the SAVCFG command. In BRMS/400, this is saved using *BKUGRP or *SYSGRP in the control group with *SAVCFG as a backup item. Users only need *SAVSYS authority to use this command.

- **OS/2 LAN Server configuration information**: OS/2 LAN Server configuration information is kept in a server storage space called the E: drive, (SRVLS40A3.SVRSTG in our example shown in Figure 89). The E: drive contains important information for the LAN Server code that runs on the Integrated PC Server, such as the domain control database and the NET.ACC file. This server storage space resides in library QUSRSYS, and its name is the same as the network server description with a suffix of 3. Once again, *SAVSYS authority is sufficient to save this object. For example, to save the E: drive for server SRVLS40A through BRMS/400, use the following command:

```
SAVOBJBRM LIB(QUSRSYS) OBJ(SRVLS40A3) DEV(*MEDCLS) MEDPCY(*SYSPCY)
```

BRMS/400 control group (*BKUGRP) can also be used with a backup item of *ALLUSR to save objects in the QUSRSYS library.

- **User data**: There are two ways to save user data (as complete storage spaces or as individual files). Saving the user data as complete storage spaces is good for disaster recovery, but files cannot be restored individually. You have to restore the entire storage space or nothing. Saving data as individual files is slower, but the advantage here is that you can restore directories or files individually.

Users who only save user data as complete storage spaces need only have *SAVSYS authority to execute the SAV command:

```
SAV DEV('/qsys.lib/tap01.devd;) OBJ(('/qfpnwsstg/srvls40a1'))
```

In BRMS/400, you must add a list entry using the Work with Lists using BRM (`WRKLBRM`) command and add a link type of `*LNK` using the backup control group as shown in Figure 90. We discuss link lists in more detail later in this chapter.

```
                      Change Link List (CHGLNKLBRM)
  Type choices, press Enter.
  List . . . . . . . . . . . . . > STGLNK        Character value
  Objects:
    Name . . . . . . . . . . . .   '/qfpnwsstg/srvls40a1'
    Include or omit  . . . . . . .   *INCLUDE      *INCLUDE, *OMIT
              + for more values
  Directory subtree  . . . . . . .   *ALL          *ALL, *DIR, *OBJ
  Text . . . . . . . . . . . . . >  'Storage Link for SRVLS40A'
```

Figure 90. Change Link List

6.2.4.1 How authority is implemented with LAN Server/400

When you first create a network server storage description, you have to specify a group profile name in the Group profile parameter. The default is *ALL, which means *all* user profiles on the system are automatically registered on the LAN Server. This can become a security exposure because you may not want everyone in your organization to have the privileges of a LAN administrator.

> **Hint**
>
> We recommend that you create a group profile for your Integrated PC Server (for example, FSIOP) and make the users part of the FSIOP group profile. This way, only users that belong to the FSIOP group profile are registered on the LAN server. If you want to perform backup and restore functions on individual files, you must have administrator authority on the LAN server to ensure all user data is saved. If the user does not have administrator authority on the LAN server, they can only save and restore files to which they have authority. You must remember to change the QBRMS user profile to have the correct group profile.

Some of the most common errors that you may come across are related to improper authorities that you may or may not have on your user profiles when saving IFS information. A common occurrence is when you do not have *ALLOBJ special authority to save IFS information or when you are not registered as a LAN administrator. For example, if you belong to the *SYSOPR user class and are not part of the Integrated PC Server group profile and you are not enrolled to the LAN Server as an administrator, when you try to save IFS directories, you see messages similar to those shown in Figure 91.

```
       Example 1 - Save of IFS directory using SAV command
       ----------------------------------------------------------
       SAV DEV('/qsys.lib/davea.lib/ifs.file') OBJ(('qlansrv/nws/itsosrv9/dsk/k/
       cid/*'))
       NetBIOS error on session with LAN Server ITSOSRV9.
       Error exchanging security information for user OPER1 on LAN Server
         ITSOSRV9.
       Object not found.
       No objects saved or restored.


       Example 2 - Save of IFS directory with BRMS/400
       --------------------------------------------------
       Begin processing for control group ADTEST type *BKU.
       Interactive users are allowed to stay active.
       Starting save of list ADTEST to save file.
       Error exchanging security information for user OPER1 on LAN Server
         ITSOSRV9.
       Object not found.
       No objects saved or restored.
       Starting save of BRM media information at level *OBJ to device *SAVF.
       Member QA1AOBJ added to output file QA1AOBJ in library QTEMP.
       12 objects saved from library QUSRBRM.
       Save of BRM media information at level *OBJ complete.
       Control group ADTEST type *BKU processing is complete.


       Description of MSGID CPDA434
       --------------------------------
       Message ID . . . . . . :   CPDA434      Severity . . . . . . . :   10
       Message type . . . . . :   Diagnostic
       Date sent  . . . . . . :   07/01/00     Time sent  . . . . . . :   23:14:45

       Message . . . . :   Error exchanging security information for user OPER1
         on LAN Server ITSOSRV9.
       Cause . . . . . :   The LAN Server/400 file system has encountered an error
         when authenticating a user with a LAN Server.
       Recovery  . . . :   Ensure the following:
            - The user is enrolled in the LAN Server domain containing this LAN
         Server.
             - The AS/400 password matches the LAN Server password.
             - The user is enabled in the domain.
           If the domain controller for this domain is an AS/400 network server,
         ensure that the user's password on that AS/400 is the same as the password
         on the local AS/400.
```

Figure 91. Examples of authority issues with IFS

Notice in example 2 in Figure 91 that the backup control group within BRMS/400
starts and completes successfully. However, the IFS information has not been
saved because the user OPER1 was not authorized to the system.

Remember

When you create a user profile, it is important to understand that the LAN
server can only accept an 8-character user profile, where the AS/400 system
can accept a 10-character user profile.

We now look at the ways in which authority to IFS information can be granted so
that the save and restore functions can be completed. Our examples are based
on using IFS with LAN Server/400 with an Integrated PC Server. At the time this
redbook was written, we were unable to perform our tests using the Integration of
Novell NetWare for OS/400.

6.2.4.2 Granting appropriate authority to users

There are three ways to grant the authority needed to save and restore all LAN server files:

- Give *ALLOBJ special authority to the user profile performing the save or restore operation. Even if the user profile has *SAVSYS special authority, you still need to grant *ALLOBJ authority to perform the save and restore operations without authority problems. For example, you can have a user profile of IFSOPER created or changed as follows:

```
CRTUSRPRF or CHGUSRPRF
          USRPRF(OPER1)
          SPCAUT(*ALLOBJ)1
          GRPPRF(FSIOP)    2
```

> **Notes**
>
> **1** Special authority *ALLOBJ is required for saving IFS directories.
>
> **2** The group profile specified here is the name of the group profile that you used when you created the network server description. If you did not select any group profiles, you do not have to select this parameter. The user is automatically enrolled on the LAN server.

In this example, both the FSIOP group profile and the OPER1 user profile were of the *USER user class. However, when the OPER1 profile was enrolled in the LAN server, it contained ADMIN privileges, which are required to perform the save and restore functions of the LAN Server/400 information. The reason the LAN server enrolled the user with ADMIN privileges is due to the fact that the user contained *ALLOBJ special authority.

> **Note**
>
> This method grants the user ADMIN privileges on the LAN server as well as gives them authority to all objects on the AS/400 system. For that reason, it may be undesirable from a security standpoint to use this approach.

- Grant OPER1 *ALL authority to the files to be saved. Unfortunately, there is no way to grant authority to all files in all sub-directories. Authority may only be granted to one sub-directory at a time, for example:

```
CHGAUT OBJ('/QLANSrv/NWS/SRVLS40A/DSK/K/*') +
    USER(username) OBJAUT(*ALL)
CHGAUT OBJ('/QLANSrv/NWS/SRVLS40A/DSK/K/MYDIR1/*') +
    USER(username) OBJAUT(*ALL)
CHGAUT OBJ('/QLANSrv/NWS/SRVLS40A/DSK/K/MYDIR1/SUB1/*') +
    USER(username) OBJAUT(*ALL)
```

- The third approach is to grant the user LAN administrator authority without actually granting the *ALLOBJ authority on the AS/400 system by using the Submit Network Server (SBMNWSCMD) command to grant the authority only in the LAN server as follows:

```
SBMNWSCMD CMD('NET USER OPER1 password /ADD /PRIV:ADMIN') +
     SERVER(SRVLS40A)
```

You can check the authorization by using the SBMNWSCMD command as follows:

```
SBMNWSCMD CMD('NET USER OPER1') SERVER(SRVLS40A)
```

You can see the results on the AS/400 command line (with detailed messages) as follows:

```
       Full Name
       Comment
       User's comment
       Parameters
       Country code              000 (System Default)
====>> Privilege level           ADMIN    <<======
       Operator privileges       None
       Account active            Yes
       Account expires           Never
       Password last set         07-01-00 07:00PM
       Password expires          08-01-00 07:00PM
       Password changeable       07-01-00 07:00PM
       Password required         Yes
       User may change password  Yes
       Requesters allowed        All
       Maximum disk space        Unlimited
       Domain controller         Any
       Logon script
       Home directory
       Last logon                Never
       Logon hours allowed       All
       Group memberships         *ADMINS
       The command completed successfully.
        Command submitted to network server SRVLS40A.
```

With this approach, you do not need to grant *ALLOBJ special authority to OPER1 user profile or enroll the user profile to the FSIOP group.

Note

This authority is overwritten if the user profile is changed on the AS/400 system. You must run the SBMNWSCMD command again each time the profile changes when you vary on the Integrated PC Server.

6.2.4.3 Special authority information
You may be familiar with saving other types of AS/400 objects. You should be aware that authority information for LAN Server for OS/400 objects is saved with the object rather than separately. Using the SAVSECDTA command does not save authority information for the Server for OS/400 file system.

*SAVSYS special authority specified on an AS/400 user profile does not have any effect on the ability to save or restore objects using the LAN Server for OS/400 file system.

6.2.4.4 Users with password *NONE
No matter what authority users have on the AS/400 system, if their password is *NONE, they are downloaded to the LAN server in an inactive state when you create the network server description with the GRPPRF(*ALL) default option. Therefore, such user profiles cannot save or restore the QLANSrv file system. The password must be reset from the AS/400 system before this user can log on to the LAN or gain access to the QLANSrv file system to perform save and restore operations.

6.2.4.5 Group profiles
The AS/400 system allows group profiles to sign on. OS/2 LAN server does not. Therefore, if a user ID, such as QSECOFR, is migrated as a group to the LAN server, that user profile cannot sign on and cannot perform save or restore

operations. Ensure that whichever user is to perform these operations is not using a user ID that is considered a group profile on the LAN server. To determine which profiles on the LAN are considered group profiles, use the following command:

```
SBMNWSCMD CMD ('net group') SERVER(yoursvr)
```

If you find QSECOFR in the list, change its profile to be a member of the group that is downloaded to the LAN server if this user ID is to perform save or restore operations.

6.2.4.6 Which job saves QLANSrv files?
Saves in the integrated file system are performed by the user profile of the job and not by QSECOFR. Therefore, any user who has administration authority to the LAN can perform save operations provided that user has *ALLOBJ authority on the AS/400 system.

6.2.5 Restricted state

To save Integrated PC Server data in a restricted state, your AS/400 system must have either a domain controller or a backup domain controller configured. It is not possible to properly vary on a network server description without access to a controller. If you have multiple Integrated PC Servers on your AS/400 system, only one of them needs to be a controller. The others can access the controller using the interconnect function.

Before you save or restore the local files for LAN Server/400, we recommend that you put the AS/400 system into a restricted state. A restricted state prevents workstations and jobs from using the system and, therefore, ensures that no changes can be made to the QLANSrv files during the save or restore process.

You can put the AS/400 system into a restricted state by ending all of the subsystems. You can put only the Integrated PC Server into a restricted state by ending the monitor job.

Note

When you put the AS/400 system into a restricted state, the Integrated PC Servers also enter a restricted state. When the Integrated PC Server is in a restricted state, the network server running on the Integrated PC Server is running, but it cannot be accessed by requesters. However, the network server can be accessed by functions running on the AS/400 system. This restricted state is equivalent to stopping the NETLOGON service on an OS/2 LAN server to perform backup functions.

6.2.5.1 Putting the AS/400 system into a restricted state
This section shows you an example of how to put the AS/400 system into a restricted state.

Use the ENDSBS command:

```
ENDSBS SBS(*ALL) OPTION(*IMMED) DELAY(*NOLIMIT)
```

This leaves only the system console operational. If you cannot put the AS/400 system into a restricted state, you must verify that no files are open using the

Work with NWS Sessions (WRKNWSSSN) command or by using SBMNWSCMD CMD('NET FILE /S'). Be aware that some applications close files between writes, so users can actually be using a file that appears closed to the administrator.

You should put the AS/400 system into a restricted state only when you want to save files that are stored on the AS/400 system itself.

6.2.5.2 Putting the Integrated PC Server into a restricted state

This section shows you an example of how to put the Integrated PC Server into a restricted state.

To put only the Integrated PC Server into a restricted state, end the monitor job. The monitor job runs in the QSYSWRK subsystem, and the job name corresponds to the name of the Integrated PC Server it is running. Figure 92 shows the domain controller, DCL10NWS, as *active*. Server ASL10NWS is in a pending state. In Figure 93 on page 134, you can see a monitor job for each of these servers. To end the monitor job, type 4 in the Options column.

```
                      Work with Network Server Status
                                                      System:    SYSAS400
  Server type . . . . . :      *LANSERVER

  Type options, press Enter.
    7=Display users    8=Work with configuration status   9=Work with aliases
   10=Work with sessions   12=Display statistics         14=Restart server

       Domain
  Opt    Server    Status               Text
  __    SYSAS400                         Network server domain
  __      ASL10NWS  PENDING              *BLANK
  __      DCL10NWS  ACTIVE               *BLANK
  __      L10SRV    INACTIVE             Another Network Server
  __      TST10NWS  INACTIVE             *BLANK
  __      RJFTEST   INACTIVE             *BLANK


                                                                     Bottom
  Parameters or command
  ===> wrkactjob
  F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve
  F11=Display type        F12=Cancel   F17=Position to
```

Figure 92. Displaying the monitor job example

```
                            Work with Active Jobs                      SYSAS400
                                                             05/25/00  13:35:38
     CPU %:      .0      Elapsed time:    00:00:00    Active jobs:    49

     Type options, press Enter.
       2=Change   3=Hold   4=End   5=Work with   6=Release   7=Display message
       8=Work with spooled files    13=Disconnect ...

     Opt   Subsystem/Job  User        Type  CPU %  Function         Status
       __    QPADEV0009    USERC       INT     .0   CMD-WRKNWSSTG    DSPW
       __    QPADEV0011    USERA       INT     .0   CMD-WRKACTJOB    RUN
       __    QSERVER       QSYS        SBS     .0                    DEQW
       __    QSERVER       QPGMR       ASJ     .0                    EVTW
       __    QSPL          QSYS        SBS     .0                    DEQW
       __    PRT01         QSPLJOB     WTR     .0                    MSGW
       __    QSYSWRK       QSYS        SBS     .0                    DEQW
       __    ASL10NWS      QSECOFR     BCH     .0   PGM-QFPAMON      TIMW
       _4    DCL10NWS      QSECOFR     BCH     .0   PGM-QFPAMON      TIMW
                                                                       More...
     Parameters or command
     ===>
     F3=Exit       F5=Refresh   F10=Restart statistics   F11=Display elapsed data
     F12=Cancel    F23=More options   F24=More keys
```

Figure 93. Ending the monitor job example

6.2.6 Integrated PC Server on or off?

For some types of save and restore, the Integrated PC Servers must be varied on. For others, they need to be varied off.

6.2.6.1 Varied ON
The Integrated PC Servers should be varied on when you want to access the data through the QLANSrv to save individual files or directories.

6.2.6.2 Varied OFF
The Integrated PC Servers should be varied off when you want to save storage spaces in /QFPNWSSTG, QXZ1, or QUSRSYS (whether they are server storage spaces or network server storage spaces). Table 3 on page 148 shows the server status requirements for different save and restore operations.

6.2.6.3 BRMS/400 considerations
Please note that we do not recommend the use of *EXIT in the backup control groups to vary off your Integrated PC Server prior to the save because there are different run times for this step. Besides, you may receive messages that you may want to answer. We recommend that you vary off the Integrated PC Server manually before you start to save your storage space. The vary off for Integrated PC Server can take several minutes.

You should wait to see the all of the following messages before you start your save operation:

```
CPC2665 - Vary off complete for network server SRVLS40A
CPC2608 - Vary off complete for line ITSCTRN
CPIA407 - Monitor job for network server SRVLS40A ended
```

> **Hint**
>
> When you use the same backup control group within BRMS/400 to save your
> IFS information, you can end up with different results depending on the status
> of your Integrated PC Server. By default, the link list (LINKLIST or *LINK) is set
> to save the entire IFS structure with the exception of QSYS.LIB and the QDLS
> file system. If your Integrated PC Server is in a varied on status, the control
> group saves the /QLANSvr file system (files and directories). If the Integrated
> PC Server is in a varied off status, the control group saves the /QFPNWSSTG
> file system (storage space).
>
> You receive CPFA09E messages indicating that the "object is in use"
> depending on the status of your Integrated PC Server, and the backup ignores
> that object. See 6.4.1, "Setting up BRMS/400" on page 138.

6.3 Save and restore strategies

Because LAN Server/400 uses various parts of the AS/400 system, your strategy
for saving and restoring LAN Server/400 and the data it manages will depend on
your company's needs.

In this section, we show you how to back up the LAN server files. You need to
incorporate these procedures into your normal AS/400 backup procedures so that
they become routine.

The most important single point about backing up your LAN server files is to be
clear why you are saving objects and under which circumstances you plan to
restore them. The ways in which you plan to restore objects determines how you
should save them.

You can also save your LAN Server/400 data by saving the entire storage space
or you can save a portion of the storage space such as a directory or a file.

6.3.1 Performance impact

Your save/restore strategy can have significant impacts on the time it takes to
save the AS/400 system. Consider this carefully.

> **Note**
>
> Saving the entire storage space through /QFPNWSSTG is significantly faster than saving only a portion of the storage space through QLANSvr unless you are saving only a small portion of the storage space. For example, when saving through /QFPNWSSTG, the save/restore data rate is measured at about 2 GB to 8 GB per hour*. When saving through QLANSvr, the save/restore data rate is approximately 75 MB to 500 MB per hour*.
>
> However, if you must later restore the data, you must restore the entire storage space. If you save only a portion of the storage space, you can restore only the files you need. Also, you do not have to vary off the Integrated PC Server to perform this type of save operation.
>
> Finally, note that if you save or restore a directory from a storage space, performance is 2.5 to 3 times slower than saving a folder and its documents using the SAVDLO command and the RSTDLO command.
>
> *** Note**: The actual data rate achieved depends on a number of factors. Things that affect results are the CPU model, the tape drive you are using, the pool size, and the size of the files you are saving.

6.3.2 Saving regularly

Your backup strategy should include saving the storage spaces (also sometimes called *network drives*) regularly. Create several storage spaces. Store data that changes infrequently on different storage spaces from data that changes frequently. Using this strategy, you can save the storage space containing the infrequently changed applications or data less often, perhaps only when you save the entire AS/400 system. The following sections provide examples and tips on how to save the entire system, storage spaces only, and the other objects that are part of the LAN Server/400 product.

It is important that you plan the frequency of your saves to ensure that you always have a usable backup available in the event of a system failure or disaster. For example, you may decide on the following strategy to ensure that your user data is thoroughly backed up.

> **BRMS/400 limitations**
>
> BRMS/400 currently does not have the ability to perform incremental saves or to save changes since the last time you performed a full save using the backup list items. In addition, BRMS/400 does not allow you to perform saves for IFS information on remote systems. Both of these functions are available through the standard AS/400 interface using the SAV command. When designing your backup and recovery strategies using BRMS/400, you must consider these important limitations.

Save recommendations
Save the network server storage spaces as a complete entity. This allows you to restore the majority of your data with one command. See *LAN Server/400*

Administration (part of the IBM Online Library SK2T-2171) for additional information.

If your environment involves a significant amount of daily change, you may find it better to save the entire storage space daily.

Consider saving the domain control database (DCDB) or the E: drive either weekly or whenever you have made significant administration changes that include alias creations. See *LAN Server/400 Administration* (part of the IBM Online Library SK2T-2171) for detailed information.

Consider saving your E: drive daily to a save file while the Integrated PC Server is varied off. This allows you to save any data that was in cache. If you do not make many changes to user profiles or aliases, keep fairly current copies of the E: drive on hand.

If your data changes frequently, and you must keep the Integrated PC Server running, you must save at the directory level. If the AS/400 system takes too long to save at the directory level, consider saving the entire storage space (for which you must vary off the Integrated PC Server). Restoring individual directories with this technique is not easy. One way to restore directories (if you do not need the entire storage space) is to first create a temporary storage space in the QLANSrv directory. You can restore into the temporary storage space and selectively restore required files from the temporary storage space. After the restore is completed, you must delete the temporary storage space.

Hint

To avoid wide variances in save time for QLANSvr, vary the Integrated PC Server off and back on. This cleans up OS/2 cache data, for example, which can cause the save times to increase.

6.4 Saving IFS using BRMS/400

The integrated file system information is saved using a control group to perform the save. There are *no* BRMS/400 commands to save the IFS information. As an overview, BRMS/400 saves the various components of IFS information:

- Configuration objects (network storage descriptions) are saved by using the *SYSGRP or by the *BKUGRP (item *SAVCFG) control groups.

- Licensed Programs (QXZ1, for example) are saved using the *SYSGRP (item *IBM) control group.

- Domain controller database (E: drive) is saved using the *BKUGRP (item *ALLUSR) control group.

- Storage spaces (most are located in /QFPNWSSTG) are saved using the *BKUGRP (LINKLIST or *LINK item) control group.

- Directories and files located in /QLANSrv are saved using the *BKUGRP (LINKLIST or *LINK item) control group.

Besides using the default BRMS control groups, you can create your own control groups and backup list items to meet your save and restore requirements.

6.4.1 Setting up BRMS/400

With OS/400 V3R6 and V3R2, the IFS information that you want to save using BRMS/400 is recorded in a backup list that is called LINKLIST. The list type is *LNK. With OS/400 V3R1, BRMS/400 does not support either a backup list or a link list to save IFS data. See 6.6, "Saving and restoring V3R1 IFS data with BRMS/400" on page 146, for information on how you can save IFS under V3R1.

You can create your own backup list to customize how you want to save the IFS directories. Once you have created your own backup list name and have added the entry of what you want to save in the list that you have created, you can use the list in a backup control group to save the IFS directories.

A good example here is that you may want to create two backup lists: one that indicates a save when the Integrated PC Server is varied on and another list that indicates when the Integrated PC Server is varied off. We briefly address these considerations in 6.2.6, "Integrated PC Server on or off?" on page 134.

In the example that follows, a backup list called FSOFF (backup list to save the /QFPNWSSTG storage space for LAN Server/400 when the Integrated PC Server is varied off) is added using option 1 (Add) from the list management function using the WRKLBRM command. This backup list shown in Figure 94 that we are creating is exactly the same as LINKLIST that BRMS gives you.

```
                              Work with Lists                        SYS400A

  Position to . . . . . .                  Starting characters


  Type options, press Enter.
    1=Add    2=Change    3=Copy    4=Remove    5=Display    6=Print


  Opt   List Name   Use    Type   Text
   1    FSOFF       *BKU   *LNK
   _    ADSPLF      *BKU   *SPL   Amit's Spool File backup list
   _    DAILYLNK    *BKU   *LNK   Daily SAVES /QLANSrv/.../BRMS
   _    FLR         *BKU   *FLR   Folder Storry
   _    ITSCID38    *BKU   *FLR    Folder Rhahn
```

Figure 94. Work with Lists

List entries are added to the list using option 2 (Change) from the Work with Lists display to include the contents of the IFS directories that need to be saved or omitted. This list entry maps to the SAV command when the backup control group is run. Figure 95 shows the settings that we use for the FSOFF link list. Notice that in addition to the QSYS.LIB and the QDLS file systems, we also omit the /QLANSrv file system from the save since we are only interested in saving the entire server storage space in /QFPNWSSTG.

```
                   Change Link List (CHGLNKLBRM)
 Type choices, press Enter.

 List . . . . . . . . . . . . . . . > FSOFF          Character value
 Objects:                          _
   Name . . . . . . . . . . . . . > '/*'

   Include or omit  . . . . . . .    *INCLUDE       *INCLUDE, *OMIT
                               _
   Name . . . . . . . . . . . . . > '/qdls'

   Include or omit  . . . . . . . > *OMIT          *INCLUDE, *OMIT
                               _
   Name . . . . . . . . . . . . . > '/qsys.lib'

   Include or omit  . . . . . . . > *OMIT          *INCLUDE, *OMIT

   Name . . . . . . . . . . . . . > '/qlansrv'

   Include or omit  . . . . . . . > *OMIT          *INCLUDE, *OMIT
                 + for more values _
 Directory subtree  . . . . . . .    *ALL           *ALL, *DIR, *OBJ
```

Figure 95. Change Link List

You can now add the backup list entries as a backup item in a backup control
group. The BRMS/400 default backup group *BKUGRP contains the default list
item LINKLIST. In our example, we add the FSOFF list item to the ITSOBKUP
backup control group (Figure 96).

```
          Edit Backup Control Group Entries              SYS400A

 Group . . . . . . . . . . . : ITSOBKUP
 Default activity  . . . . . . *BKUPCY
 Text  . . . . . . . . . . . . ITSO Backup Control Group

 Type information, press Enter.

                             Weekly   Retain   Save      SWA
           Backup      List  Activity Object   While     Message
 Seq       Items       Type  SMIWTFS  Detail   Active    Queue

 _10       *SAVSECDTA  ____  FIIIIII  *NO
 _20       *ALLUSR     ____  FIIIIII  *NO      *NO
 _30       *ALLDLO     ____  FIIIIII  *NO      *NO
 _40       FSOFF       *LNK  F_____  *NO      *NO
 _50       *EXIT       ____  *DFTACT
```

*Figure 96. Example of an *LNK list in a control group*

You can create similar backup link lists to save the file and directory information
in /QLANSrv in the same manner that we created a separate backup link list to
save the storage spaces only when the Integrated PC Server is varied off. In this
case, you can omit the /QFPNWSSTG directory from your save since you cannot
save this when the Integrated PC Server is varied on.

The advantage of creating two separate backup link lists is to eliminate
information errors from the job log indicating that the "object is in use" during your
save operation.

With V3R7 of OS/400, the default backup control group now contains a new keyword, *LINK, instead of LINKLIST for the backup items. By default, the backup control group *BKUGRP saves all of the IFS directories except for QSYS.LIB and QDLS file systems. Figure 97 shows an example of the backup control group in V3R7.

```
                    Edit Backup Control Group Entries              SYS400B

   Group . . . . . . . . . . . : *BKUGRP
   Default activity . . . . . *BKUPCY
   Text  . . . . . . . . . . Entry created by BRM configuration


   Type information, press Enter.


                          .......................................................
           Backup      :                  Backup Items - Help              :
   Seq     Items       :                                                   :
                       :  o  *ASPnn     - save an ASP                      :
    10     *SAVSECDTA  :  o  *IBM       - save all IBM libraries           :
    20     *SAVCFG     :  o  *LINK      - save all integrated file system  :
    30     *ALLUSR     :     libraries                                     :
    40     *ALLDLO     :  o  *QHST      - save history information         :
    50     *LINK       :  o  *SAVCAL    - save calendar information        :
    60     *EXIT       :  o  *SAVCFG    - saves configurations             :
                       :  o  *SAVSECDTA - save security data               :
                       :                                        More...    :
                       :  F2=Extended help   F11=Search Index   F12=Cancel :
   F3=Exit             :  F20=Enlarge        F24=More keys                 :
   F11=Display exits   :                                                   :
                       :.....................................................:
```

*Figure 97. Example of the *LINK list in the V3R7 control group*

6.4.2 Managing IFS saves with BRMS/400

In the previous sections, we discussed how you can set up backup link lists for saving IFS information using BRMS/400 including considerations for varying on or varying off the Integrated PC Server. This section looks at the information that you should look for to ensure that your saves are complete. It also explains how you can use the Work with Link Information (WRKLNKBRM) command to restore files and directories from BRMS/400 saves.

Once your save has completed, we strongly recommend that you check your job log and use the DSPLOGBRM command to ensure that the save has completed normally, and most importantly, that you do not have any authority problems. You should use the DSPLOGBRM command, the WRKMEDIBRM command, the WRKMEDBRM command, and the WRKLNKBRM command to verify your save. You can find some information in the QSYSOPR message queue or in the job log.

Figure 98 shows an example of the DSPLOGBRM command output confirming that the save operation completed successfully.

```
  6/18/00                    Display BRM Log Information                SYS400B
 17:03:21                                      Position to . . . . 6/12/00

 Begin processing for control group SAVSTGS type *BKU.
 Devices TAPLIB01 will be used for control group SAVSTGS type *BKU.
 Interactive users are allowed to stay active.
 Starting save of list LANSTGS to devices TAPLIB01.
 3747 objects saved.
 Starting save of BRM media information at level *LIB to device TAPLIB01.
 10 objects saved from library QUSRBRM.
 Save of BRM media information at level *LIB complete.
 SAVSTGS *BKU 0020 *EXIT SNDMSG MSG('SAVE for FULL-STORAGE-SPACE ENDED') TOUSR
 Control group SAVSTGS type *BKU processing is complete.
 Last run date for BRM maintenance was 06/06/00.
 System start up program executed.
```

Figure 98. Display BRM Log Information

Figure 99 shows an example of the WRKMEDIBRM command.

```
                         Work with Media Information                   SYS400B

 Position to Date . . . . .

 Type options, press Enter.
   2=Change   4=Remove   5=Display   6=Work with media    7=Restore
   9=Work with saved objects


      Saved                         Save   Volume    File  Expiration
 Opt  Item         Date     Time    Type   Serial    Seq     Date

      QDSNX        6/14/00  17:51:35  *FULL  TUV708    116   7/19/00
      QPFRDATA     6/14/00  17:51:35  *FULL  TUV708    117   7/19/00
      QS36F        6/14/00  17:51:35  *FULL  TUV708    118   7/19/00
      QUSRINFSKR   6/14/00  17:51:35  *FULL  TUV708    119   7/19/00
      LINKLIST     6/14/00  17:52:55  *FULL  TUV708    123   7/19/00
      QUSRBRM      6/14/00  18:02:57  *QBRM  TUV708    124   7/19/00
```

Figure 99. Work with Media Information

You can see the saved information using the WRKLNKBRM command (Figure 100).

```
                         Work with Link Information                    SYS400B
                                                    06/18/00  17:00:22
 Type options, press Enter.
   4=Remove    9=Work with directory information


 Opt     Directory
   9     /QFPNWSSTG
         /QFPNWSSTG/DRIVEK
         /QFPNWSSTG/DRIVEL
         /QLANSrv
         /QLANSrv/NWS
         /QLANSrv/NWS/RCHPID
```

Figure 100. Work with Link Information

You can enter 9 in the Opt column for a directory path on the Work with Directory Information display to see the directory information, the date, time, media volume, and the number of objects that were saved in a particular directory as shown in Figure 101.

```
                  Work with Directory Information              SYS400B
                                                        06/18/00  17:02:51
 Directory  . . . . :    /QFPNWSSTG


 Type options, press Enter.
   4=Remove    5=Display    7=Restore    9=Work with objects


        Date        Time       Save      Volume     Expiration   Objects     Not
 Opt    Saved       Saved      Type      Serial        Date      Saved     Saved
        06/12/00   10:37:41   *FULL     ABC592      07/17/00        2         0
        06/12/00   11:54:32   *FULL     ABC447      07/17/00        2         0
        06/12/00   16:18:42   *FULL     ABC877      07/17/00        2         0
        06/12/00   17:04:34   *FULL     QRS188      07/17/00        0         2
```

Figure 101. Work with Directory Information

6.5 Restoring IFS directories with BRMS/400

Security and authority to files and directories are as important to the restore operation as it was when saving the IFS information. If you want to restore an object from /QLANSrv, you should have the authority for this object from the LAN server's point-of-view. If you do not have enough authorities, you receive the message CPFA09C - Not authorized to object. Your restore operation fails with the message CPF3823 - No objects saved or restored.

For additional information on security considerations for IFS, see *LAN Server/400 Administration* (part of the IBM Online Library SK2T-2171).

6.5.1 Restoring objects to /QLANSrv with BRMS/400

Before you can restore individual files or directories to /QLANSrv, you must ensure that the Integrated PC Server is in the varied on status or at least in a restricted state. You can restore objects using either the WRKLNKBRM command or the WRKMEDIBRM command.

In the example shown in Figure 102, we want to restore (from the BRMS/400 link list) using the command:

/QLANSrv/NWS/RCHPID/DSK/K/edel_k/BRMS

```
                       Work with Link Information                SYS400B
                                                        06/18/00  18:02:08
  Type options, press Enter.
    4=Remove    9=Work with directory information

  Opt    Directory
         /QLANSrv/NWS/RCHPID/DSK/K/edel_k
         /QLANSrv/NWS/RCHPID/DSK/K/edel_k/ADSMSERV
         /QLANSrv/NWS/RCHPID/DSK/K/edel_k/ADSMSERV/DLL
         /QLANSrv/NWS/RCHPID/DSK/K/edel_k/ADSMSERV/DOC
   9     /QLANSrv/NWS/RCHPID/DSK/K/edel_k/BRMS
         /QLANSrv/NWS/RCHPID/DSK/K/edel_k/PMSX
```

Figure 102. Work with Link Information

Note

The WRKLNKBRM command provides the ability to restore a single directory
or multiple directories within the path. All of the directories are displayed in a
hierarchy, and each of these directory paths can be restored individually. This
is a different view to what you get using the native Work with Links (WRKLNK)
command, where you have to select options to go to the next level in the
hierarchy.

Figure 103 identifies the versions of the saves that BRMS/400 is aware of for the
directory that we are planning to restore. If you are not planning to restore the
entire directory, you can continue to "drill down" to the next level of information.

```
                     Work with Directory Information             SYS400B
                                                        06/18/00  18:02:28
  Directory  . . . . :   /QLANSrv/NWS/RCHPID/DSK/K/edel_k/BRMS

  Type options, press Enter.
    4=Remove    5=Display   7=Restore    9=Work with objects

        Date        Time      Save    Volume    Expiration   Objects     Not
  Opt   Saved       Saved     Type    Serial       Date        Saved     Saved
        06/11/00    23:24:24  *FULL   DD0376     07/16/00       11          0
        06/12/00    17:04:34  *FULL   QRS188     07/17/00       11          0
   9    06/18/00    17:56:27  *FULL   ABC130     07/23/00       11          0
```

Figure 103. Work with Directory Information

You can now work with the objects that were saved and decide on which ones
you want to restore from the list as shown in Figure 104 on page 144.

```
                          Work with Objects                         SYS400B
                                                          06/18/00  18:02:34
Directory  . . . . :    /QLANSrv/NWS/RCHPID/DSK/K/edel_k/BRMS
Saved date/time  . :    06/18/00  17:56:27


Type options, press Enter.
  4=Remove   5=Display   7=Restore


                                                 Volume
Opt     Object                                   Serial            Size
        ARC.SH                                   ABC130            263213
        BACKUP.SH                                ABC130            220739
        BRM.EXE                                  ABC130            459040
        BRM.SH                                   ABC130            688769
        COST.SH                                  ABC130             53792
```

Figure 104. Work with Objects

Our example shows the display in Figure 104 for information only. We restore the
entire directory from the Work with Directory Information display using the latest
version (volume ABC130). See Figure 105 and Figure 106.

```
                        Select Recovery Items                       SYS400B

 Type options, press Enter.  Press F16 to select all.
   1=Select   4=Remove    5=Display   7=Specify object




       Saved                          Save    Volume    File  Expiration Objects
 Opt   Item         Date      Time    Type    Serial     Seq     Date     Saved

  1    DAILYLNK    6/18/00  17:56:27  *FULL   ABC130      1    7/23/00      11
```

Figure 105. Select Recovery Items

```
                     Additional Message Information

Message ID . . . . . . . :  CPC370E       Severity . . . . . . . :   00
Message type . . . . . :  Completion
Date sent  . . . . . . :   06/18/00       Time sent  . . . . . . :   18:06:17

Message . . . . :   11 objects restored.
Cause . . . . . :   11 objects were restored from ABC130  sequence number 1 at
  06/18/00 18:05:32.  The restore operation ended on volume ABC130.
```

Figure 106. Additional Message Information

As you can see, restoring the IFS information through BRMS/400 is relatively
easier than restoring the same information using the AS/400 system RST
command interface. With the RST command, you are required to type various
command parameters correctly, along with the directory syntax, which often leads
to several attempts before the restore function will work for you. For additional
information on the SAV command and the RST command, see *Backup and
Recovery - Basic*, SC41-4304.

6.5.2 Restoring a storage space with BRMS/400

As with restoring files and directories, you have to use the WRKLNKBRM command to restore the storage space. Before you can start the restore operation, you must ensure that the Integrated PC Server is varied off. You can also use the WRKMEDIBRM command to restore the storage space if you prefer. In our example, we use the WRKLNKBRM command to restore two storage spaces (DRIVEK and DRIVEL) from the /QFPNWSSTG directory. On the WRKLNKBRM command, enter 9 in the Opt column for the /QFPNWSSTG directory. You see the Work with Directory Information display. Enter 9 in the Opt column for the saved version from which you want to restore your directory. The Work with Objects display is shown in Figure 107 and the Select Recover Items display is shown in Figure 108.

```
                          Work with Objects                      SYS400B
                                                       06/18/00  16:49:23
Directory  . . . . :    /QFPNWSSTG
Saved date/time  . :    06/12/00  10:37:41


Type options, press Enter.
  4=Remove    5=Display    7=Restore

                                               Volume
Opt      Object                                Serial           Size
  7      DRIVEK                                ABC592          34816
  7      DRIVEL                                ABC592          29184
```

Figure 107. Work with Objects

```
                        Select Recovery Items                    SYS400B

 Type options, press Enter.  Press F16 to select all.
    1=Select    4=Remove    5=Display    7=Specify object




     Saved                          Save   Volume   File  Expiration Objects

Opt  Item          Date      Time   Type   Serial   Seq    Date     Saved

 1   LANSTGS      6/12/00  10:37:41 *FULL  ABC592     1   7/17/00    3747
 1   LANSTGS      6/12/00  10:37:41 *FULL  ABC592     1   7/17/00    3747
```

Figure 108. Select Recovery Items

Select option 7 on the Work with Objects display to restore the drives and the storage spaces in those drives. You can verify if the storage spaces have restored successfully by using the Work with Network Server Storage Spaces (WRKNWSSTG) command (Figure 109 on page 146).

```
                 Work with Network Server Storage Spaces
                                                    System:    SYS400B
  Type options, press Enter.
    1=Create   4=Delete   5=Display   6=Print   10=Add link   11=Remove link


                    Percent              Drive
  Opt  Name         Used      Size  Server  Letter   Text

       DRIVEK          7      500                    500 MB Server RCHPID /
       DRIVEL          3      500                    500 MB Server RCHPID /
```

Figure 109. Work with Network Server Storage Spaces

You now need to link the storage names with appropriate drive letters using the Add Server Storage Link (ADDNWSSTGL) command or by selecting option 10 on the WRKNWSSTG display.

You can now vary on the Integrated PC Server. This can take several minutes. Once the Integrated PC Server is active, you should check your LAN Server/400 environment with the WRKLNK command and by trying a few options from the NWSADM menu to ensure that everything is working correctly.

6.6 Saving and restoring V3R1 IFS data with BRMS/400

When Client Access for OS/400 is installed on V3R1, the new clients use the new integrated file system. A complete system save is not possible without performing the Save Object (SAV) command. Under V3R1, BRMS/400 does not support the SAV command. To ensure that you have a complete system save, use the following technique:

1. Create a library and a save file:

   ```
   CRTLIB IFSSAVF
   CRTSAVF IFSSAVF/IFS
   ```

2. Specify the following exits in the backup control group to save the IFS data to save file created earlier. Use a BRMS list to save the save file to tape so that you can store both media information, and also save history about the save. Alternatively, you can save the entire IFSSAV library if you do not want to use list entries. The following exit entries in the backup control group save the entire IFS and not just client access data:

   ```
   10 *EXIT CLRSAVF IFSSAV/IFS
   20 *EXIT SAV DEV('QSYS.LIB/IFSSAV.LIB/IFS.FILE')
           OBJ(('/*') ('QSYS.LIB' *OMIT) ('/QDLS' *OMIT))
   30 IFSSAV
   ```

To recover the IFS data, add a step where you restore the data from the save files into library IFSSAV after the BRMS/400 recovery is complete. Use the Restore Objects in directories (RST) command as shown in the following example. Before you perform the RST command, ensure that you have varied off the Integrated PC server:

```
RST DEV('/QSYS.LIB/IFSSAV.LIB/IFS.FILE')
    OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT))
```

6.6.1 Disaster recovery for LAN Server/400 environment with BRMS/400

Let's discuss the case where you have to recover the entire system, including LAN Server/400 environment. Your first step should be to follow the instructions in the BRMS/400 Recovery Report created after your last save using BRMS/400.

6.6.1.1 Recommendations

Use the following process to restore your LAN Server/400 environment with BRMS/400:

1. The configuration objects, licensed programs, and objects in QUSRSYS restore in the normal way through the BRMS recovery commands.

Hint

With V3R1, restoring a configuration object for a network server description fails since the CRTNWSD command creates the device configuration and tries to copy QXZ1/QFPHSYS1 and QXZ1/QFPHSYS3 from QXZ1 to QUSRSYS as C: drive and E: drive. Since QXZ1 is not there during the restore operation, the RSTCFG command fails. This is because the SAVCFG command does not save the contents of C: drive, D: drive, and E: drive. All it does is save the description of the Integrated PC Server (network server description). Informational APAR II088a56 documents this restriction.

With V3R6, V3R2, and V3R7, this problem has been circumvented. The RSTCFG command does not fail even when library QXZ1 does not exist. Once the user objects and IBM licensed programs are restored, you can re-run the RSTCFG command to restore the network server description configuration.

---

2. During the recovery, let the Integrated PC Server remain in a varied off state.

3. Restore IFS information with default LINKLIST item in backup control group *BKUGRP.

4. After ending all of the restore steps in conjunction with the BRMS/400 Recovery Report, vary on the Integrated PC Server with your first IPL after the recovery.

5. Check the LAN Server/400 environment and try some options using the GO NWSADM menu.

6. Use the `ADDNWSSTGL` command to link your storage spaces to drive letters.

7. Vary on the Integrated PC Server again.

8. Use the `WRKLNK` command to check the status of your data in the /QLANSrv directory.

9. Use the `WRKLNKBRM` command to restore the latest save of your individual data in /QLANSrv (for example, your daily saves).

6.7 Save and restore hints

Here are some other points that you should be aware of when you develop your save and restore strategy:

- Differences exist between saving and restoring the LAN Server for OS/400 and saving and restoring other AS/400 objects. Parts of the LAN Server/400 product are stored in AS/400 objects, and parts are stored in the LAN Server for OS/400. See 6.2.2, "LAN Server/400 structure" on page 125, for an overview of the parts that make up LAN Server/400.

- You can ensure that QLANSrv objects are available for saving by placing the AS/400 system in a restricted state. This prevents users from using the Integrated PC Server, but does not vary it off. Place the AS/400 system in a restricted state by ending all subsystems.

- Storage spaces are not the same as other AS/400 objects. You must vary off the Integrated PC Server to save storage space objects, even when the AS/400 system is in a restricted state.

- The SAV command locks LAN Server for OS/400 objects so that other users cannot write to them while the save operation is in progress. This lock may conflict with client workstations accessing LAN Server/400 files when they are using LAN Requester.

- You cannot have objects opened with write access while using Save (SAV).

6.7.1 Save and restore options for LAN Server/400

Save and restore options for LAN Server/400 are outlined in Table 3.

Table 3. Summary of save and restore options

Objects saved	Saved command	Integrated PC Server varied on or off	Restricted state AS/400 system "yes" or "no"
Storage spaces located in /QFPNWSSTG and libraries QUSRSYS and QXZ1, and any national language version of QXZ1 for disaster recovery for the entire system.	SAV DEV('/QSYS.LIB/TAP01.DEVD') OBJ(('/*') ('QLANSrv' *OMIT))	Off	yes
Storage spaces of a specific network server located in /QFPNWSSTG on the local AS/400 system.	SAV DEV('/QSYS.LIB/TAP01.DEVD') OBJ ('QFPNWSSTG/DISK1)	Off	N/A
Files and directions located in /QLANSrv for disaster recovery and file restoration.	SAV DEV('/QSYS.LIB/TAP01.DEVD') OBJ(('/*') ('QFPNWSSTG' *OMIT))	On	Yes
Files and directions located in /QLANSrv that were changed or created within a date range saved to a file. Incremental backup.	SAV DEV('/QSYS.LIBSAVTO.FILE') OBJ('QLANSrv/*') CHGPERIOD(mm/dd/yy)	On	Yes
Files and directions located in /QLANSrv of a remote system that were changed or created within a date range saved to a file. Incremental backup.	SAV DEV('/QSYS.LIBSAVTO.FILE') OBJ('QLANSrv/*') CHGPERIOD(mm/dd/yy SYSTEM(*RMT)	On	No
Specific directories and files on a local system saved to a file.	SAV DEV('/QSYS.LIBSAVTO.FILE') OBJ('QLANSrv/NWS/SRVL40A/DSK/K/ FILE')	On	Yes

Objects saved	Saved command	Integrated PC Server varied on or off	Restricted state AS/400 system "yes" or "no"
Specific directories and files on a remote system saved to a file.	SAV DEV('/QSYS.LIBSAVTO.FILE') OBJ('QLANSrv/NWS/SRVOS2A/DSK/D/rfiles')SYSTEM(*RMT)	On	No
LAN Server/400 licensed program.	SAVLIB *NONSYS	N/A	Yes
Storage space containing the DCDB; the name of the object is the name of the server followed by a "3".	SAVOBJ OBJ(SRVLS40A3) LIB(QUSRSYS) OBJTYPE(*SVRSTG)	Off	N/A

Chapter 7. AS/400 hardware support for automated tape libraries

This chapter discusses the various types of tape automation that are supported when you use your AS/400 system with BRMS/400.

Originally, the only media library available was the 3494 Automated Tape Library Data Server. However, beginning with V3R1, other library devices, such as the 9427 tape library, 3590 tape library, and most recently, the 3570 Magstar MP tape subsystem, can be attached.

Although the libraries attach to both CISC and RISC systems, only RISC systems fully implement the media library. Functional differences may, therefore, exist on the same library that is being shared by both CISC and RISC systems. We attempt to outline these differences in this chapter and subsequent chapters.

Not all automated tape libraries can be attached to all models of the AS/400 system or used as alternate IPL devices. The announcement letters or your IBM Marketing Representative can provide you the required information.

We recommend that you *always* refer to *Automated Tape Library Planning and Management,* SC41-5309, to obtain latest hardware and software configuration information relevant to the OS/400 release on which you are operating. This book contains updates to the library management functions by their releases and outlines the functional differences between the CISC and RISC OS/400 releases.

7.1 3494 Automated Tape Library Data Server

The 3494 Automated Tape Library Data Server provides automated tape solutions for the AS/400 system user as well as for users of the ES/9000, RISC System/6000, and some non-IBM systems. The 3494 supports the 3490E models C1A and C2A, and the 3590 B1A tape drives.

For additional information on the control unit models and storage unit models, refer to the IBM announcement letters or the *iSeries Handbook*, GA19-5486.

7.1.1 3494 Automated Tape Library Data Server system attachment

The 3494 is attached to the AS/400 system with one connection for the library manager and one or more connections for the tape drives. The library manager connection uses a communications line that can be either EIA-232 or LAN. One communications line on the AS/400 system is required for each 3494. The tape drive connection can be a S/370 parallel channel (Feature #2644) for 3490E or SCSI attachment for 3590.

The Electronic Communications Support (ECS) adapter on the AS/400 system should not be used to support the 3494. It is reserved for obtaining electronic customer support.

7.1.2 Connection considerations

When calculating the maximum interface distance between the 3494 Automated Tape Library Data Server and the AS/400 system, you must consider both connections.

7.1.2.1 RS232

The RS232 connection allows the AS/400 system to talk to the 3494 through the Library Manager PC that comes with the 3494. The 3494 EIA-232 communications cable (Feature #5211) has a limit of 50 feet, unless modems are used to boost the signals. Feature #5213 provides a 400-foot cable for the RS232 attachment.

The 3494 may be shared between eight AS/400 systems attached through the Library Manager using RS232. An expansion attachment card (Feature #5229) is required to support the fifth through eighth RS232 connections and the fifth through eighth tape control units.

7.1.2.2 LAN

The 3494 can be attached to the AS/400 systems through the Library Manager using either a token-ring LAN (uses Feature #5219) or an Ethernet LAN (uses Feature #5220). Both TCP/IP and APPC connections are supported by the 3494, but only APPC is supported by the AS/400 system. The 3494 LAN communications cable limit is determined by the type of LAN implemented. Typical LAN technology supports connections at a distance of up to 1000 meters.

If attaching through LAN, the 3494 can be shared between 16 AS/400 systems. Appendix C, "Example LAN configuration for 3494" on page 303, provides an example line, controller, and device configuration for attaching the 3494 to the AS/400 through a token-ring.

The Tape Control Unit Expansion (feature #5228) expands the number of tape control units that can be attached to the Library Manager. One feature converts four RS232 host processor connections into four tape control unit connections on either the base Library Manager or the expansion attachment card (feature #5229). The following combination is possible:

```
          Available    Available
Number    RS-232 ports Tape
of #5228  (for direct  Control Unit
Features  host attach) Connections  Additional Features Required
--------  ------------ ------------  ------------------------------
   0           4            4        None
   0           8            8        #5229 Expansion Card
   1           0            8        #5219 (#5220) LAN adaptor
   1           4           12        #5229 Expansion Card
   2           0           16        #5229 AND #5219 (#5220)
```

The Remote Console Feature (Feature #5226) provides the capability of controlling and monitoring the status of up to eight 3494s from a remote location. The console can be password protected.

7.1.3 3494 Automated Tape Library Data Server: Multiple systems

The 3494 can be shared by AS/400 systems, RS/6000 systems, and ES/9000 systems (a total of 16 systems). Other non-AS/400 systems share the library by partitioning the 3494 by assigning each cartridge to a specific category. The categories used by the AS/400 system are *SHARE400 and *NOSHARE, which equate to *YES and *NO on the Shared Media parameter of Media Class. These cartridges can only be used by AS/400 systems and cannot be accessed by non-AS/400 systems that are sharing the 3494.

The common media inventory function of BRMS/400 manages the *NOSHARE cartridges and the sharing of *SHARE400 cartridges between any of the attached AS/400 systems.

Note

*NOSHARE cartridges may only be changed by the *owning* system and can only be seen with the WRKMLMBRM command by the owning system.

7.1.4 Alternate IPL support for the 3494

The 3494 device can be used as an alternate IPL (Alt IPL) device on the AS/400 system. This task requires that correct device addresses are set. Your IBM Service Engineer sets the correct hardware configuration settings on your 3494 and the AS/400 system.

Note

With CISC AS/400 systems, you cannot use the 3590 tape as your preferred IBM distribution medium for obtaining PTFs, licensed programs, or an OS/400 release. However, you are allowed to use the 3590 device as your Alt IPL device through ordering a Request for Price Quotation (RPQ). See 7.3.1, "Alternate IPL for the 3590" on page 154, for more information on the RPQ.

For RISC AS/400 systems, the 3590 is fully supported as your preferred distribution medium and as an Alt IPL device.

7.2 9427 tape library

The 9427 tape library is a 20-cartridge tape library based on the 8mm helical scan technology. It is available in two models (9427 tape library models 210 and 211). Model 210 is a stand-alone version of the tape library, and model 211 is the rack-mounted version.

The 9427 tape library supports up to two 7 GB, 8mm drives. It includes a barcode reader that reads the labels on the cartridges to determine the cartridge identifier without the need to load the cartridges in the tape drives. Unlike the 3494, the 9427 tape library does not have an input/output slot.

The 7 GB tape drive is based on the 7208 half-high product. Hardware changes were made to support the 160 meter tape media. The 160 meter tape media is required for 7 GB (uncompressed) data storage. The Initialize Tape (INZTAP) command supports the new density type of *FMT7GB for the 160 meter tape. The 160 meter tape media cannot be written to or read by the 7208 models 002, 012, and 232. The 7 GB drive also supports 112 meter tapes with formats *FMT2GB and *FMT5GB.

Tape library commands and support are provided by OS/400 from V3R1. BRMS/400 is the preferred application program that assists with tape library manager and unattended operations.

7.2.1 Alternate IPL support for the 9427

The 9427 tape library can be used as an alternate IPL (Alt IPL) device on the AS/400 system. This task requires that correct device addresses are set. Your IBM Service Engineer sets the correct hardware configuration settings on your 9427 and the AS/400 system.

The 9427 tape library must be put in the sequential mode where it acts as an automated cartridge loader, when using it as an alternate IPL device. See *IBM 9427 210 and 211 Operator's Guide*, SA26-7108, for information on how to set the 9427 tape library in sequential mode.

Note

The cartridges are loaded from the bottom up. Tape cartridges must be mounted in the 9427 tape library magazine in the correct order. The first data cartridge of the installation must be placed in the first slot for the 9427 tape library drive.

7.3 3590 with automated cartridge facility

The 3590 tape drive uses high-capacity, 128-track bi-directional recording and can store up to 10 GB per cartridge. With the Lempel Ziv (LZ1) data compaction algorithm, the capacity can increase up to 30 GB of data on a single cartridge depending on the type of data you have. The 3590 model B11 is a rack mounted tape device that includes a 10-cartridge automatic cartridge facility that can be used in random mode as a mini-library providing up to 300 GB of unattended storage.

The 3590 with automated cartridge facility operates as an Random Access Cartridge Loader (RACL) with the following features:

- Contains up to 10 cartridges in a removable magazine
- One 3590 tape device
- Two host attachments

The 3590 model B1A device is used to attach the drive in a 3494.

7.3.1 Alternate IPL for the 3590

The 3590 can be used as an alternate IPL (Alt IPL) device on the AS/400 system. Your IBM Service Engineer sets the correct hardware configuration settings on your 3590 and the AS/400 system.

> **Note**
>
> For CISC Systems, you must order RPQ 843860. This RPQ provides
> instructions on how to set up your 3590 as an alternate IPL device and
> provides the Model Unique Licensed Internal Code (MULIC) tape and Feature
> Unique Licensed Internal Code (FULIC) tape. The MULIC tape is for AS/400
> systems (Models B through F). The FULIC tap is for Advanced Series AS/400
> systems (Models 2xx through 3xx). You do *not* always need the MULIC or
> FULIC tapes. See the *Backup and Recovery - Advanced*, SC41-4305, for
> additional information. You also cannot use the 3590 device as your preferred
> IBM software distribution media for obtaining PTFs, software releases, or
> licensed programs.
>
> AS/400 systems using PowerPC technology (RISC) do not require MULIC or
> FULIC tapes. You can use the 3590 as your preferred IBM software distribution
> media.

7.4 3570 Magstar MP tape library

The IBM 3570 Magstar MP tape library model B01/B11 is based on the IBM
Magstar technology used for the 3590 tape device. The 3570 Magstar MP tape
library is designed to provide the midrange systems with a tape solution with a
lower price than the 3590 tape device. The device performance is 2.2 MB native
and up to 6.6 MB with LZ1 compaction. The 3570 Magstar MP tape subsystem
uses a new and unique data cartridge that is approximately half the size of the
3480/3490/3590 cartridges. The capacity is 5 GB per cartridge and up to 15 GB
per cartridge with LZ1 compaction. The 3570 Magstar MP tape library is designed
to operate with two 10-cartridge magazines providing random access to 100 GB
to 300 GB of data. In addition to the data cartridges, a cleaner cartridge is stored
in the subsystem and is available for automatic cleaning of the tape device.

The 3570 Magstar MP tape library models use a cassette loading and transport
mechanism (priority slot) to automatically transport the tape cassettes to and
from the cassette magazines and the tape drive.

7.4.1 Managing cassettes and magazines for the 3570

When the 3570 Magstar MP tape library is attached to the RISC AS/400 systems
in *random mode*, you can insert a cassette in the import/export slot, and the
transport loader takes the cassette and inserts it in the tape drive if the user
invokes a command on the AS/400 to use the cassette. When the tape drive has
finished processing the cassette, the transport loader puts the cassette into an
available slot in the magazine depending on the cartridge category. When you
eject the cassette, it ejects from the slot and BRMS/400 movement performs the
eject through the import/export slot to complete the movement. You must ensure
that an operator is available to take out the cassettes as they are being ejected. If
you are running in an unattended mode, you receive a message on QSYSOPR
message queue indicating that the storage slot is full if you have more than one
cassette. All of the remaining movements of the cassettes are queued until the
slot is freed up. Your job performing the moves will not complete until all of the
required cartridges are ejected.

On the CISC AS/400 systems, this slot is referred to as the *convenience slot* (the drive, and the documentation for the drive refer to this slot as the priority slot). When you insert a cassette in the priority slot, the transport loader takes the cassette and inserts it in the tape drive. When the tape drive has finished processing the cassette, it ejects it back in the same priority slot. The cassette does not use one of the available slots in the magazine. Until you remove the cassette or re-insert the cassette, the priority slot cannot be used for other operations. During the BRMS/400 media movement, the ejects do not schedule the cassettes to be removed one-by-one using the priority slot. The cassettes remain in the magazine, and you have to manually remove them by opening the library door. The library will always re-inventory the cassettes when the library door is closed.

In both the preceding cases, the 3570 was set up in random mode. If you use the automatic cartridge loader (ACL) mode, the cassettes inserted using the priority slot or the import/export slot are inserted in one of the empty slots in the magazine. You should be in the ACL mode when you want to recover from your SAVSYS tapes.

7.4.2 Alternate IPL support for the 3570

The 3570 can be used as an alternate IPL (Alt IPL) device on the AS/400 system. The system should be in the automatic cartridge loader (ACL) mode for this. Your IBM Service Engineer sets the correct hardware configuration settings on your 3570 and the AS/400 system.

> **Note**
>
> Alternate IPL support for the 3590 is available on all RISC AS/400 systems and the Advanced Series CISC AS/400 systems (Models 2xx through 3xx). The support on CISC AS/400 systems is only available through RPQ 843910. This RPQ ships IBM service instructions for attaching the 3570 as an alternate IPL device and FULIC tape. You cannot obtain any IBM software distribution on the 3570 cassette, such as PTFs, OS/400 releases, and licensed programs.

Chapter 8. AS/400 software support for automated tape libraries

This chapter discusses the software support for tape automation on the AS/400 system.

The original media library was the 3494. However, beginning with V3R1, support was added to OS/400 for library devices such as the 9427 tape library, the 3590 tape device, and most recently the 3570 Magstar MP tape subsystem.

AS/400 with 64-bit PowerPC technology (RISC) fully implements the media library that gives greater flexibility to OS/400 to manage resources. However, it introduces some considerations for BRMS/400, especially managing location, media policies, and defining backup devices. As always, using the *MEDCLS parameter in BRMS/400 for a backup device is the most flexible.

Another significant change in RISC is that the Media Library Device Driver (MLDD) code is no longer required for the 3494.

Customer scenarios evolve to different combinations of architecture and function. To attempt to cover each possibility (and to remain current) is not within the scope of this redbook.

The following chapters describe the functional areas of media library support. You should refer to *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171), for each release, and to the most current edition of *Automated Tape Library Planning and Management*, SC41-5309, for detailed information.

There are also BRMS/400 workshops and support from IBM Availability Services personnel. Check with your marketing representative for further information.

8.1 Software support for automated tape libraries

The total AS/400 solution for automated tape libraries is made up of the following components. See Figure 110 on page 158 for how these components interrelate.

BRMS/400
BRMS/400 manages the media. It submits tape operations to the appropriate interface as a result of a BRMS/400 command or as part of the BRMS/400 control group process.

OS/400 CL commands and APIs
OS/400 manages the tape drives by providing functions such as varying on, varying off, and read and write operations. It also provides the native library XXXTAPCTG commands that are available to drive the media libraries independently of BRMS/400. All BRMS/400 commands are translated into native OS/400 commands internally.

Media Library Device Driver (CISC only)
Media Library Device Driver (MLDD) is only required on the AS/400 CISC systems when you have a 3494. The MLDD code translates BRMS/400 and OS/400 command requests to the Library Manager of the 3494. These requests, such as mount volume, are sent over a communications link from an AS/400

system to the 3494. On AS/400 RISC systems, these functions are incorporated into the licensed internal code.

The MLDD software is shipped with the 3494 and is installed using the Restore Licensed Program (RSTLICPGM) command. As a result, two libraries are created: QMLD and QUSRMLD. The QMLD library contains commands and programs. The commands are loaded into QSYS at installation time. The QUSRMLD library contains user system configuration information. In addition to the two libraries, a subsystem, QMLDSBS, is created.

Since the newest modification level of the MLDD and LM software contains all of the known fixes from the previous levels, we highly recommend that you upgrade these products when you upgrade OS/400.

To check what fix level you installed for the LM code, go to the Library Manager PC in the 3494 and on the display, select **Help**. Then select the **About** option. This displays your current level of LM software.

For information on new releases of the microcode (MLDD and LM), consult with your country hardware second-level support. They can pass the request to the 3494 trained hardware engineers.

Library Manager
The Library Manager (which is effectively a PC) is located inside the 3494. It manages the 3494 inventory and provides the interface to the accessor, or robot, to make it functional. The software code is installed and maintained by IBM Customer Engineers. See 8.4, "Library Manager for the 3494" on page 160, for additional information.

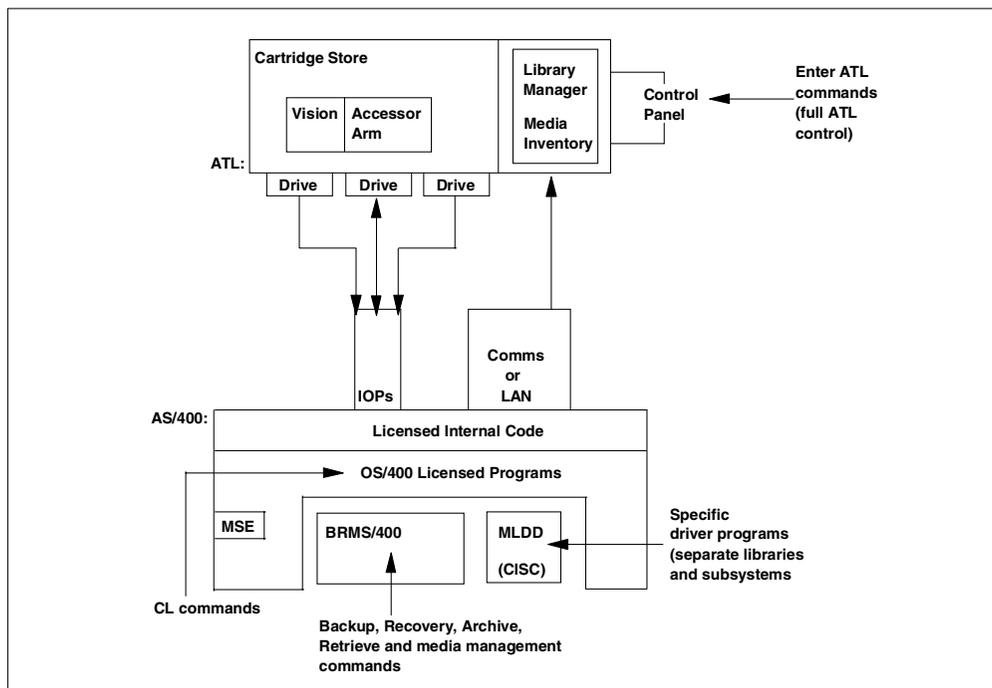Figure 110 shows the components that are involved.

Figure 110. Overview of the automated tape library components

8.2 AS/400 with IMPI technology (CISC)

V3R1 saw the introduction of Media and Storage Extensions (5763-SS1, Option 18). In this release, new media library devices were also added to OS/400. With the new media library device, a number of new OS/400 commands are added to work with cartridges and categories for tape automation. The tape commands are issued to the tape devices (9427 tape library, 3590 with automated cartridge facility, and 3570 Magstar MP tape subsystem). OS/400 continues to use MLDD for the 3494 Automated Tape Library Data Server (Figure 111).
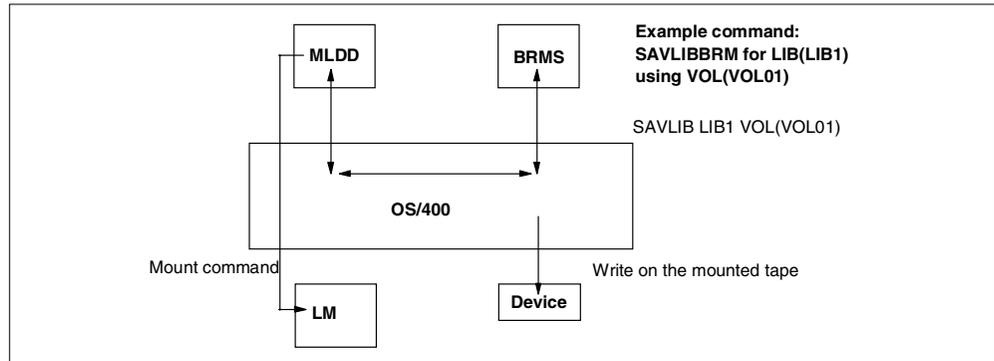

Figure 111. V3R1 or V3R2: OS/400 splits the command into MOUNT and SAVLIB

V3R2 works in the same way as V3R1 in that tape commands are issued to the tape device and OS/400 uses MLDD for the 3494.

Another difference with CISC AS/400 systems is that you have to use the Display Tape Status (DSPTAPSTS) command or the Work with Library Media using BRM (WRKMLMBRM) command to manage your tape libraries. You do not have a single command interface, such as the Work with Media Library Status (WRKMLBSTS) command, available with RISC AS/400 systems.

8.3 AS/400 with 64-Bit PowerPC technology (RISC)

V3R6 represents the total integration of tape automation for the AS/400 system. Media library devices are now fully functional devices with configurations and resources. All OS/400 commands for tape and cartridges now use the media library device. The 3494 solution complexity has been reduced. The 3494 media library device driver (MLDD) application and the corresponding subsystems are no longer required because the functions are now handled by OS/400 (Figure 112 on page 160). These enhancements allow for multi-user environments and restricted state tape processing. New commands, such as WRKMLBSTS and Configure Media Library Device Description (CFGDEVMLB), are available to support your tape libraries.
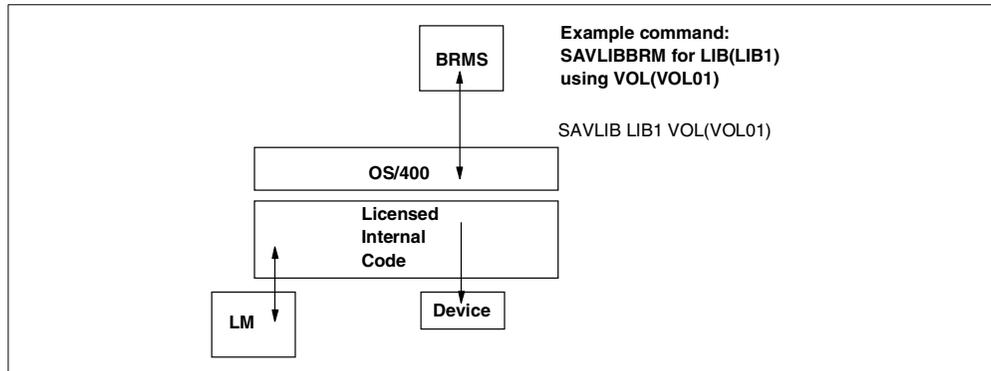
```
                                          Example command:
                                  BRMS    SAVLIBBRM for LIB(LIB1)
                                          using VOL(VOL01)

                                          SAVLIB LIB1 VOL(VOL01)

                          OS/400

                          Licensed
                          Internal
                          Code

                   LM                Device
```

Figure 112. V3R6 LIC processes the MOUNT command instead of MLDD

V3R7 provides the same functions as V3R6. There are some ease-of-use
enhancements to the WRKMLBSTS command.

8.4 Library Manager for the 3494

Library Manager (which is effectively a PC) is integrated in the 3494 Automated
Tape Library Data Server. In normal use, Library Manager is transparent to users.
However, it is possible to operate the 3494 to mount and demount cartridges
without OS/400 commands using the *stand-alone device mode*. You can select
this mode from the library manager display in the back of the 3494. The following
sections document how you can mount and demount cartridges. You must also
be in the stand-alone mode when you are recovering from your SAVSYS tapes.

Note

When you use the stand-alone mode of operation with the AS/400 RISC
systems, you have to use the tape device description (TAPxx) and not the tape
library device description (TAPLIBxx or TAPMLBxx) to address the drive.

Within BRMS/400, you can use the WRKMLBBRM command to put the device
on hold if you want to use the library in a stand-alone mode.

8.4.1 Mounting a single volume from the 3494

This section shows you how to mount a single volume from the 3494. Follow
these steps:

1. To select the manual mount and demount of the cartridges, from the menu bar,
   select **Commands->Stand-alone device->Setup stand-alone device** as
   shown in Figure 113. The Setup Stand-alone Device display appears as
   shown in Figure 114.
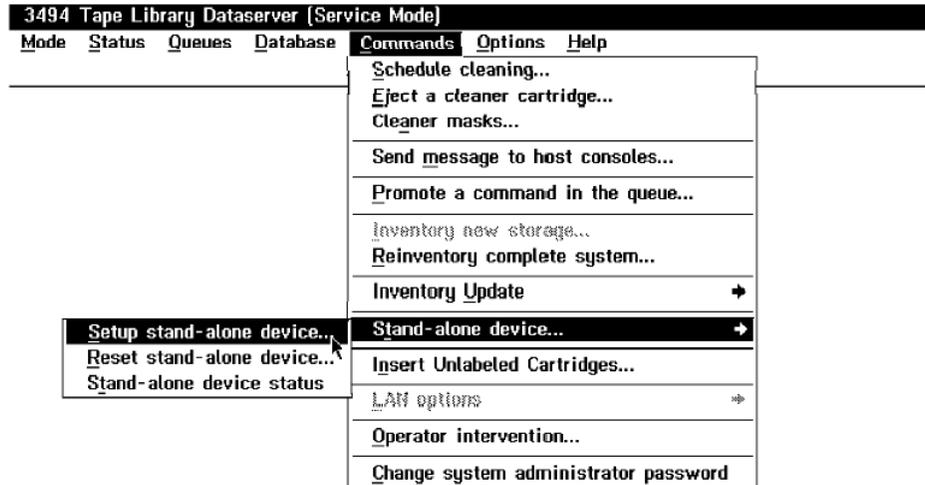
Figure 113. Commands pull-down window
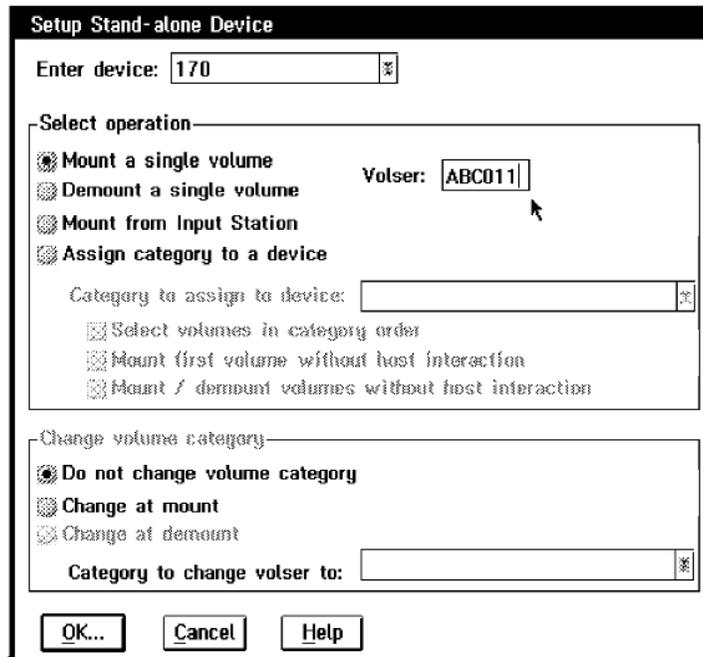
Figure 114. Setup Stand-alone Device window

2. On this window, choose one of the following options:

   - Click the arrow to the right of the box, and select the 3-digit device name.
   - Enter the 3-digit device name.

3. Select the **Mount a single volume** operation.

4. In the Volser field, enter the volume ID of the SAVSYS tape that contains the Licensed Internal Code tape.

Once the mount operation is requested, the Stand-alone Device Status window is shown. This window displays the library manager activity, as shown in the example in Figure 115 on page 162.

Figure 115. Mount complete window

8.4.2 Demounting a single volume from the 3494

When a new cartridge is required, you must demount the cartridge, using the Demount a single volume command, or you can select the Reset stand-alone device operation shown in Figure 120 on page 164. Specify the tape drive by number. Once the demount operation is finished, you see the Library Manager window shown in Figure 116.
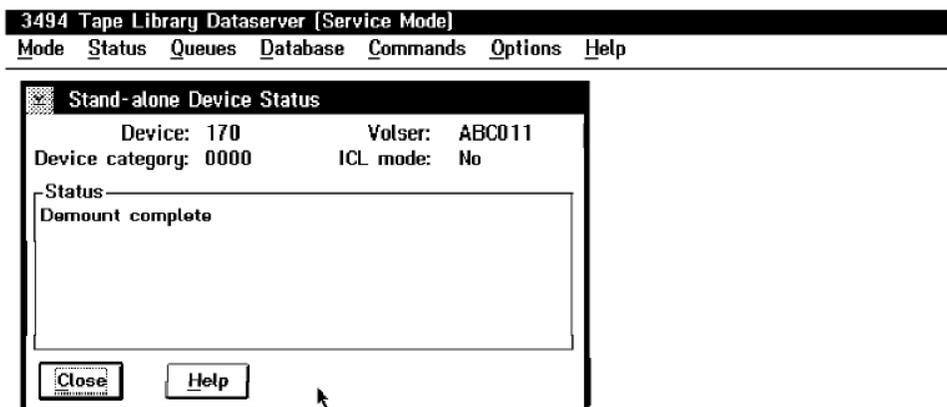
Figure 116. Stand-alone Device Status window

After the demount completes, you can select the mount of another cartridge using the stand-alone mode shown in Figure 114 on page 161.

8.4.3 Mounting a cartridge from the convenience I/O station

To mount a cartridge from the convenience I/O station of the 3494 and move it back to the convenience station after use, you have to select the transient mode. This mode is required if the cartridges you want to mount and process are not labeled (for example, MULIC, PTF, or software upgrade cartridges) or you want to use labeled cartridges, but they should not be placed inside the 3494 after use.

1. From the menu bar, select **Commands->Stand-alone device->Setup stand-alone device** as shown in Figure 113 on page 161.
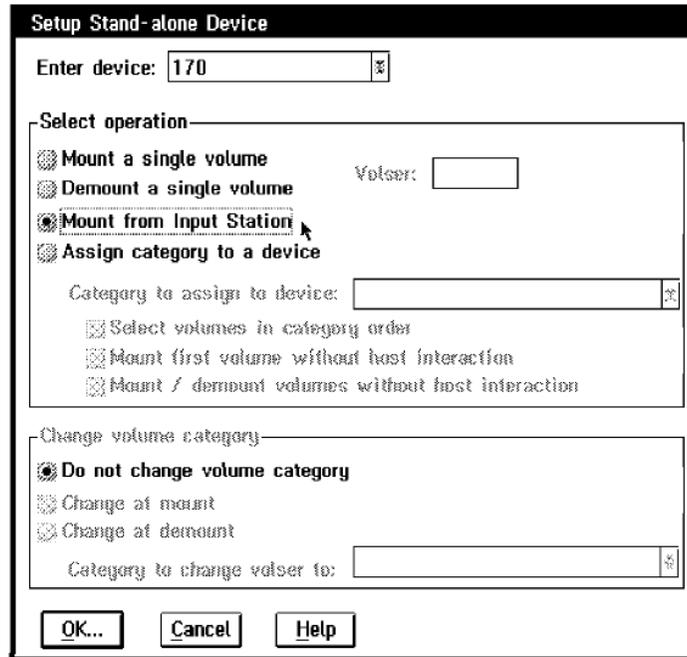
Figure 117. Setup transient mode on the Setup Stand-alone Device window

2. From this window (Figure 117), perform either of the following options:

   - Enter the 3-digit device name as known by the library manager.
   - Click the arrow to the right of the box, and select the 3-digit device name by clicking it.

3. Select the **Mount from Input Station** operation.

4. Click the **OK** button.

The Mount from Input Station window in Figure 118 shows where you find the instructions on how to continue the transient mode.
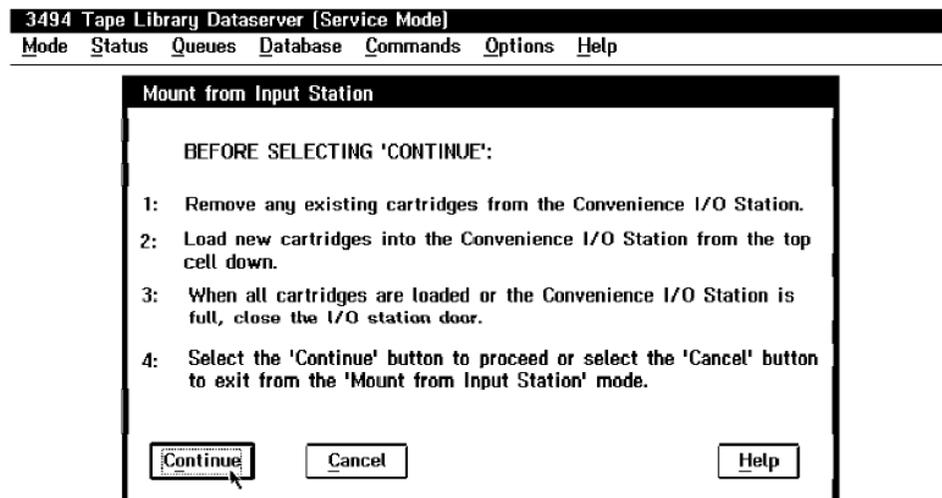
Figure 118. Mount from Input Station window

Once the mount operation is requested, the Stand-alone Device Status window is shown. This window displays the library manager activity as shown in Figure 119.
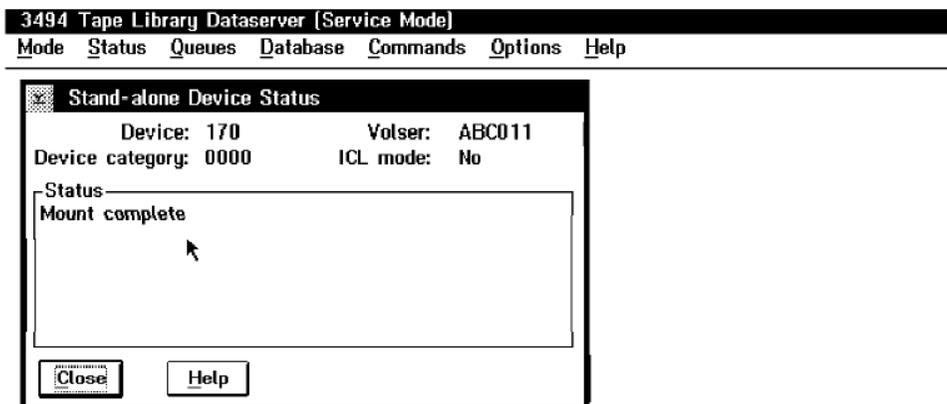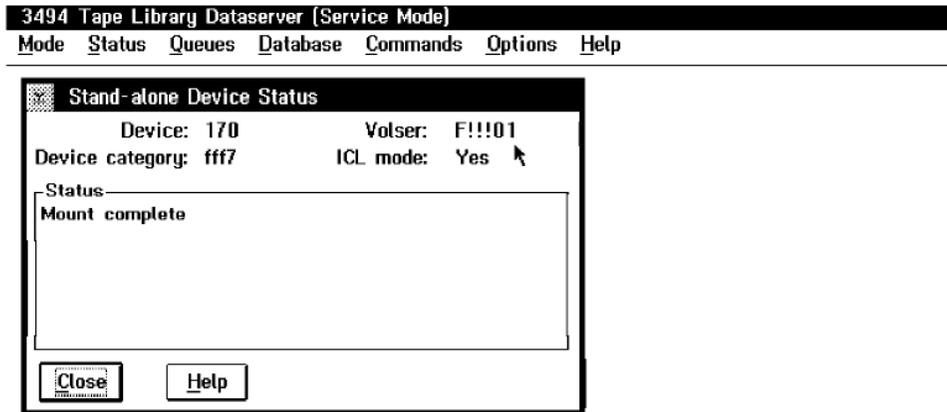
Figure 119. Mount complete window

Note: The Volume ID of the cartridge is not displayed in the window.

8.4.4 Resetting the stand-alone mode

When you are finished using the stand-alone mode, reset it. For the 3494 Automated Tape Library Data Server, select the **Reset stand-alone device** operation shown in Figure 120. Specify the tape unit by number.
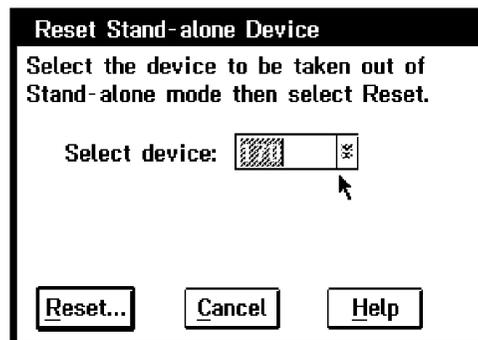
Figure 120. Reset Stand-alone Device window

The Reset stand-alone device operation unloads the mounted cartridge from the selected device and makes the device ready for tape automation.

Chapter 9. Implementing automated tape libraries

This chapter discusses some of the actions required to set up automated tape libraries in BRMS/400. It describes the OS/400 commands that relate to these libraries and the management of cartridges within them.

9.1 Configuring the 3494 Automated Tape Library Data Server for CISC

The 3494 differs from other libraries because it also requires separate communications. To configure communications, use the Add Media Library Device (ADDMLD) command.

Three jobs control communications to the 3494:

- **QMLMAIN**: Converts AS/400 system MLDD commands to library manager commands.
- **QMLCOM**: Contains the communications link program.
- **QMLTRACE**: Logs the 3494 Automated Tape Library Data Server trace details.

Figure 121 shows the Work with Active Jobs display with the 3494 Automated Tape Library Data Server communications jobs running in the QMLDSBS subsystem.

```
                        Work with Active Jobs
                                                      MM/DD/YY  00:00:00
   CPU %:    5.1     Elapsed time:   00:01:57     Active jobs:   40


   Type options, press Enter.
     2=Change   3=Hold   4=End    5=Work with   6=Release   7=Display message
     8=Work with spooled files   13=Disconnect ...


   Opt  Subsystem/Job  User       Type  CPU %  Function        Status
        QMLDSBS        QSYS        SBS    .0                    DEQW
          QMLMAIN      QPGMR       BCH    .0   PGM-QMLMPMAIN    DEQW
          QMLCOM       QPGMR       BCH    .0   PGM-QMLRSMAIN    DEQW
          QMLTRACE     QPGMR       BCH    .0   PGM-QMLTRMAINR   DEQW
```

Figure 121. Work with Active Jobs

The communications line is varied on, and these jobs are started by issuing the INZMLD command.

You can use the End Media Library Device (ENDMLD) command to end the jobs if you need to perform a problem analysis or error recovery. You should use the INZMLD command again to restart them.

After an IPL, or when the system is returned from a restricted state by using the STRSBS QCTL command, this command is automatically re-issued in an autostart job entry that runs when the QMLDSBS subsystem is started.

The MLDD commands operate differently than most other AS/400 commands. They are asynchronous in nature in that you enter the command, and a completion message is sent to a message queue after the requested process has

completed. Most MLDD commands have a message queue name field for you to specify where the completion message is to be sent.

When using BRMS/400 with the 3494, BRMS/400 calls OS/400 commands (that drive all ATLs). Where appropriate, some of these MLDD commands are called by OS/400. Typically, operators and users never have to use the MLDD commands explicitly.

When BRMS/400 performs a SAVSYS operation on CISC AS/400 system, it premounts a cartridge on a 3494 before it ends the MLDD subsystem. This allows the SAVSYS operation to continue under a restricted state. You *should not* end the subsystems to a restricted state using an exit in your backup control group as BRMS/400 automatically premounts one cartridge for you. If your SAVSYS requires more than one cartridge, you must use a different approach. See 9.6, "Restricted state automation for the 3494" on page 189, for a possible solution.

For more information on the MLDD commands, see *Automated Tape Library Planning and Management*, SC41-5309, or *IBM 3494 User's Guide: Media Library Device Driver for the AS/400*, GC35-0153.

9.2 Configuring other media library devices for CISC

For V3R1 and V3R2, you need to use the command:

```
CRTDEVMLB DEVD(TAPMLB01) TAPDEV(TAPxx)
```

Here, *xx* is the device name obtained from the WRKCFGSTS *DEV TAP* command. You can also select your own tape library device name instead of using TAPMLB01.

Figure 122 shows the Create Device Media Library (CRTDEVMLB) display that appears after you press the Enter key.

```
                  Create Device Media Library (CRTDEVMLB)

 Type choices, press Enter.

 Device description . . . . . . . DEVD          tapmlb01
 Tape device  . . . . . . . . . . TAPDEV        tap03
                  + for more values
```

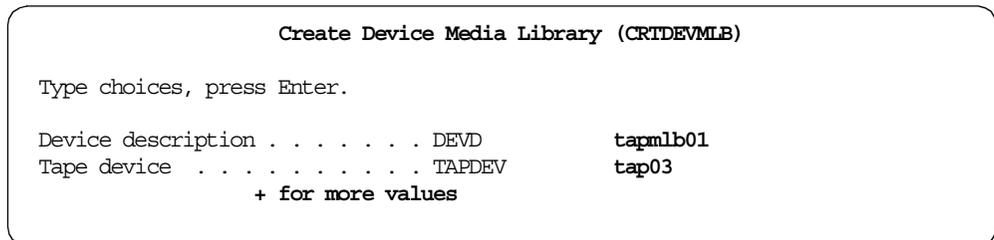*Figure 122. Create Device Media Library: V3R1 and V3R2*

If the 9427 and the 3570 libraries have two tape devices and are attached to a single AS/400 system, *do not* use the CRTDEVMLB command separately for each tape device, but specify both here. If the 9427 or the 3570 library is being shared between two AS/400 systems, each system must have a media library description with one tape device.

After you create the media library device description, you must remember to run the INZBRM OPTION(*DEVICE) command on a V3R2 system, or the INZBRM OPTION(*DATA) command on a V3R1 system to add the media devices into BRMS/400.

9.3 Configuring media library devices for RISC

In V3R6 and V3R7, the media library device descriptions are fully implemented under OS/400 and are required for all library devices including the 3494 Automated Tape Library Data Server. The media library device descriptions are created automatically if auto-configuration is enabled (*YES). They are created as a TAPMLBxx (TAPLIBxx for earlier versions of V3R6) device description, where *xx* is the next available device description number. The tape devices within the library are configured as media library resources (MLBRSCs) with resource names TAPxx. In addition to the media library device description with tape resources, tape device descriptions are created for each tape resource. These tape device descriptions are used for stand-alone operations.

<blockquote>
Note

3494 media library devices cannot be varied on until the ROBOTDEV (robot device) parameter is updated. This parameter refers to the communications line associated with the library manager PC and only applies to the 3494. See 9.3.3, "Creating a Robot Device Description (ROBOTDEV) for the 3494" on page 170, for details.
</blockquote>

9.3.1 Determining resource names

Creating the media library device description for all media library devices requires you to know the resource name. This is only required when you have the automatic configuration system value (QAUTOCFG) turned off.

The DSPHDWRSC *STG command provides the resource names associated with the tape libraries, controllers, and devices (Figure 123 on page 168).

```
                    Display Storage Resources
                                                    System:    SYSTEM01
 Type options, press Enter.
   7=Display resource detail    9=Display associated resources

 Opt   Resource        Type  Status              Text
   _   SI02            2621  Operational         Storage Controller
   _     TAPMLB01      9427  Operational         Tape Library
   _   SI04            2624  Operational         Storage Controller
   _     DC07          6390  Operational         Tape Controller
   _     DC06          6390  Operational         Tape Controller
   _   SI05            2644  Operational         Storage Controller
   9     TAPMLB02      3494  Operational         Tape Library
```

Figure 123. Display Storage Resources

Library names are automatically allocated by the system beginning with
TAPMLB01 and continuing with TAPMLB02 and so on as shown in Figure 123.

You can select option 9 to view resources. When you do, the Display Associated
Resources screen appears (Figure 124).

```
                    Display Associated Resources
                                                    System:    SYSTEM01
 Type options, press Enter.
   5=Display configuration descriptions    7=Display resource detail

 Opt   Resource        Type-Model  Status          Text
   _   TAPMLB02        3494-010    Operational     Tape Library
   _     TAP07         3490-C2A    Operational     Tape Unit
   _     TAP06         3490-C2A    Operational     Tape Unit
```

Figure 124. Display Associated Resources

9.3.2 Creating media library device descriptions

You need to create the media library device description for all the media library
devices if QAUTOCFG is turned off. You can use the CRTDEVMLB command as
follows:

CRTDEVMLB MLB(TAPMLB01) RSRCNAME(TAPMLB01) DEVCLS(*TAP)

Figure 125 shows the Create Device Description for Media Library
(CRTDEVMLB) command display that is shown after you press the Enter key.

```
                    Create Device Desc (Media Lib) (CRTDEVMLB)

 Type choices, press Enter.

 Device description . . . . . . .  TAPMLB01        Name
 Device class . . . . . . . . . .  *TAP            *OPT, *TAP
 Resource name  . . . . . . . . .  TAPMLB01        Name, *NONE
 Device type  . . . . . . . . . .  *RSRCNAME       *RSRCNAME, 3494, 3495, 3590...
 Online at IPL  . . . . . . . . 1  *YES            *YES, *NO
 Unload wait time  . . . . . . .   *SYSGEN         *SYSGEN, 1-120
 Maximum device wait time . . . 2  *SYSGEN         *SYSGEN, *NOMAX, 1-600
 Generate cartridge ids . . . . 3  *VOLID          *VOLID, *SYSGEN
 Robot device description . . . 4  *NONE           Name, *NONE
 Message queue  . . . . . . . . .  QSYSOPR         Name, QSYSOPR
   Library  . . . . . . . . . . .  *LIBL           Name, *LIBL, *CURLIB
 Text 'description' . . . . . . .  MLB DEVICE DESCRIPTION




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

Figure 125. Creating a device media library: V3R6 and V3R7

The reverse bold numbers that follow correspond to the reverse bold numbers shown in Figure 125:

1 If the 3494 is auto-configured, it is auto-configured ONLINE(*NO) because you should not attempt to vary it on until the ROBOTDEV parameter is filled in correctly. For all other non-3494 tape libraries, the CRTDEVMLB sets the ONLINE parameter to *YES.

For the 3494, you have to use the CFGDEVMLB command to define the communications link. See 9.3.3, "Creating a Robot Device Description (ROBOTDEV) for the 3494" on page 170, for details.

2 On AS/400 RISC systems, you issue such commands as SAVLIB to the media library device. The media library device chooses the tape resource for you if one is available. OS/400 queues requests until an appropriate tape resource becomes available. The default is to wait for one minute, as specified by *SYSGEN in the Maximum device wait time parameter (MAXDEVTIME). If a tape resource is not available, you receive a message on QSYSOPR indicating that the tape resource is not available.

The MAXDEVTIME parameter specifies the maximum number of minutes a request will wait for allocation of a tape resource. If the time is reached, a message is sent to QSYSOPR indicating device allocation time-out. If you specify a value other than *SYSGEN, such as 120 minutes, OS/400 will queue your tape resource request until a maximum of 120 minutes before sending a message to QSYSOPR. The help text in V3R6 is misleading for this parameter and suggests (wrongly) that this is the amount of time that the tape remains loaded. See 9.3.5, "Allocating resources" on page 174, for more details on resource allocation.

Specifying a value of *SYSGEN means that i1.DFTWAIT, the default wait time of the job attributes, is used instead of a global value for all users using this particular media library device. You can view the Default wait time (DFTWAIT) value by running the Display Job (DSPJOB) command. DFTWAIT time is specified as 30 seconds, but tape management rounds this to the nearest

minute so the minimum wait time is actually one minute. The *SYSGEN value allows batch jobs and interactive jobs to run with a different wait time. You should avoid using a value of *NOMAX for the maximum device wait time parameter.

3 The Generate cartridge identifiers field is only valid for media library devices that do not have vision systems or barcode readers for reading cartridge labels (for example, the 3590 tape device and the 3570 Magstar MP tape subsystem).

When an inventory change is detected and *VOLID is specified, the media library device loads all tape volumes to attempt to read the volume identifiers from the media. This is fast on the 3570 Magstar MP tape subsystem, but it can take approximately 10 minutes for a full library on the 3590 tape device.

Non-labeled tapes, blank tapes, cleaning tapes, and error situations result in system-generated cartridge identifiers.

The value *SYSGEN means that cartridges are not loaded but are assigned system generated cartridge ID. This can cause confusion with BRMS/400, which manages media using VOLIDs. Therefore, this value is not recommended for use with BRMS/400. The default value of *VOLID is appropriate for BRMS/400.

To learn how to set up the tape devices, see 7.3, "3590 with automated cartridge facility" on page 154, for the 3590 with automated cartridge facility, and 7.4, "3570 Magstar MP tape library" on page 155, for the 3570 Magstar MP tape library.

4 The CRTDEVMLB command is used for all media library devices, but the Robot Device Description parameter only applies to the 3494.

9.3.3 Creating a Robot Device Description (ROBOTDEV) for the 3494

The 3494 requires a communications interface for the library functions. The communication interface can either be RS232 or LAN. Before the 3494 media library device can be varied on, the communication interface needs to be specified in the ROBOTDEV parameter in the media library device description.

The Configure Device Media Library (CFGDEVMLB) command connects the media library device description with the communication interface for media library devices. The CFGDEVMLB command configures the necessary communication information based on the input to the command, updates the necessary information in the device description specified, and attempts to vary on the media library device description.

The CFGDEVMLB command must be issued once for each media library device description that uses a communication interface, although one line, controller, and device description is actually used for each Library Manager PC.

9.3.3.1 Creating an RS232 configuration

To configure the ROBOTDEV parameter for a media library device using an RS232 interface, use the following command as an example:

```
CFGDEVMLB DEV(TAPLIB01) ADPTTYPE(*RS232) RSRCNAME(CMN01)
```

This creates the line, controller, and device description under the line resource called CMN01. Figure 126 shows the Configure Device Media Library

(CFGDEVMLB) display. To determine the correct resource name that should be used for this command, use the command:

```
WRKHDWRSC TYPE (*CMN)
```

```
                Configure Device Media Library (CFGDEVMLB)

 Type choices, press Enter.

 Library device . . . . . . . . . > TAPLIB01          Name, F4 for list
 Adapter type . . . . . . . . . .   *RS232               *RS232, *LAN
 Communication resource name  . . > CMN01         Name




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

Figure 126. Configure Device Media Library - RS232

Note

The RS232 line, controller, and device descriptions are created with ONLINE(*NO). Do *not* vary them on. They are varied on as needed internally by OS/400 when the tape media library is varied on.

9.3.3.2 Creating the LAN configuration

To attach your 3494 to the AS/400 system through LAN, you need to perform the following steps in order:

1. On the AS/400 system, create a LAN line description. In our example, we use a token-ring as our LAN interface, and it is called TRN3494. See Appendix A, "Summary of changes" on page 289, for a sample description. You do not need to create the APPC controller or the APPC device descriptions. These are created automatically by the Configure Device Media Library (CFGDEVMLB) command.

2. If you have already set up your 3494 Library Manager, go to step 3 on page 172. If you have not set up your 3494 Library manager, perform the following tasks:

   a. On the AS/400, enter:

      ```
      DSPLANMLB LIND(TRN3494)
      ```

      You will see a display similar to the example in Figure 127 on page 172.

```
                   Display LAN Media Library Information

Use the following information from the system to configrue the library manager
console. Select APPC as the communication protocol.


Host transaction program name . . . . . " "QMLD/QMLDSTRCC"
Host network ID . . . . . . . . . . . :    APPN                 1
Host location name. . . . . . . . . . :    SYSTEM01             2
Host adapter address. . . . . . . . . :    40101010101"         3
```

Figure 127. Display LAN Media Library Information

> b. Write down the following values from the Display LAN Media Library
>   Information. Write down the values for the following reverse bold numbers
>   that correspond to the reverse bold numbers shown in Figure 127:
>
>   - **1** Host network ID . . . APPN
>   - **2** Host location name . . SYSTEM01
>   - **3** Host adapter address . 40101010101
>
>   **Note**: These are sample values. Change these to meet your installation
>   requirements.
>
> c. Go to your 3494 Library Manager PC, and select the **Commands** option
>   from the menu bar.
>
> d. Select **Add LAN Host**, and add host (your AS/400) information using the
>   values obtained from the DSPLANMLB command in step b.

3. On the Library Manager PC, select **Commands** from the menu bar.

4. Select **LM LAN Information**. Make note of the following information:

   - Library Location Name **4**
   - Adapter Address **5**
   - On the AS/400, use the CFGDEVMLB command to configure the robot name
     (ROBOTDEV) as follows:

CFGDEVMLB DEV(TAPMLB01)	Sample library device name.
ADPTTYPE(*LAN)	
LIND(TRN3494)	Line name created in step 1.
RMTLOCNAME(APPN.MLD01)	Information obtained from step 4 **4**.
	APPN is the network ID on the AS/400.
ADPTADR(11221122112)	Sample adapter address for the Library Manager
	obtained in step 4 **5**.

Hint

The CFGDEVMLB command will automatically vary on the line, controller,
and device description for you.

9.3.4 Changing media library device descriptions

If your installation has different standards, or if you need to preserve naming
conventions, you may need to change the device descriptions to a common set
across the attached network of systems. We recommended that you standardize

unique descriptions for your tape devices and configure each system to use those descriptions.

For BRMS/400 to work optimally with movement and shared devices, the device name on each AS/400 system *must* be the same. For example, TAPMLB01 on SYSTEM01 must be the same physical library as TAPMLB01 on SYSTEM02.

This can be accomplished easily by taking into consideration the points that are presented in the following sections.

Important

Whenever you make changes to the media library device descriptions, it is important that you make the changes in BRMS/400 to reflect the correct storage location in the media policies, move policies, device descriptions, and system policies.

9.3.4.1 Changing the device description on CISC

For V3R1 and V3R2, the media library device description is a partial implementation. To change the media library device description for the 9427 tape library, the 3590 tape device, and the 3570 Magstar MP tape subsystem, the old description is deleted with the Delete Device MLB (DLTDEVMLB) command. Then a new description is created with the Create Device MLB (CRTDEVMLB) command.

The 3494 Automated Tape Library Data Server uses MLDD for adding and removing the device. To change the 3494 Automated Tape Library Data Server MLD name, end MLDD (ENDMLD), remove the old MLD device (RMVMLD), and add the new one (ADDMLD). Initialize MLDD and begin using the new device name. For more information on the MLDD commands, see *IBM 3494 User's Guide: Media Library Device Driver for the AS/400*, GC35-0153.

Note

If the Autocreate Controller parameter on the LAN line description is set to *YES, you receive a configuration error when you use the ADDMLD command, because it automatically creates the controller description before you have the chance to create the new description yourself. This happens when you wait too long between the RMVMLD command and the ADDMLD command.

For a LAN-attached 3494 Automated Tape Library Data Server, MLDD requires the library device description to be in the form MLDxxxxx. Do not use the same name for the media library device description and the Library Manager remote location name. This results in a duplicate device description error.

For V3R1 and V3R2, the tape library commands (WRKTAPCTG, DSPTAPSTS, and so on) are issued with the media library device specified. However, tape commands (SAVLIB, SAVCHGOBJ, and so on) are issued with the tape device specified. To change the tape device description, use the following command:

```
WRKCFGSTS *DEV TAP*
```

Vary off the device description, and select option 8 (Work with Device Description) and option 7 (Rename). Once the device description is renamed, vary on the new device description, and it is ready for use.

9.3.4.2 Changing the device description on RISC

On RISC AS/400 systems, you have the media library device description and the tape resource names that show up when you use the WRKMLBSTS command. The media library device descriptions can be renamed using the WRKDEVD command or using option 8 from the WRKMLBSTS display. You need to vary off the media library device description first.

To change the tape resource name, you have to vary off the media library device description and start System Service Tools (SST). Let us assume that you currently have a tape resource called TAP11 and you want to change it to be TAP02. Your media library device description is called TAPMLB01. Use the following steps as a guide for changing the resource names:

1. Vary off the library device TAPMLB01.

2. Type STRSST.

3. Select the following options:

   - Option 1 (Start Service Tool)
   - Option 7 (Hardware Service Manager)
   - Option 2 (Logical hardware resources (buses, IOPs, and controllers))
   - Option 1 (System Bus Resources)

4. Locate the IOP and select resources associated with the IOP. For example, selecting option 9 for Storage IOP 6501-001 displays the results shown in Figure 128.

```
                                                     Resource
Opt   Description                Type-Model  Status       Name
 _     Storage IOP               6501-001    Operational  SI01
 _       Tape Library            3494-012    Operational  TAPMLB01
 _         Tape Unit             3590-B1A    Operational  TAP11
```

Figure 128. Locating and selectomg resources associated with the IOP

5. Select option 2 (Change Detail) to change the tape unit resource name to a new name.

6. Exit from SST.

7. Vary on TAPMLB01.

We recommend that you also change the tape device name, which is still called TAP11, to match the new tape resource name of TAP02. To rename the tape device description from TAP11 to TAP02, use the command:

```
WRKDEVD TAP11
```

You then have to vary on the new tape device description.

9.3.5 Allocating resources

The Work with Configuration Status (WRKCFGSTS) command has been updated to handle the new media library devices. To work only with media library devices,

specify CFGTYPE(*DEV) and CFGD(*MLB). This displays the media library devices on the system and their current status and activity.

For media libraries, the preferred command is Work with Media Library Status (WRKMLBSTS). It provides the same function as the WRKCFGSTS command, plus a new function to manage the tape resources associated with the media library.

Each tape resource has an ALLOCATION STATUS associated with it as shown in Figure 129.

```
                        Work with Media Library Status
                                                      System:    SYSTEM01
Type options, press Enter.
  1=Vary on   2=Vary off   3=Reset drive       4=Allocate drive
  5=Allocate unprotected   6=Deallocate drive   8=Work with description
  9=Work with volumes


       Device/
Opt     Drive            Status                   Allocation
        TAPMLB01         VARIED ON
  _      TAP01           OPERATIONAL              UNPROTECTED
  _      TAP02           OPERATIONAL              DEALLOCATED
  _     TAPMLB02         VARIED OFF
  _      TAP03           OPERATIONAL              ALLOCATED
```

Figure 129. Work Media Library Status: V3R6

The possible allocation status values are:

- **Allocated**: The tape resource is available for use in the library device and the resource has been assigned (or reserved) to this system. No other system can use this tape resource. The tape resource is available to the resource manager. The allocation status change and assign are done when the media library device is varied on. Or, if the media library device is varied on, it stays assigned to the system until it is changed using the WRKMLBSTS command.

- **Unprotected**: The tape resource is available for use in the library device and the resource has *not* been assigned or reserved to this system. The tape resource is available to the resource manager. Any attached system can share this tape resource. As a request comes to the resource manager for a tape resource, an assign/reserve (this command is executed at the Licensed Internal Code level and you cannot see it) command is attempted to the device. If the system cannot obtain an assign/reserve, other available resources are used. If no other resources are available, the system waits for an available resource to successfully obtain an assign/reserve to the system. The wait is based on the MAXDEVTIME parameter in the device description. It is possible for a resource to be released and reassigned by another system before this system can obtain a successful assign.

- **Deallocated**: The tape resource is *not* available to the resource manager. Requests to media library devices with no tape resources in ALLOCATED or UNPROTECTED status result in an error message due to device allocation time out.

- **Stand-alone**: The tape resource is not available. It has been DEALLOCATED and has been varied on to the stand-alone tape device description. This status is new for V3R7.

When using BRMS/400, device allocations can be manipulated when systems are sharing one tape library. This can be done by using the UNPROTECTED status and device wait times. Or it can be done by using ALLOCATE and DEALLOCATE requests through the Vary Config (VRYCFG) command in the control group exits (*EXIT). You can use the control groups to ALLOCATE and DEALLOCATE resources and use job scheduler to coordinate the job dependencies.

In V3R7, the Work Media Library Status (WRKMLBSTS) command was enhanced with new capabilities and ease of use changes. Status and resource allocation have been separated into two displays. The primary display (Figure 130) shows the resource status. From this display, the media library device can be varied on or off.

```
                    Work with Media Library Status

 Type options, press Enter.
   1=Vary on   2=Vary off   3=Reset resource        4=Allocate resource
   5=Allocate unprotected   6=Deallocate resource   8=Work with description
   9=Work with volumes     10=Configure device


     Device/
 Opt   Resource    Status
     TAPMLB01     VARIED ON
       TAP01      OPERATIONAL
     TAPMLB02     VARIED ON
       TAP02      OPERATIONAL
       TAP03      OPERATIONAL
     TAPMLB03     VARIED OFF
       TAP04      OPERATIONAL
       TAP05      OPERATIONAL
```

Figure 130. Work with Media Library Status: V3R7

Function key F11 invokes the resource allocation display (Figure 131). This display is used to view the current and requested allocation of the device resources. *Current allocation* refers to the present state of the device resource, and *requested* refers to the state that occurs when the media library device is varied on. If the device resource is varied on for a stand-alone tape device description, "Stand-Alone" is displayed in the Current allocation field.

Option 8 (Work with Description) was enhanced to work with the tape device description associated with the tape device resource.

Option 10 (Configure device) invokes the Configure Device Media Library (CFGDEVMLB) command used to configure the 3494 Library Manager communication line (ROBOTDEV).

```
                          Work with Media Library Status

Type options, press Enter.
  1=Vary on    2=Vary off    3=Reset resource        4=Allocate resource
  5=Allocate unprotected   6=Deallocate resource   8=Work with description
  9=Work with volumes      10=Configure device


      Device/          Current                 Requested
Opt    Resource       allocation               allocation
    TAPMLB01
       TAP01         ALLOCATED                 ALLOCATED
    TAPMLB02
       TAP02         ALLOCATED                 ALLOCATED
       TAP03         DEALLOCATED               ALLOCATED
    TAPMLB03
       TAP04         DEALLOCATED               ALLOCATED
       TAP05         STAND-ALONE               DEALLOCATED
```

Figure 131. Work with Media Library Status: Resource allocation

9.3.6 Managing multiple devices in a single 3494

The 3494 supports multiple 3490 and 3590 devices within the same physical
library unit. If a system is attached to multiple devices within the same library unit
and auto-configuration is enabled (*YES), one media library device description is
created for each tape subsystem connection. This results in multiple media library
device descriptions being created for one library unit.

Support for multiple devices under a single media library device description is
provided through PTFs for V3R6 and V3R7. See Informational APAR II09724 for
information on the PTFs.

Before you apply the PTFs, each subsystem within the 3494 library is
represented in the system as a library (MLB) device with access only to those
drives in its own subsystem. For example, a 3494 that contains two 3490 tape
subsystems and two 3590 tape subsystems are automatically configured as
shown in Figure 132 on page 178.

```
                    Work with Media Library Status

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


        Device/
Opt      Drive           Status              Allocation
       TAPMLB01        VARIED ON
         TAP01         OPERATIONAL           ALLOCATED
         TAP02         OPERATIONAL           ALLOCATED
       TAPMLB02        VARIED ON
         TAP03         OPERATIONAL           ALLOCATED
         TAP04         OPERATIONAL           ALLOCATED
       TAPMLB03        VARIED ON
         TAP05         OPERATIONAL           ALLOCATED
       TAPMLB04        VARIED ON
         TAP06         OPERATIONAL           ALLOCATED
```

Figure 132. WRKMLBSTS prior to applying PTFs in a shared environment for the 3494

This causes problems for BRMS/400 users in that a separate location in
BRMS/400 must be defined for each tape drive in the system. Therefore, using
this configuration, two separate locations need to be defined. Because of this,
multiple device saves across multiple tape drives are not possible.

After you apply the PTFs, you can have one library device description for each
type of tape subsystem in the 3494. All subsystems still have a library (MLB)
device description created using automatic configuration, but you now have
access through any one of those descriptions to all of the drives of the same type
in the 3494. Using our example of two 3490 subsystems and two 3590
subsystems in the 3494, you see that each of the AS/400 systems has four media
library devices configured as shown in Figure 133. You can use the WRKMLBSTS
command to display the configuration.

```
                     Work with Media Library Status

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


         Device/
 Opt      Drive            Status               Allocation
         TAPMLB01          VARIED ON
          TAP01            OPERATIONAL          ALLOCATED
          TAP02            OPERATIONAL          ALLOCATED
          TAP03            OPERATIONAL          ALLOCATED
          TAP04            OPERATIONAL          ALLOCATED
         TAPMLB02          VARIED OFF
          TAP01            OPERATIONAL          DEALLOCATED
          TAP02            OPERATIONAL          DEALLOCATED
          TAP03            OPERATIONAL          DEALLOCATED
          TAP04            OPERATIONAL          DEALLOCATED
         TAPMLB03          VARIED ON
          TAP05            OPERATIONAL          ALLOCATED
          TAP06            OPERATIONAL          ALLOCATED
         TAPMLB04          VARIED OFF
          TAP05            OPERATIONAL          DEALLOCATED
          TAP06            OPERATIONAL          DEALLOCATED
```

Figure 133. WRKMLBSTS after applying PTFs in a shared environment for the 3494

You can now allocate the drives so that you only have two active descriptions: one to use with your 3490 cartridges and the other to use with your 3590 cartridges. The drives can be allocated to only one library (MLB) device description at a time. If you want to separate a particular drive, you can manage this by how you allocate the drives.

To share all tape resources between the two hosts, both systems should have the media library device description varied on. It is better to ignore the second media library device description rather than delete it. If you delete it and you have QAUTOCFG set to on, the media library device descriptions are re-created at IPL.

9.3.7 Selecting and varying on devices

On CISC systems, use the following command to work with the tape devices:

WRKCFGSTS *DEV TAP*

All shared devices should be left varied off. When an AS/400 system wants to use the shared device, BRMS/400 varies it on. After the backup is complete, BRMS/400 varies it off again.

BRMS/400 selects drives sequentially according to the list of BRMS/400 devices. In the preceding example, this means that it selects TAP01 and TAP02, which are both connected to the same controller before it selects TAP03 or TAP04. This may cause performance degradation. It may be better to rename the drives as TAP01, TAP03, TAP02, and TAP04. In larger installations where there is more than one media library, a naming convention such as M1.TAPL1, M1.TAPR1, M1.TAPL2, and M1.TAPR2 may be convenient.

On RISC systems, the media library device is used and must be varied on. The tape device is used *only* for stand-alone operations.

For example, consider SYSTEM01 and SYSTEM02 sharing TAPMLB01, which has two drives TAP01 and TAP02. If both systems are CISC, tape devices TAP01 and TAP02 are both defined as SHARE(*YES) and varied off.

If SYSTEM01 is CISC and SYSTEM02 is RISC, SYSTEM01 is still defined as before. However, SYSTEM02 has the media library device TAPMLB01 varied on, and the resources TAP01 and TAP02 are in allocated UNPROTECTED mode.

If both systems are RISC, both systems have TAPMLB01 varied on as before, and the resources are allocated as UNPROTECTED.

If more control is needed for complex setups where performance or some other concern needs to be addressed, the second media library device description can be used to manage the device resource independently. See Figure 134 for the resulting configuration that is displayed by the WRKMLBSTS command. In this setup, TAP01 and TAP03 are shared, while TAP02 and TAP04 are dedicated. The second system can share TAP01 and TAP03, but cannot use TAP02 or TAP04.

Note: On RISC systems, BRMS/400 always selects the first varied on media library that has resources allocated if *MEDCLS is specified for the device.

```
                     Work with Media Library Status

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


        Device/
 Opt     Drive          Status                  Allocation
        TAPMLB01        VARIED ON
         TAP01          OPERATIONAL             UNPROTECTED
         TAP02          OPERATIONAL             DEALLOCATED
         TAP03          OPERATIONAL             UNPROTECTED
         TAP04          OPERATIONAL             DEALLOCATED
        TAPMLB02        VARIED ON
         TAP01          OPERATIONAL             DEALLOCATED
         TAP02          OPERATIONAL             ALLOCATED
         TAP03          OPERATIONAL             DEALLOCATED
         TAP04          OPERATIONAL             ALLOCATED
```

Figure 134. Work with Media Library Status: TAPMLB01 and TAPMLB02 varied on

> **Hint**
>
> Another possibility is to leave the resources on the RISC systems deallocated and varied on. If these devices are SHARE(*YES) on CISC, BRMS/400 will vary them on and off as it processes the control groups. For each control group on RISC systems, add two *EXITs: one at the beginning to VRYCFG on or more resources in the library to ALLOCATED before any save processing begins, and one at the end to VRYCHG again to DEALLOCATED. If a failure occurs due to a time-out, the user sees it more quickly and may be able to take actions to correct the problem. This setup is particularly useful if the save window is small.

9.4 Updating BRMS/400 device information

After you've created, and if necessary, updated the media library device descriptions and tape device descriptions, you need to create BRMS/400 device descriptions.

Use the following command to add new devices to BRMS/400:

```
INZBRM OPTION(*DATA)
```

If you want to clean up your device descriptions, you can use the following command as an alternative:

```
INZBRM OPTION(*DEVICE)
```

Instead of adding the new devices, this clears all the existing information and replaces it with information about the devices currently attached to the system.

Note: The `INZBRM OPTION(*DEVICE)` command is not available in V3R1.

We recommend that you print your existing media device information before you run this command to capture any changes you may have already made to existing default values. You must use the "Print Screen" utility to obtain hard copies.

After you've created the BRMS/400 device descriptions, you need to update the device location, next volume message and tape mount delay, auto enroll media, shared device, and IDRC parameters to reflect your installation. Use the Work with Device Information (`WRKDEVBRM`) command to make these changes.

The INZBRM command automatically creates media classes appropriate for the devices. However, at this stage, you may want to review these and create additional ones.

9.4.1 Device location

It is important that the device location (as specified in the WRKDEVBRM command) reflects the true location of that device. This is especially true for media libraries that are used in random mode where the volumes and the resources should both be at the same location. If you are implementing BRMS/400 for the first time, or if you have run the `INZBRM OPTION(*DEVICE)` command, you should ensure that the device locations are correct.

If you one library is shared between AS/400 systems, the location and library name should be consistent across the AS/400 systems if you want to run movement for all systems at once. An easier option to avoid communications problems is to run movement locally on each system. This ensures that ejects are done on all library devices. See 9.5.5, "Exporting cartridges" on page 189, for more information.

You should pay special attention to naming locations when you are using the 9427 tape library in split mode. Using the bonus slots in a split library configuration can result in a tape cartridge being moved to a slot in either half of the library. Since each host has access to only one half, the tape cartridge may become inaccessible to the host after the move.

Normally, you create a single storage location for the tape library unit and define all of the tape drives within the frame as being in that location. However, in split mode, tapes in Magazine 1 of the library can *never* be selected by the accessor for loading in tape drive 2, nor tapes from Magazine 2 in drive 1.

If you have a single storage location, BRMS/400 recognizes Magazine 1 and Magazine 2 as being one location and may request a tape from Magazine 1 to be mounted in Drive 2. The tapes and drives, therefore, need to be defined in separate locations.

Let's look at an example based on a RISC processor using OS/400 V3R6.

A possible naming convention that you can use when using the 9427 tape library with BRMS/400 is to have the storage location for the first magazine named as MLB9427TOP and the second magazine named as MLB9427BOT using the following steps:

1. Create a new storage location, either MLB9427TOP or MLB9427BOT, as appropriate.

2. From the BRMMED menu, select option 8 (Work with device information).

   You find two device descriptions defined within BRMS/400. These have been generated from the OS/400 device descriptions and called TAPxx.

3. Update both entries to specify device location = MLB9427TOP (if you are on System A) or MLB9427BOT (if you are on System B) as appropriate.

   Although this device description is only used when you explicitly request TAPxx, for example, in a stand-alone environment where the accessor is unavailable, we recommend, for completeness, that you update this as well as the media library device. They are, in practice, the same device.

4. From the BRMMED menu, select option 9 (Work with media libraries).

   An entry has been automatically generated for you with a name of MLB9427. Update this entry with the specified storage location MLB9427TOP or MLB9427BOT.

You have now defined Drive 1 as being located in storage location MLB9427TOP, and Drive 2 as being located in storage location MLB9427BOT.

To preserve the integrity of the inventory, use the Move Tape command on the 9427 tape library front panel to move tapes to the appropriate magazine.

9.5 Managing cartridges in the media library device

Any OS/400 command that has a VOL parameter will cause the cartridge identifier specified to be mounted. If the cartridge identifier does not match the logical volume identifier for standard labeled tapes, a message is issued. All AS/400 tapes are initialized with the volume identifier matching the cartridge identifier.

When you use BRMS/400 with non-barcode reader libraries, you should be careful when you initialize blank tapes. See 9.5.1, "Special cartridge identifiers" on page 184, for more information.

The easiest way to find existing cartridges for use in the media library device inventory is to use the Work with Media Library Media (WRKMLMBRM) command. For example, use the following command to display a complete inventory of cartridges and volume identifiers and their status as shown in Figure 135:

WRKMLMBRM DEV(TAPMLB01)

```
                        Work with Media Library Media
   Media library . . . . . . :  TAPLIB01
   Position to . . . . . . . .              Starting characters

   Type options, press Enter.
     1=Add MLB media     2=Work with media     5=Initialize
     6=Change category   7=Eject    8=Mount     9=Demount

                             ---BRM Information---
   Opt   Volume   Category    Media Class   Expired  Status

    __   CLN001   *SHARE400   *NONE                  Available
    __   VOL002   *SHARE400   FMT5GB        *YES     Available
    __   VOL003   *INSERT     FMT5GB                 Available
    __   VOL004   *SHARE400   FMT5GB                 Available
    __   VOL005   *INSERT     FMT5GB                 Available
    __   VOL006   *SHARE400   FMT5GB                 Available
    __   VOL007   *SHARE400   FMT5GB        *YES     Available
    __   VOL008   *SHARE400   FMT5GB                 Available
```

Figure 135. Work with Media Library Media

You can see a similar display by using the OS/400 Work with Tape Cartridges (WRKTAPCTG) command. You need to use F11 on the Work with Tape Cartridges display to view the category, density, and other information that appears on the WRKMLMBRM display.

Hint

If the system name is changed, all cartridges in the associated categories become unavailable until a categroy is created with the previous system name. Cartridges in the *NOSHARE category that belong to that system are not accessible. We highly recommend that you remove all cartridges from the media library device or change them to the *SHARE400 category prior to changing the system name by using a media class that is SHARE(*YES).

9.5.1 Special cartridge identifiers

Every cartridge and volume ID can contain the following characters: A through Z, 0 through 9, $, and @. Only the first six characters are recognized by OS/400. Therefore, the uniqueness of the cartridge ID must be within the first six characters of the name. For libraries with a vision system (for example, the 3494 Automated Tape Library Data Server and the 9427 tape library), the first six characters of the cartridge ID should match the volume ID for the tape.

For libraries without a vision system, which includes the 3590 tape device and 3570 Magstar MP tape subsystem, specially generated cartridge IDs have been implemented on RISC systems:

NLTxxx Non-Labeled Tape: This cartridge contains data written in non-Standard tape label format.

CLNxxx Cleaning: This cartridge has been identified as a cleaning tape.

BLKxxx Blank: This cartridge contains no data.

UNKxxx Unknown: This cartridge is not identifiable.

IMPxxx Import: This refers to the cartridge that is in the Priority slot.

SLTxxx Slot: This refers to the cartridge by its slot number. This only occurs if the device description is created with the GENCTGID parameter set to *SYSGEN mode (see 9.3.2, "Creating media library device descriptions" on page 168) and is not appropriate for BRMS/400, which refers to media by volume identifier.

When using BRMS/400 with non-barcode reader libraries, take care when initializing blank tapes. The system generates a volume ID of BLK001 and so on. BRMS/400 users should never initialize cartridges to these IDs, whether through a BRMS/400 or OS/400 command. If a real volume exists in the library with ID BLK001 and a new tape is added that causes OS/400 to generate another BLK001, you receive an instant duplicate. Further, BRMS/400 thinks that every new BLK001 is that same original BLK001 and tries to use it for saves and so on.

A similar situation can occur when you add an already known cartridge to the library through the priority slot using CHECKVOL(*NO). The cartridge is moved to a slot in the ACF, but the cartridge identifier remains IMP001. See 9.5.4, "Importing cartridges" on page 187, for more information on importing cartridges.

You must *not* use the ADDMLMBRM command to initialize these tapes. You must first put the media library device into auto-mode and use the ADDMEDBRM command to add the cartridges. Once the cartridges are added, you should use the MOVMEDBRM command to place the cartridges in the correct library location. You must hold the library using the WRKMLBBRM command to do this and release the library when you have completed the move operation.

Hint

When you use such libraries as the 3590 tape device and 3570 Magstar MP tape subsystem, avoid initializing new cartridges when the libraries are in random mode. This is because of the danger of initializing media to a system generated identifier. You should put the device into automatic mode, and on RISC systems, vary off the library description and vary on the device description. You should also use the WRKMLBBRM command and put the library on hold in BRMS/400 when using the media library in automatic or manual mode. Otherwise device failures occur. If possible, it may be convenient to purchase extra magazines for the 3570 Magstar MP tape subsystem and use one or two to load 20 new cartridges at once for initialization. Use the ADDMEDBRM command to add the 20 tapes. Once the tapes are initialized, the device can be returned to random mode. You can use the MOVMEDBRM command to move the cartridges into the library location.

9.5.2 VOL(*MOUNTED) usage

Prior to V3R6, the library device commands were directed to a specified tape device. Beginning with V3R6, library device commands are issued to a media library device. If the media library device has all of the available tape resources loaded with media, it is meaningless to use VOL(*MOUNTED). For V3R6 and later, the VOL parameter is required when you issue a command to a media library device. If VOL(*MOUNTED) is specified, the system returns an error.

This should not really concern BRMS/400 users. If, for example, a scratch volume is required, BRMS/400 suggests a volume from its own scratch pool based on the media class selected for the save operation. This is passed to the media library and the specified volume loaded.

If you ever receive a *MOUNTED volume not correct type of message, it usually means that BRMS/400 has run out of tape volumes to suggest at that location. You should check for the tape volumes by using the WRKMEDBRM command and the WRKMLMBRM command. Ensure that volumes are available at the location of the library.

9.5.3 End option (ENDOPT) setting

The major design change for RISC is that media library devices have been implemented to support multiple concurrent users. Commands are issued to the media library device specifying a cartridge identifier. If the cartridge and a tape resource are available, the cartridge is mounted on that tape resource and command processing begins. BRMS/400 always selects the first varied on media library device that suitable resources allocated if *MEDCLS is specified for the device.

If no tape resource is available, the request is queued in a first-in, first-out basis with a priority and time limit. The time limit is specified by the MAXDEVTIME parameter in the media library device description. The priority is based on the run priority of the job attributes. The priority is referenced when a request for a tape resource is made. Changing the priority of the job after the request has been queued does not affect the current request, only subsequent requests. Commands that require multiple volume mounts generate multiple media library

requests. Changing the run priority affects the priority of the requests for subsequent tape resource operations.

On RISC systems, the End option (ENDOPT) parameter has a significant affect on the operation of the media library device.

End options on OS/400 commands include *REWIND, *UNLOAD, and *LEAVE:

- ***REWIND**: At the end of command processing, the cartridge is rewound and left loaded in the tape resource. At this point, the tape resource is available for other media library requests. If the next request requires a different cartridge, the present cartridge is unloaded, and the new cartridge is mounted. BRMS/400 SAVxxxBRM commands have a default of *REWIND.
- ***UNLOAD**: At the end of the command processing, the tape resource is unloaded, and the cartridge is demounted. At this point, the tape resource is available for other media library requests. At the end of every BRMS/400 control group, *UNLOAD is issued.
- ***LEAVE**: At the end of command processing, the media is positioned at the last point accessed. The tape resource is only available to commands to the same cartridge identifier (or, as long as the resource is not in use, to commands that require a tape resource but do not mount tapes (for example, WRKTAPCTG)). BRMS/400 uses the option of *LEAVE when a control group performs multiple save operations.

In a multiple user environment, take care when using *LEAVE. Consider the situation where SYSTEM01 and SYSTEM02 share the same library that contains two drives:

- SYSTEM01 processes a control group containing some saves with *EXIT processing in between.
- SYSTEM01 starts the save to cartridge XYZ001, and the user changes the ENDOPT parameter to *LEAVE.
- SYSTEM01 performs *EXIT processing for some minutes before the next save starts.
- At that point, if SYSTEM02 attempts to access the drive, it will fail. However, if another job on SYSTEM01 is queued and requesting cartridge XYZ001, that job can interrupt the job that did the *LEAVE processing and steal the resource and the cartridge.
- When job 1 on SYSTEM01 resumes saving after the *EXIT, it finds the cartridge is not available and tries another cartridge, perhaps mounting it on the second drive. In this way, it is possible to have one control group with APPEND(*YES) to end up on two different cartridges.

You should be aware of this when you queue up save jobs on the same system. If necessary, change the media class so that the same cartridge ID is not requested (BRMS/400 does not know which cartridge is being used in a control group that is in progress until the save completes and the media information is written). In other words, *LEAVE processing holds the cartridge to the resource for that system; it does not lock the resource to the job.

> **Note**
>
> The Check Tape (CHKTAP) command is the only OS/400 command that
> defaults to *LEAVE. OS/400 does not honor the *LEAVE processing of the
> CHKTAP command unless a file is specified by file name or sequence number.
> This prevents the CHKTAP commands from locking up all of the tape resources
> when you use the command defaults.

9.5.4 Importing cartridges

When you return expired cartridges to the media library, or when you add new
cartridges, the most obvious way is to open the door and remove the magazine. If
the library is in random mode, this causes a re-inventory of the library. For this
reason, the 3494 Automated Tape Library Data Server has a convenience I/O
station for importing and exporting cartridges without stopping any automatic
operations. The 3590 with automated cartridge facility and 3570 Magstar MP tape
library provide a convenience or priority slot. The 9427 tape library does not have
a convenience station, so you can only import by halting automation and opening
the door to access the cartridge slots.

In V3R1 and V3R2, the priority slot of the 3590 with automated cartridge facility
and the 3570 Magstar MP tape library has a simple implementation. The
cartridge in the priority slot is assigned a generated identifier of IMP001 (actually
IMPxxx where *xxx* is the next available IMP number). The commands for this
cartridge can either reference IMP001 or the actual volume identifier in the VOL
parameter. Upon issuing the command, the cartridge is moved from the priority
slot to the device. When the device is unloaded, the cartridge is returned to the
priority slot for removal.

V3R6 and V3R7 enhances the library support to provide full import capability from
the priority slot to the device or ACF inventory. Because there is often more than
one cartridge to be imported, we still recommend that you physically replace the
cartridges in a magazine and then re-inventory the magazine.

Cartridges that have been imported into the library remain in the *INSERT
category until they are enrolled into BRMS/400. To do this, you can either use the
Work with Media Libraries (`WRKMLBBRM`) command and type option `11` next to the
required library or directly use the Add MLB Media using BRM (`ADDMLMBRM`)
command. The tapes must already be initialized if it is a non-barcode reading
media library (Figure 136 on page 188).

```
                    Add MLB Media using BRM (ADDMLMBRM)

 Type choices, press Enter.

 Media library device . . . . . . > TAPLIB01       Name
 Volume identifier  . . . . . . .   *INSERT         Character value, *INSERT
              + for more values
 Add volume to BRM  . . . . . . . > *YES            *NO, *YES
 Initialize tape  . . . . . . . .   *NO             *NO, *YES
 Media class  . . . . . . . . . . > FMT3590         CART3490E, QIC120...
 Last moved date  . . . . . . . .   *NONE           Date, *NONE
 Move policy  . . . . . . . . . .   *NONE           *NONE, OFFSITE
```

Figure 136. Add MLB Media using BRM display

9.5.4.1 Re-activating enrolled tapes after re-inventory

If cartridges already enrolled in BRMS/400 are added to the magazine, they are
in the *INSERT category after re-inventory. To make them usable for the
operations, the category has to be changed. To activate these cartridges, use the
ADDMLMBRM command, but change the Add volume to BRM field to *NO. This
changes the category, and the cartridges are available for use.

If the shared media attribute in the media class is *NO, the category is changed
from *INSERT to *NOSHARE. Otherwise, the category is changed to
*SHARE400.

For such libraries as the 3494 Automated Tape Library Data Server where the
cartridges are physically moved to a storage cell location by Library Manager, a
single ADDMLMBRM command changes all volumes with the *INSERT category.

9.5.4.2 Enrolling new tapes into BRMS/400

If you need to enroll new volumes into the BRMS/400 media inventory, you can
use the default value for the VOL parameter (*INSERT) and change the Add
volume to BRM field to *YES; all volumes that were previously in the *INSERT
category are enrolled into the BRMS/400 media inventory and are available for
use. You should supply the media class for the MEDCLS parameter on the
ADDMLMBRM command.

9.5.4.3 Missing cartridges

When BRMS/400 requests a tape mount of a cartridge that is not in the library,
and this cartridge is placed in the priority slot, the cartridges already in the library
are checked, followed by the cartridge in the priority slot. If this cartridge is the
required one, it is imported into the library.

It is also possible to import a cartridge to the library using the OS/400 Add Tape
Cartridge (ADDTAPCTG) command, for example:

```
ADDTAPCTG DEV(TAPLIB01) CTG(TAPE01) CGY(*SHARE400) CHKVOL(*YES)
```

However, we recommend that you *do not use* this technique when using
BRMS/400 enrolled tapes. In this case, you lose the benefits of the
ADDMLMBRM command, which allows you to run the ADDTAPCTG and
ADDMEDBRM commands and moves the media to your library using the
MOVMEDBRM command through one simple command.

When you use the ADDTAPCTG command, and if the cartridge ID is not found, OS/400 searches the device starting with the priority slot and any cartridge IDs with the volume ID of *UNKNOWN. When the cartridge in the priority slot is loaded, it is found to be TAPE01. The cartridge identifier is changed to TAPE01, and the cartridge is added to the *SHARE400 category. When the cartridge is unloaded (ENDOPT(*UNLOAD)), the cartridge is moved to the ACF.

9.5.5 Exporting cartridges

Cartridges that are due to move from the media library, perhaps to an off-site store, need to be "exported" from the library. That is, they need to have their category changed to *EJECT and need to be physically removed from the library. All media library devices use the Remove Tape Cartridge (RMVTAPCTG) command to change media to the *EJECT category and, where possible, physically eject it from the library. BRMS/400 uses this command when doing the movement from tape library locations to your default *HOME location. The WRKMLMBRM command also uses this option to perform the ejects.

For the 3590 tape device and 3570 Magstar MP tape subsystem on CISC systems, the cartridges are left in the device in the *EJECT category. This also applies to 9427 tape library on CISC or RISC since the 9427 tape library does not have a convenience station.

For all libraries, except the 9427 tape library on RISC systems, and for 3494 Automated Tape Library Data Server on CISC, the cartridges are moved to the convenience station. If more cartridges exist than the convenience station can hold, the additional cartridges are queued by the media library device for ejection.

When BRMS/400 movement is run, it causes a volume to move from the library. A RMVTAPCTG command is also issued to eject the cartridge. As long as the system that runs the MOVMEDBRM command is attached to the library (in other words, it recognizes the media library device description), it can take action on the RMVTAPCTG command and eject the cartridge. If there are multiple systems and multiple libraries attached to different systems and the MOVMEDBRM command is run on one system only, the BRMS/400 files are updated around the network, but the cartridges are not ejected from the remote libraries. To ensure cartridges are ejected, run MOVMEDBRM on those systems that are attached to the libraries. We recommend you run the MOVMEDBRM command individually on *all* systems in the network.

9.6 Restricted state automation for the 3494

V3R6 and V3R7 no longer use MLDD for running the 3494; the subsystems associated with it are no longer necessary. This change allows for automation to work in a restricted state once the device descriptions exist and QUSRSYS is installed, for example, when you perform a system recovery.

Four files in QUSRSYS are required for complete automation of the media library devices: QATAMID, QLTAMID, QATACGY, and QLTACGY. If these files do not exist on the system, a limited set of automation function is supported. Cartridges can be mounted by specifying the cartridge identifiers in the VOL parameter of the OS/400 commands. This subset of automation does not support the use of the cartridge commands such as WRKTAPCTG, DSPTAPCTG, and so on.

CISC systems rely on MLDD for full 3494 function. However, this is not available when the system is in a restricted state so tapes must be loaded in another way. One way is to use the 3494 Automated Tape Library Data Server in stand-alone mode as mentioned earlier. Another way is to mount a specific category to use the Mount Category (MNTCTGMLD) command and allow the 3494 to load the tapes automatically in that category. This means that it is possible to run SAVSYS followed by SAVLIB to a 3494 while it is in restricted state for the entire save.

The steps required for this process are outlined here:

1. Hold the QSYSOPR message queue so that it does not interrupt the save.

2. Create a temporary tape category and add volumes to it in the order that BRMS/400 expects them.

3. Rename the QMLDSBS subsystem so that BRMS/400 cannot restart it after the SAVSYSBRM command completes.

4. Save the system using the SAVSYSBRM command and specify STRCTLSBS(*NO).

5. Save QGPL, QUSRSYS, QUSRMLD, and QMLD.

6. Rename the QMLDSBS subsystem back again.

7. Run the following command to restart MLDD: INZMLD *START

8. Change the media category back to *NOSHARE. Delete the temporary category.

See Appendix D, "Performing restricted saves to a 3494 on CISC" on page 305, for sample programs on automating this (should *only* be used on CISC systems).

9.7 Using a tape resource as a stand-alone unit (RISC)

To use a tape resource as a stand-alone device, deallocate the tape resource from the media library device. To deallocate all resources, simply vary off the media library or select option 6 (DEALLOCATE) on the Work with Media Library Status (WRKMLBSTS) display for each resource that needs to be deallocated.

Once the resource is deallocated, it is a free resource for any device description. Tape device descriptions are auto-configured for the tape resources, but are not varied on. The WRKCFGSTS *DEV *TAP command displays the current tape device descriptions that exist on the system. Find the device description that corresponds to the tape resource, and vary on the tape device description. Alternatively, use the WRKMLBBRM command to hold the media library device. Now, commands can be sent to this device description, but no library functions occur.

Many media library devices provide modes or commands to move media to the device during a stand-alone operation. The 9427 and 3590 media library devices both support modes that are used for stand-alone devices. The 9427 provides a sequential mode where cartridges are moved to the device automatically in sequence from the inventory. The 3590 has three modes for stand-alone mode: auto, manual, and accumulate. The Library Manager software on the 3494 supports the stand-alone mode from the command pull-down on the Library Manager console. In this mode, the operator can mount a tape from the I/O station or from the inventory either by volume identifier or by a category.

The 3570 has an automatic mode, which loads cassettes from right to left. In the manual mode, the cassettes are loaded in the furthest right slot.

Chapter 10. Recovery using BRMS/400

This chapter deals with the most important function of BRMS/400, which is recovery. The main objective is to describe recovery of a complete system and identify the key differences between the CISC and RISC BRMS/400 releases so that you can plan accordingly. This chapter also covers the recovery of individual objects and libraries.

The intent of this chapter is not to provide you with step-by-step instructions on how you should recover your AS/400 system. For this, you must use the BRMS/400 *Recovering Your Entire System* report for a guide to the recovery steps for your specific installation.

Every effort has been made in BRMS/400, in the recovery manuals, and in this redbook to ensure that the recovery information is complete. However, the *only* way to know that you have a recoverable system is to *try it*.

If it is not already part of your operational processes, we strongly recommend that you schedule a full disaster recovery test as soon as possible and on a regular basis thereafter. If you can recover your complete system to another AS/400 system, it is most likely that you can recover all or any part of your system to your own AS/400 system.

Recovery is often viewed as an inevitable consequence of backup. This is not necessarily true. Recovery is only as good as your backup strategy. It is vital that you consider your business recovery requirements *before* you design your backup.

There are two major factors to consider: data and timing. Of course, there are other factors such as people, skills, facilities, and processes. However, it is not within the scope of this redbook to cover these aspects of recovery planning.

You can secure you data by making sure you have complete and up-to-date backups, including recovery documentation and regularly moving backups off-site or to a secure location. Timing needs to be addressed in the design of your backup.

For example, it may be necessary to recover a critical application and restart the business before any other recovery is undertaken. Using backup lists to secure critical files, documents, spooled files, in addition to the main libraries for this application, can facilitate this.

You may have to ensure that unnecessary recovery of incremental saves does not occur. Rebuilding access paths is also time consuming. Where possible, you should have access paths and their associated files in the same libraries and save the access paths.

10.1 Overview of BRMS/400 recovery

The basic recovery "tool" in BRMS/400 is the Start Recovery using BRM (STRRCYBRM) command. This not only performs the recovery, but is regularly used to print reports to help you manage the recovery. Printing recovery reports is also an option during maintenance.

The Start Recovery using BRM command can be selected by using the menus (option 4 (Recovery) from the Main menu) or by typing the command directly. In BRMS/400 V3R6, V3R2, and V3R7, you should take care when printing the recovery report using the menus since the default has been changed to *RESTORE. The default is still *REPORT in the STRRCYBRM command. See Appendix A, "Summary of changes" on page 289, for information on the functional enhancements between the BRMS/400 releases.

Figure 137 shows the main parameters of the STRRCYBRM command.

```
             Start Recovery using BRM (STRRCYBRM)

 Type choices, press Enter.

 Option . . . . . . . . . . . . .   *SYSTEM   1    *SYSTEM, *SAVSYS, *IBM...
 Action . . . . . . . . . . . . .   *REPORT        *REPORT, *RESTORE
 Time period for recovery:
   Start time and date:
   Beginning time . . . . . . . .   *AVAIL         Time, *AVAIL
   Beginning date . . . . . . . .   *BEGIN         Date, *CURRENT, *BEGIN
   End time and date:
   Ending time  . . . . . . . . .   *AVAIL         Time, *AVAIL
   Ending date  . . . . . . . . .   *END           Date, *CURRENT, *END
 Use save files . . . . . . . . .   *NO       2       *NO, *YES
 Volume location  . . . . . . . .   *ALL      3    *ALL, *HOME, COMPROOM...
               + for more values
 Library to omit  . . . . . . . .   *DELETE   4    *DELETE, *NONE
 From system  . . . . . . . . . .   *LCL      5
```

Figure 137. Start Recovery using BRM (STRRCYBRM)

The numbers in reverse bold that follow correspond to the numbers in reverse shown in Figure 137:

1 To recover a specific control group, enter *CTLGRP. You are prompted for the control group name. If the restore is halted or fails, you can restart the recovery from the point of failure by specifying *RESUME here. With the *RESUME option, no other parameters are shown.

2 If the latest backup was to a save file that still exists, setting this parameter to *YES includes the save file in the recovery report. If you want to exclude this latest save (for example, recover only from off-site tapes), setting this parameter to *NO will cause BRMS/400 *only* to use information from the tape.

3 You can recover from a location (for example, an older copy now in the vault). You can specify up to 10 locations.

> **Note**
>
> If you have duplicated your backup tapes using the Duplicate Media Using BRM (DUPMEDBRM) command, it is good practice to move these tapes within BRMS/400 to a separate BRMS/400 location. This location does not need to be physically separate from the main secure location.
>
> 1. Use the MOVMEDBRM or VFYMOVBRM commands to update the BRMS/400 database.
>
> 2. Run the SAVMEDIBRM command to save the BRMS/400 recovery information.
>
> 3. Move this to the same location and run the MOBMEDBRM command or the VFYMOVBRM command to update the BRMS/400 database. BRMS/400 now recognizes that the recovery media and the BRMS/400 recovery information is at the separate location.
>
> 4. Use the STRRCYBRM command to run a recovery report using volumes from that location. Make sure that the report is also stored in the location with the tapes.
>
> You now have the information to recover using the duplicated tapes.

4 You can specify that you do not want to recover libraries that have been deleted after the save to which you are now recovering. That not only helps recovery time but also reduces catch-up time.

If you created libraries, but have not run maintenance before deleting them again, these libraries are still marked for recovery. You must run maintenance between creating the library and deleting it to have it omitted. One way around this is to manually delete the library from the WRKMEDIBRM displays.

5 You can specify the system name and remote location of another system in your BRMS/400 network from which to restore media information.

10.1.1 Synchronizing maintenance, movement, and recovery reports

It is important that you schedule maintenance, media movement, and recovery report creation correctly to ensure they are synchronized. There are circumstances that lead to a recovery report being out-of-date within a few hours of its creation unless this happens. These include:

- Performing a save to save files and running maintenance (with recovery report) after the save. The report is only accurate as long as the save files exist. If you run the Save Save Files using BRM (SAVSAVFBRM) command and move the data to tape, you should reproduce the report. You should also save the BRMS/400 recovery data again using the SAVMEDIBRM command.

- If move policies contain Verify moves *YES, and the MOVMEDBRM command is run during maintenance followed by the recovery report, the recovery report shows the media as in their current location. As soon as verification takes place, the moved media will appear in their new location, and the recovery report is out of date. The recovery report should be run after verifying the move.

- In a network situation, the recommendation is to run the Move Media using BRM (MOVMEDBRM) command separately on each system. However, running the MOVMEDBRM command once on a single system, which

propagates the information around the network, is a satisfactory solution for many installations.

Media movement is often performed after maintenance has been run on each system and the recovery reports produced. The recovery reports should be run on each system after the MOVMEDBRM command has been completed for the network.

• Unlike Backup Control Groups, Archive Control Groups do not have a parameter for automatically backing up media information. You should, therefore, ensure that you run the SAVMEDIBRM command after archiving to save the recovery data. Make sure you change the default in the SAVMEDIBRM command to *OBJ because you must save the recovery information at object level to retrieve archived objects such as spooled files.

As a general rule, saving recovery data should always be done at the end of processing. QUSRBRM is frequently saved early in the backup cycle. It is important for recovery to have the most up-to-date recovery information.

To actually perform the recovery, either use the STRRCYBRM command with the action parameter of *RESTORE or use the BRMS/400 recovery menus.

10.1.2 Recovery from a central point

Recovery using backup control groups requires access to media content information (QA1AHS) in the QUSRBRM library. If you have a complete system failure, this information is no longer available, and you need to restore the latest QUSRBRM recovery data to perform the recovery. Depending on the frequency of saves and the timing of the failure, the restored information may not be current (Figure 138).

```
                         Change Network Group              SYSTEM05 ITSCNET
  Network group . . . . :  *MEDINV          Position to  . . . . ._____
  Text . . . . . . . . . . Centralized media network systems
  Receive media info  . .  *LIB             *NONE, *LIB

  Type options, press Enter.
    1=Add   4=Remove   8=Set time
       Remote Local     Remote      Receive

  Opt Location Name  Network ID   Media Info    Status

       SYSTEM09       ITSCNET      *NONE       Active
```

Figure 138. Receive media information on SYSTEM05

Beginning with V3R6, V3R7, and V3R2, a new parameter, Receive Media Information (circled in Figure 138) has been introduced on the Change Network Group display (option 4 from the System Policy menu). This gives you the ability to specify for a system or systems, whether you want to receive media content information from the other systems in the network group.

If you use this feature, you have the recovery information at a central point and can create recovery reports for other systems, if necessary.

10.2 Recovering an entire system (starting with licensed Internal Code)

Recovering the entire system is required if you need a scratch installation for disaster recovery or if the load source disk unit in the system ASP is damaged and needs to be replaced. This assumes that you have no disk protected enabled such as device parity protection (RAID5) or mirroring.

Note: When you recover from SAVSYS or IBM distribution tapes, your tape libraries *must not* be in random or library mode. See the appropriate *Operator's Guide* for the library in use to set the correct mode.

Important

We used the 3494 library device as a topic to discuss the recovery of an entire system. The intent of Table 4 on page 196 and subsequent sections is to provide an overview of the steps that are required when restoring your CISC AS/400 system or the RISC AS/400 system. You *must not* use this section as a checklist to perform your system recovery. You *must always* use the BRMS/400 *Recovering Your Entire System* report along with *Backup and Recovery - Basic*, SC41-4304, to guide you through the *correct* recovery steps based on your OS/400 release.

10.2.1 Preparation for the recovery process

When you are planning your restore process, you need to ensure that you have the appropriate documentation and the tape volumes, including any special recovery tapes that may be required during the recovery process. For example, if you are restoring your system after a load source disk failure, and if you are running on a CISC AS/400 system, you need the appropriate MULIC or FULIC tape during the recovery. Remember that MULIC or FULIC tapes are not required for RISC AS/400 systems.

Helpful information is available in the following documentation:

- *Backup and Recovery - Basic*, SC41-4304: Keep a copy of this documentation close to you while doing recovery.
- *Backup and Recovery - Advanced*, SC41-4305
- *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171)
- *Automated Tape Library Planning and Management*, SC41-5309
- We recommend that you keep a copy of the *Operator's Guide* and the *Installation and Planning Guide* for all of your tape libraries that are used for recovery. You may need to refer to these documentation.

Your starting point in the recovery process should *always* be with the Recovering Your Entire System report (QP1ARCY) produced by BRMS/400. This report identifies the first volumes that are needed during the recovery process. You should use the Recovery Volume Summary Report (QP1A2RCY) that is produced together with the System Recovery Report to identify the locations for the required tape volumes.

Table 4 contains a summary of the steps that are required for a full system recovery. Tape automation requires a minimum level of system functions to be recovered before automatic cartridge mounting can occur. In general, 3494 tape automation can occur after the configuration data is restored. For V3R6 and V3R7, tapes can automatically be mounted for you starting with step 3a, recover the BRMS licensed program, if the media library device is auto-configured, or created by the user. You have to specify the media library name and the volume name on the restore commands to mount the tapes automatically.

Table 4. AS/400 recovery steps (using BRMS/400 and the 3494)

BRMS/400 recovery step	Description	Command
1	Recover Licensed Internal Code	Control panel function (02-D IPL) in manual mode Function code 24 for CISC Install Licensed Internal Code menu for RISC • Option 2 if restoring on a different system • Option 3 if restoring to the same system.
2a	Recover operating system	IPL or install the system menu (option 2)
2b	Perform disk configuration.	Refer to *Backup and Recovery - Advanced*, SC41-4305, if you plan to configure disk protection or user ASPs. In V3R7, this information is in *Backup and Recovery - Basic*, SC41-4304.
3a	Recover BRMS/400 licensed program and data. You may also need to recover libraries named Q1ABRMSFnn. These libraries will be listed in your BRMS/400 Recovery Report.	•RSTLIB QUSRBRM •RSTLIB QBRM •RSTLIB Q1ANRMSFnn
3b*	Recover MLDD, 3494 library driver code (not needed for RISC AS/400 systems).	• RSTLIB QMLD (for 3494 only) • RSTLIB QUSRMLD (for 3494)
3c	Recover OS/400 Media and Storage Extensions.	RSTLIB QMSE
4	Recover BRMS recovery data.	RSTOBJ *ALL QUSRBRM
5	Recover user profiles.	STRRCYBRM *SYSTEM *RESTORE Ensure that *SAVSECDTA has recovered.
6	Recover BRMS/400 required system libraries.	•RSTLIB QGPL •RSTLIB QUSRSYS •RSTLIB QSYS2
7	Recover configuration data.	STRRCYBRM *SYSTEM *RESTORE
8*	Recover IBM product libraries.	STRRCYBRM *IBM *RESTORE
9*	Recover user libraries	STRRCYBRM *ALLUSR *RESTORE
10*	Recover document library.	STRRCYBRM *ALLDLO *RESTORE
11*	Recover objects in directories. This option is not available on V3R1 and V3R6. See 10.4, "Restoring the integrated file system" on page 208, for details.	STRRCYBRM *LNKLIST *RESTORE
12*	Recover spooled files	WRKSPLFBRM

BRMS/400 recovery step	Description	Command
13a*	Apply journal changes	Refer to *Backup and Recovery - Basic*, SC41-4304, for information on how to apply journal changes.
13b*	End subsystems	`ENDSBS SBS(*ALL) OPTION(*IMMED)`
14*	Recover authorizations	`RSTAUT`
15*	Return the system to normal mode.	`PWRDWNSYS OPTION(*IMMED) RESTART(*YES)`
Notes: Step 3b is *only* required for the 3494 library device with V3R1 or V3R2. Step 8 through step 15 require no manual intervention.		

10.2.2 Setting up the tape device for SAVSYS recovery

If you have an automatic cartridge loader or equivalent, insert the cartridges in the correct sequence.

Ensure the media library devices are in the correct mode. For devices other than the 3494, this is automatic/sequential mode or manual mode. See the device documentation on how to properly change the mode for the hardware. The random or library mode cannot be used until OS/400 is loaded.

For the 3494 Automated Tape Library Data Server, use Library Manager to set up the library as a stand-alone device to mount your SAVSYS tape or the Licensed Internal Code distribution tape. See 8.4, "Library Manager for the 3494" on page 160, for more information on setting up stand-alone mode.

If you have multiple tape devices inside the 3494 or multiple 3494s, the device names may vary between the different systems. Notice that for each AS/400 system, the tape drive name and the corresponding device name of the library manager for this device name has to be selected in the stand-alone mode, for example:

```
AS/400          AS/400          Library Manager
System        Tape Device        Device Name

SYSTEM01         TAP01               170
SYSTEM02         TAP01               170
SYSTEM03         TAP01               180
SYSTEM04         TAP01               180
```

SYSTEM01 and SYSTEM02 share the same device, and SYSTEM03 and SYSTEM04 share the other device.

10.2.3 Recovering the Licensed Internal Code and operating system

When you recover from a complete system loss, follow the steps in the Recovering Your Entire System report produced by BRMS/400. You must also follow the steps documented in *Backup and Recovery - Basic*, SC41-4304.

> ┌─ **Important** ───┐
>
> The following steps are for your reference only. You should *not* use them to perform your system recovery. You must *always* use the System Recovery Report produced by BRMS/400, which is customized to your system environment, along with *Backup and Recovery - Basic*, SC41-4304.
>
> Depending on your OS/400 release, the actual step numbers outlined here can change. In addition, reference to any documentation can also change with each release. Where possible, we attempted to identify the key differences between the various releases of OS/400.
>
> └──┘

Select 02-D IPL in Manual Mode on the AS/400 control panel to load the Licensed Internal Code and OS/400 from the alternate IPL device.

Select the required option (function code 24) on the front AS/400 control panel for systems at V3R1 and V3R2. For systems with V3R6 and V3R7, on the Install Licensed Internal Code display, select option 2 if you are recovering to a different system or option 3 if you are recovering to the same system as detailed in *Backup and Recovery - Basic*, SC41-4304.

Step 1 in the following example assumes that you are using V3R1 or V3R2:

```
STEP 1:  Recover Licensed Internal Code
         Use media shown in the this example and the procedure for
         "Recovering the Licensed Internal Code" using function code 24
         in the book in chapter 10.
  Saved                     Save     Save            File   Control
  Item        Type   ASP    Date     Time    Objects Seq    Group       Volume(s)
  *SAVSYS      *FULL  01    6/04/00  20:35:20       0    1   RHSAVSYS    ABC011
```

After you install the Licensed Internal Code, select **Install the Operating System** on the OS/400 installation menu:

```
STEP 2:  Recover operating system.
         Use the media shown here and the procedure for "Restoring the Operating
         System using the Complete Restore Method" as detailed in the Backup
         Recovery - Basic book.
  Saved                     Save     Save            File   Control
  Item        Type   ASP    Date     Time    Objects Seq    Group       Volume(s)
  *SAVSYS      *FULL  01    6/04/00  20:35:20       0    1   RHSAVSYS    ABC011
```

The disk units may be in non-configured status for different reasons so they have to be configured. Refer to *Backup and Recovery - Advanced*, SC41-4305, if you plan to configure disk protection or user ASPs. For V3R7, the disk configuration information is in *Backup and Recovery - Basic*, SC41-4304.

The first sign-on to the system uses no password. Shortly after that, you are asked to change the password for QSECOFR. The display asks for the old password, as well as a new password. The old password for QSECOFR is set to the default value, QSECOFR. This new password display is only for V3R2 and V3R7. On V3R1 and V3R6, no password is required at this time.

To see which tape devices are configured on your system, use the following command:

```
WRKCFGSTS *DEV TAP*
```

10.2.4 Recovering BRMS/400 and system information

When the installation of the Licensed Internal Code and operating system has completed, the BRMS/400 product and associated libraries must be recovered before you can use the product to perform other recovery operations.

At this point on RISC systems, if you had auto-configure on, you can go to random mode on your 3494. You can use the CFGDEVMLB command to update the Robot device name (ROBOTDEV) parameter for the 3494 Automated Tape Library Data Server. See 9.3.3, "Creating a Robot Device Description (ROBOTDEV) for the 3494" on page 170, for more information.

Note: On the restore command, you need to specify the media library device and the volume identifier to have the tapes mounted automatically.

On CISC systems, you must wait until after step 7 when you have restored the configuration data before you can go to random mode.

If you prefer to wait until after step 7 for RISC systems, you should DEALLOCATE the library resource and vary on the tape device. When step 7 is completed, vary off the tape device and vary on the library resource as ALLOCATED (UNPROTECTED). For token-ring attached libraries, you need to vary on the token-ring line.

```
STEP 3:  Recover the BRMS/400 product and associated libraries.
         The BRMS/400 product and associated libraries must be recovered
         before you can use the product to perform other recovery operations.
         Use WRKCFGSTS *DEV *TAP to see which tape devices are configured.
         Then run RSTLIB for each of the following libraries specifying SEQNBR
         and using media as shown below.
   Saved                    Save      Save              File    Control
   Item         Type    ASP  Date      Time    Objects  Seq     Group       Volume(s)
   QUSRBRM      *FULL   01   6/04/00  20:49:29    143     13     RHBRMS      ABC017
   QBRM         *FULL   01   6/04/00  20:50:09    823     14     RHBRMS      ABC017
   QUSRMLD      *FULL   01   6/04/00  20:50:54      8     15     RHBRMS      ABC017
   QMLD         *FULL   01   6/04/00  20:50:56    375     16     RHBRMS      ABC017
   QMSE         *FULL   01   6/04/00  20:51:10      5     17     RHBRMS      ABC017
```

Use the sequence number for the following restore so you are sure to restore the correct objects in case there is more than one item of QUSRBRM on that tape. Using the sequence number also improves performance if you are using a 3590 tape device.

```
STEP 4:  Recover BRMS/400 related media information.
         You must recover this information for the BRMS/400 product to
         accurately guide you through remaining recovery operations.
         To do so, run RSTOBJ OBJ(*ALL) SAVLIB(QUSRBRM) MBROPT(*ALL)
         specifying library name, SEQNBR, and using media as shown below.
   Saved                    Save      Save              File    Control
   Item         Type    ASP  Date      Time    Objects  Seq     Group       Volume(s)
   QUSRBRM      *QBRM   01   6/05/00   8:21:30     10      1     RHBKUGRP    ABC592
```

Before you recover the user profiles, clear the BRMS/400 device and media library information, and initialize the files with the tape devices currently configured on the system. Use the command:

```
INZBRM OPTION(*DEVICE)
```

Verify your BRMS/400 device and media library information for the correct settings (for example, next volume message, densities, device location, shared devices, and so on). Some of the values are reset to the defaults when you use the `INZBRM OPTION(*DEVICE)` command.

Note: On the V3R6 recovery report, there is no mention of INZBRM OPTION(*DEVICE) in step 5 even though it is available. On V3R1 systems, you have to use the WRKDEVBRM command to verify the device information.

```
STEP 5:  Recover user profiles.
         Before recovering user profiles, use the INZBRM *DEVICE command to clear
         the BRMS/400 device and media library information and initialize the files
         with the tape devices currently configured on the system.
         You should restore a current version of your system's user profiles.
         To do so, run STRRCYBRM OPTION(*SYSTEM) ACTION(*RESTORE) OMITLIB(*DELETE)
         using media shown in this example.
         Press F9 (Recovery defaults) on the Select Recovery Items display.
         Ensure the tape device name that you are using is correct.  If recovering
         to a different system, you must specify *ALL on the Allow object differences
         (ALWOBJDIF) parameter and *NONE on the System resource management (SRM)
         parameter.

  Saved                      Save      Save              File   Control
  Item        Type   ASP     Date      Time     Objects  Seq    Group       Volume(s)
  *SAVSECDTA  *FULL   01   6/04/00   20:35:20      43      11    RHSAVSYS    ABC011
```

If you are recovering to a different system and your security level is 30 or greater, *ALLOBJ special authority has been removed from all user profiles, except certain IBM-supplied profiles. Use the CHGUSRPRF command to give *ALLOBJ authority to user profiles who need it.

Note: You should use the CHGUSRPRF command to grant *ALLOBJ authority to user profiles after the recovery is complete as detailed in *Backup and Recovery - Basic*, SC41-4304. You should also review the implications of setting the Allow object differences parameter (ALWOBJDIF) to *ALL in *Backup and Recovery - Basic*, SC41-4304. You should only use *ALL when you perform a full system recovery and there is no data on the system. Specifying ALWOBJDIF(*ALL) when you recover to a different system allows the restored data to be automatically linked to the authorization lists associated with the object.

You must restore specific system libraries before you can use BRMS/400 to perform other recovery operations and tape automation. These libraries are QGPL, QUSRSYS, and QSYS2. QUSRSYS contains the tape exit registration information and QSYS2 contains the LAN code for the 3494 media library.

The QGPL library must be restored prior to the QUSRSYS library because there are dependencies in QGPL that QUSRSYS needs.

Step 6 is new a step beginning with V3R6 and V3R2. In V3R1, this step is equivalent to step 5.

```
STEP 6:  Recover BRMS/400 required system libraries.
         You must restore specific system libraries before you can use BRMS/400 to
         perform other recovery operations.  To do so, run STRRCYBRM OPTION(*SYSTEM
         ACTION(*RESTORE) OMITLIB(*DELETE) using media shown below.

  Saved                      Save      Save              File   Control
  Item        Type   ASP     Date      Time     Objects  Seq    Group       Volume(s)
  QGPL        *FULL   01   6/04/00   20:51:11     120      18    RHBRMS      ABC017
  QUSRSYS     *FULL   01   6/04/00   20:51:55   1,045      19    RHBRMS      ABC017
  QSYS2       *FULL   01   6/04/00   20:53:12     104      20    RHBRMS      ABC017
```

You are now ready to restore your configuration data. When you restore the configuration data, you should use F9 to see the restore command defaults from the Select Recovery Items display. If you are restoring configuration data on the same system that you had saved from, you should leave the System resource

management (SRM) parameter set to *ALL. However, if you are restoring on a different system, you should change the parameter to *NONE.

If you have restored the SRM database, and the hardware configuration does not match, to correct the errors, you must refer to the "Correcting Problems with the System Resource Management Database" chapter in *Backup and Recovery - Basic*, SC41-4304.

For RISC AS/400 systems, only token-ring descriptions are found in the SRM database. The SRM database has been incorporated into Hardware Resource Manager (HRM). You should not see the same problems with a corrupted SRM database as with the CISC AS/400 systems.

```
STEP 7:  Recover configuration data.
         You should restore a current version of your system configuration.
         To do so, run STRRCYBRM OPTION(*SYSTEM) ACTION(*RESTORE) OMITLIB(*DELETE)
         using media shown below.
         Use the INZBRM *DEVICE command to clear the BRMS/400 device and media
         library information and initialize the files with the tape devices currently
         configured on the system after you have restored the configuration.
  Item        Type   ASP  Date      Time     Objects  Seq    Group      Volume(s)
  *SAVCFG     *FULL   01  6/04/00  20:35:20     59     12   RHSAVSYS     ABC011
```

For a LAN-attached 3494 Automated Tape Library Data Server, you must vary on the LAN line description. To vary on the LAN description, use the command:

```
WRKCFGSTS *LIN
```

If your 3494 is attached through an RS232 connection, you do not need to vary on the RS232 line description.

Use the following command to clear the BRMS/400 device and media library information and initialize the files with the tape devices currently configured on the system:

```
INZBRM OPTION(*DEVICE)
```

Verify your BRMS/400 device and media library information for the correct settings (for example, next volume message, densities, device location, shared devices, and so on). Some of the information is reset to the default values by using the INZBRM OPTION(*DEVICE) command after you restore the configuration.

10.2.5 Completing the recovery

After the previous step, for CISC machines, the restricted state portion of the recovery is complete so you can return to random/library mode. If you chose not to go to random mode for RISC systems at step 3, you may do so now.

If you used the 3494 in stand-alone mode and there is another cartridge required, the cartridge that is still inside the drive from the stand-alone mode is demounted, and the required cartridge is mounted. On the Library Manager, you see the demount complete display shown as shown in Figure 116 on page 162. You do not have to reset stand-alone mode on the Library Manager; this is done automatically for you.

```
STEP 8:  Recover IBM product libraries.
         You should restore the current version of IBM product libraries on your system.
         To do so, run STRRCYBRM OPTION(*IBM) ACTION(*RESTORE) OMITLIB(*DELETE)
         using the media shown here.
         Press F9 (Recovery defaults) on the Select Recovery Items display.
         Ensure the tape device name that you are using is correct.
  Saved                       Save     Save            File    Control
```

```
Item          Type    ASP   Date      Time       Objects   Seq    Group      Volume(s)
#CGULIB       *FULL   01    6/04/00   19:45:02         4     3    RHBKUGRP   ABC454
#COBLIB       *FULL   01    6/04/00   19:45:02        86     4    RHBKUGRP   ABC454
#DFULIB       *FULL   01    6/04/00   19:45:02         6     5    RHBKUGRP   ABC454
#DSULIB       *FULL   01    6/04/00   19:45:02         7     6    RHBKUGRP   ABC454
#RPGLIB       *FULL   01    6/04/00   19:45:02        58     7    RHBKUGRP   ABC454
#SDALIB       *FULL   01    6/04/00   19:45:02         4     8    RHBKUGRP   ABC454
#SEULIB       *FULL   01    6/04/00   19:45:02         6     9    RHBKUGRP   ABC454
QADM          *FULL   01    6/04/00   19:45:02       178    10    RHBKUGRP   ABC454
QADMDISTP     *FULL   01    6/04/00   19:45:02        15    11    RHBKUGRP   ABC454
QAFP          *FULL   01    6/04/00   19:45:02       132    12    RHBKUGRP   ABC454
QAFPLIB       *FULL   01    6/04/00   19:45:02         2    13    RHBKUGRP   ABC454
QBBCSRCH      *FULL   01    6/04/00   19:45:02       247    14    RHBKUGRP   ABC454
QBGU          *FULL   01    6/04/00   19:45:02        84    15    RHBKUGRP   ABC454
QCBL          *FULL   01    6/04/00   19:45:02        75    17    RHBKUGRP   ABC454
```

In the preceding step, we showed you only a few libraries to restore to give you an idea. In reality, the list is longer than shown in the preceding report. Your BRMS/400 System Recovery Report lists all of the IBM libraries that are required to be restored.

Before the recovery, the display in Figure 139 shows where you can select which libraries to recover, or you can press F16 on the Select Recovery Items display to select all of the libraries. Unless you are absolutely sure of the IBM product libraries that you want to omit, and if you are concerned about the recovery time window, we recommend that you select all of the IBM product libraries.

```
                    Select Recovery Items                        SYSTEMA

  Type options, press Enter.   Press F16 to select all.
    1=Select    4=Remove    5=Display    7=Specify object

      Saved                            Save    Volume     File    Expiration Objects
Opt   Item          Date      Time     Type    Serial     Seq       Date     Saved

      #CGULIB       6/04/00   19:45:02  *FULL   ABC454      3      2/23/01       4
      #COBLIB       6/04/00   19:45:02  *FULL   ABC454      4      2/23/01      86
      #DFULIB       6/04/00   19:45:02  *FULL   ABC454      5      7/09/00       6
      #DSULIB       6/04/00   19:45:02  *FULL   ABC454      6      7/09/00       7
      #RPGLIB       6/04/00   19:45:02  *FULL   ABC454      7      7/09/00      58
      #SDALIB       6/04/00   19:45:02  *FULL   ABC454      8      7/09/00       4
      #SEULIB       6/04/00   19:45:02  *FULL   ABC454      9      7/09/00       6
      QADM          6/04/00   19:45:02  *FULL   ABC454     10      7/09/00     178
      QADMDISTP     6/04/00   19:45:02  *FULL   ABC454     11      7/09/00      15
```

Figure 139. Selecting Recovery Items

You can use the F9 function key to change the recovery defaults as shown in Figure 140. You can set the recovery defaults to specify:

- The tape drive you are using on the device parameter.
- *ALL for the allow object difference parameter if recovering on a different system.
- *ALL for the system resource management parameter if you are recovering on your system. You should use *NONE if you are recovering on a different system.

```
                          Select Recovery Items                   SYSTEMA

  Type options, press Enter.  Press F16 to select all.
    1=Select   4=Remove   5=Display   7=Specify object
   ........................................................................
   :                                                                      :
   :                       Restore Command Defaults                       :
   :                                                                      :
   : Type information, press Enter.                                       :
   : Device . . . . . . . . . . . . . TAP02       Name, *MEDCLS           :
   : End of tape option . . . . . . . *UNLOAD     *REWIND, *LEAVE, *UNLOAD :
   : Option . . . . . . . . . . . . . *ALL        *ALL, *NEW, *OLD, *FREE  :
   : Data base member option . . . . . *ALL       *MATCH, *ALL, *NEW, *OLD :
   : Allow object differences . . . . . *ALL      *NONE, *ALL             :
   : Document name generation . . . . . *SAME      *SAME, *NEW            :
   : Restore to library . . . . . . . . *SAVLIB    Name, *SAVLIB          :
   : Auxiliary storage pool ID . . . . . *SAVASP   1-16, *SAVASP          :
   : System resource management . . . . *NONE      *ALL, *NONE, *HDW, *TRA :
   :                                                                      :
```

Figure 140. Selecting Recovery Items

If the BRMS/400 recovery ends in error or is cancelled using F12, you can restart
the procedure using the STRRCYBRM *RESUME command. The Select Recovery Items
display is set at the library that has to be restored next.

Note: In V3R1, any changes to recovery defaults do not remain in force if the
recovery ends in error or has been cancelled using F12. Beginning with V3R6
and V3R2, the changes in recovery defaults remain until the user signs off the
system.

The next step is to recover user libraries. Depending on how you saved the
libraries, you can choose the STRRCYBRM OPTION (*ALLUSR) or STRRCYBRM
OPTION(*CTLGRP) commands. The latter gives you more control and allows you to
start concurrent restores. In a full restore, BRMS/400 restores full and
incremental saves. You may want to avoid unnecessarily restoring multiple times
by using control groups. You should also give consideration to unnecessarily
rebuilding access paths when restoring your data.

Important

If you used option 21 from the SAVE menu to save your entire system, you
should use option 21 from the RESTORE menu even if you have BRMS/400
installed. You should not mix native save and restore menu options with
BRMS/400 save and resotore process.

The following step only shows you a few libraries for reference. The Recovering
Your Entire System report lists all of the user libraries that need to be restored.

```
STEP 9:  Recover user libraries.
         You should restore the current version of your libraries.
         To do so, run STRRCYBRM OPTION(*ALLUSR) ACTION(*RESTORE) OMITLIB(*DELETE)
         using the media shown here.
         Depending on your recovery strategy, you may choose to use the
         STRRCYBRM OPTION(*CTLGRP) ACTION(*RESTORE) OMITLIB(*DELETE) command to
         restore individual control groups.
         ATTENTION - If you have logical files whose based-on file is in a different
         library, you must restore all based-on files before you can restore the
         logical file.
         If you use journaling, the libraries containing the journals must be
```

```
                        restored before restoring the journaled files.
         Saved                       Save      Save               File  Control
         Item        Type   ASP     Date      Time    Objects    Seq   Group       Volume(s)
         #LIBRARY    *FULL  01    6/04/00  20:17:47        5     113   RHBKUGRP    ABC454
         ASN         *FULL  01    6/04/00  20:17:47        8     114   RHBKUGRP    ABC454
         BRMSTST1    *FULL  01    6/04/00  20:17:47      119     115   RHBKUGRP    ABC454
         BRMSTST2    *FULL  01    6/04/00  20:17:47        1     116   RHBKUGRP    ABC454
         BRMSTST3    *FULL  01    6/04/00  20:17:47       11     117   RHBKUGRP    ABC454
         QDSNX       *FULL  01    6/04/00  20:17:47        3     118   RHBKUGRP    ABC454
         QPFRDATA    *FULL  01    6/04/00  20:17:47        3     119   RHBKUGRP    ABC454
         QS36F       *FULL  01    6/04/00  20:17:47        1     120   RHBKUGRP    ABC454
         QUSRIJS     *FULL  01    6/04/00  20:17:47       62     121   RHBKUGRP    ABC454
         QUSRINFSKR  *FULL  01    6/04/00  20:17:47        1     122   RHBKUGRP    ABC454
         RHAHN       *FULL  01    6/04/00  20:17:47        7     123   RHBKUGRP    ABC454
         SPLMCHRM    *FULL  01    6/04/00  20:17:47      116     124   RHBKUGRP    ABC454
```

STEP 10: Recover document library.
        You should restore the current version of your documents, folders, and mail.
        To do so, run STRRCYBRM OPTION(*ALLDLO) ACTION(*RESTORE) using
        the media shown here. Before you begin,
        use the *Backup and Recovery - Basic* book to determine if
        Document Library Objects need to be reclaimed.
        To do so, run RCLDLO DLO(*ALL).

```
         Saved                       Save      Save               File  Control
         Item        Type   ASP     Date      Time    Objects    Seq   Group       Volume(s)
         *ALLDLO     *FULL  01    6/04/00  20:54:16    3,569      21   RHSAVSYS    ABC011
```

Step 11 is new beginning with V3R2 and V3R7. You can run the STRRCYBRM command with the *LNKLIST value to restore the integrated file system (IFS) objects.

For V3R6, the IFS objects are restored when you restore the LINKLIST item listed under your user libraries in the backup control group. When you restore this control group, your IFS objects are restored.

For V3R1, you have to remember to restore IFS objects manually. In V3R1, there is no special *LINK value or *LNK type, and you cannot use LINKLIST in the STRRCYBRM command. You must use an exit (*EXIT) within the control group that performs a save operation (SAV) of the integrated file system to a save file. Once you recover the library containing the save file, you can use the Restore Object (RST) command outside of BRMS/400 to restore the integrated file system objects. See 6.6, "Saving and restoring V3R1 IFS data with BRMS/400" on page 146, for additional information.

STEP 11: Recover objects in directories.
        Run STRRCYBRM OPTION(*LNKLIST) ACTION(*RESTORE) using the media shown here.

```
         Saved                       Save      Save               File  Control
         Item        Type   ASP     Date      Time    Objects    Seq   Group       Volume(s)
         LINKLIST    *FULL  01    6/05/00   8:26:51    4,072       1   RHBKUGRP    ABC594
```

Step 12 is also new beginning with V3R2 and V3R7. Although the save spooled file support within BRMS/400 is supported since V3R1, the recovery report for V3R1 and V3R6 does not guide you through the actual recovery of the spooled files. With V3R1 and V3R6, you have to remember to use the WRKSPLFBRM command to recover your spooled files.

STEP 12: Recover Spooled files.
        If spooled files were saved, restore your spooled files using the
        WRKSPLFBRM command.

STEP 13: Apply journal changes.
        To determine if you need to apply journal changes, refer to Task 2 -
        Determining Whether You Need to Apply Journaled Changes under the
        chapter of Restoring Changed Objects and Applying Journaled Changes
        as detailed in the Backup and Recovery - Basic book.

STEP 14: Recover authorizations.

```
          You should recover private authorizations if user profiles were
          recovered in an earlier step.
          To do so, end all subsystems using ENDSBS SBS(*ALL) OPTION(*IMMED) and
          then run RSTAUT USRPRF(*ALL). This operation requires a dedicated system
          and can be long running.
```

After the recovery has completed, you should check the job log to ensure all objects were restored and that all authorities were correctly recovered. The job log contains information about the restore operation. Print the job log and any other remaining spooled output.

To print the job log, use the SIGNOFF *LIST command or the DSPJOBLOG * *PRINT command.

The CPC3703 message is sent to the job log for each library that was successfully restored. The CPF3773 message is sent to tell you the number of objects that were restored. Sometimes objects may not be restored for various reasons. You need to identify these objects and take appropriate action to recover these objects.

You must check for all error messages, correct the errors, and restore any missing objects from the media.

STEP 15: IPL
          Return system to normal mode and IPL using PWRDWNSYS OPTION(*IMMED)
          RESTART(*YES).

10.3 Recovering specific objects

If the system is within a network and you want to restore a single library from another system of the network, you have to find the tape that contains the object. You can use BRMS/400 to search for the object in several ways:

- Use the WRKMEDBRM command to list the volumes and select option 13 to list the contents of the volume. If you saved the object details, you can use option 9 to list the objects.

- Search for the library using the WRKMEDIBRM command and use option 9 to list the objects.

- Use the WRKOBJBRM command to list objects directly.

Figure 141 on page 206 shows the parameters for the WRKMEDIBRM command.

```
                    Work with Media Information (WRKMEDIBRM)

 Type choices, press Enter.

 Library  . . . . . . . . . . . . > RHAHN*          Name, generic*, *ALL...
 Volume . . . . . . . . . . . . .   *ALL            Character value, *ALL
 Auxiliary storage pool ID  . . .   *ALL            1-16, *ALL
 Control group  . . . . . . . . .   *ALL            Name, *ALL, *BKUGRP...
 Save type  . . . . . . . . . . .   *ALL            *ALL, *FULL, *CUML, *INCR...
               + for more values
 Select dates:
   From date  . . . . . . . . . .   *BEGIN          Date, *CURRENT, *BEGIN, nnnnn
   To date  . . . . . . . . . . .   *END            Date, *CURRENT, *END, nnnnn
 Save status  . . . . . . . . . .   *ALL            *ALL, *NOERROR, *ERROR
 Sequence option  . . . . . . . .   *DATE           *DATE, *LIB, *VOL
 Entries to be displayed first  .   *LAST           *LAST, *FIRST
 From system  . . . . . . . . . .   SYSTEM02
 Output . . . . . . . . . . . . .   *               *, *PRINT
```

Figure 141. Work with Media Information (WRKMEDIBRM)

You have to press Enter to see these last two entries. The default is *LCL to search the local system. However, you may enter the location and network identification of another system in the network to work with that system. If the entry in the Receive media info parameter of the system group is set to *LIB, all library entries from the history of the remote system are on your system. Otherwise, a DDM link is activated and you receive the information from the remote system. The values in the FROMSYS parameter are ignored if you specify a volume identifier in the VOL parameter. In this case, the values associated with the volume are used.

When you press Enter, the Work with Media Information display is shown (Figure 142). Select option 7 to select the library to restore.

```
                    Work with Media Information                 SYSTEM02

   Position to Date . . . . .

   Type options, press Enter.
     2=Change   4=Remove   5=Display   6=Work with media   7=Restore
     9=Work with saved objects


       Saved                          Save   Volume    File  Expiration
 Opt   Item         Date     Time     Type   Serial    Seq     Date


       RHAHN      6/10/00  17:51:58  *FULL  RH0002      1   *VER 002
   7   RHAHN2     6/10/00  17:52:17  *FULL  RH0002      2   *VER 002
```

Figure 142. Work with Media Information display

Since there may be more than one entry, make sure you choose the entry with the date and time that correspond to the save from which you want to recover.

When you press Enter, a confirmation display is shown (Figure 143).

```
                      Select Recovery Items                    SYSTEM02

 Type options, press Enter.  Press F16 to select all.
   1=Select   4=Remove   5=Display   7=Specify object


       Saved                            Save   Volume   File  Expiration Objects
 Opt   Item            Date      Time   Type   Serial   Seq     Date     Saved

  1    RHAHN2       6/10/00  17:52:17  *FULL  RH0002     2   *VER 002        8
```

Figure 143. Select Recovery Items display

Use F9 to change the recovery default options and F14 to submit to batch if required.

This procedure can be used between systems with different releases and also between systems with CISC and RISC OS/400 releases. If you restore to a previous release, you have to select your save with the Target release parameter, specifying the release to which you are going. This can be selected in the backup control group or in the save commands such as SAVLIBBRM or SAVOBJBRM.

At the completion of the recovery, you receive a message that tells you how many objects have been restored. Use the following command to look at the recovery activity:

DSPLOGBRM *RCY

If you have not saved object detail, you cannot use BRMS/400 to search for the object. However, you can still restore it if you know its name. At this point, if you replace option 1 with option 7 (Specify object), you are prompted with the Restore Object Display (Figure 144).

```
                       Restore Object (RSTOBJ)

 Type choices, press Enter.

 Objects  . . . . . . . . . . . .              Name, generic*, *ALL
               + for more values
 Saved library  . . . . . . . . > QUSRBRM      Name
 Device . . . . . . . . . . . . > TAP01        Name, *SAVF
               + for more values
 Object types . . . . . . . . . > *ALL         *ALL, *ALRTBL, *BNDDIR...
               + for more values
 Volume identifier  . . . . . . > RH0002       Character value, *MOUNTED..

 Sequence number  . . . . . . . > 0003         1-9999, *SEARCH
 Label  . . . . . . . . . . . .   *SAVLIB
 End of tape option . . . . . . > *REWIND      *REWIND, *LEAVE, *UNLOAD
 Option . . . . . . . . . . . . > *ALL         *ALL, *NEW, *OLD, *FREE
```

Figure 144. Recovering individual objects

10.3.1 Recovering individual user profiles

Beginning with V3R7, you can recover individual user profiles in a similar manner to recovering objects.

In earlier versions, when you save user profiles using *SAVSECDTA in a backup control group, you can select Retain Object Detail. If you run the WRKMEDIBRM command and select option 9 on the *SAVSECDTA line, a display is shown with all of the user profiles listed. However, if you select option 7 (Restore on a single user profile), you receive the error message `BRM1659 - Restoring security data not valid`.

The only way to restore a single user profile is to use the native OS/400 RSTUSRPRF command.

10.4 Restoring the integrated file system

Beginning with V3R6 and V3R2, BRMS/400 has been enhanced to support save and restore of the integrated file system. The integrated file system information is saved from BRMS/400 by using a control group to perform the save. There are no new BRMS/400 commands to save and restore the integrated file system information. The new BRMS/400 function is implemented through a backup item called LINKLIST and a list type of *LNK.

Beginning with V3R7, there is a new special value called *LINK. See 6.5, "Restoring IFS directories with BRMS/400" on page 142, for more details on the integrated file system.

For V3R1, you can only save the integrated file system using the SAV command in a *EXIT in a control group. BRMS/400 recovers the library where you processed the SAV command. However, you must use RST outside of BRMS/400 to recover the integrated file system. See 6.6, "Saving and restoring V3R1 IFS data with BRMS/400" on page 146, for more information.

Chapter 11. Planning for upgrades to PowerPC AS

This chapter discusses the issues and considerations that you need to investigate when you have the BRMS/400 licensed program installed and you are planning to upgrade your IMPI processor to a PowerPC AS processor (CISC to RISC). At all times, you must follow the instructions documented in the *AS/400 Road Map for Changing to PowerPC Technology*, SA41-4150, for all your upgrade methods. The latest edition contains additional updates on the steps that are related to BRMS/400. We provide this list these for planning purposes only:

- Ensure that you have the following books available:

  - *AS/400 Road Map for Changing to PowerPC Technology*, SA41-4150
  - *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171)
  - *Automated Tape Library Planning and Management*, SC41-5309

- BRMS/400 stores information that depends on your system name (SYSNAME network attribute). If your target system has a different system name than your source system, order and read Informational APAR II09475.

- Informational APAR II09772 is an index to all informational APARs about BRMS/400. You should check this index for new information periodically during your upgrade process.

- PowerPC AS releases handle media libraries differently than IMPI releases of OS/400. If you have media libraries, you should order *Automated Tape Library Planning and Management*, SC41-5309, for your target release before you begin the upgrade process. This book describes the differences in how the system handles media libraries. You can use it to help you plan the changes you might need to make after you upgrade.

If you have access to the Internet, use the following procedure to find current information about upgrading BRMS/400 and other IBM products:

1. Access the AS/400 service home page:

   `http://as400service.rochester.ibm.com`

2. From the Service page, select **AS/400 Authorized Program Analysis Reports (APAR)**.

3. From the APAR page, select all Informational APARs.

4. Use the search function to find Informational APARs about BRMS/400 (or other licensed programs that you have installed).

11.1 Preparing BRMS/400 on your source system

Complete the following steps before you begin the upgrade procedure:

1. To create a printed record of your BRMS/400 device information, follow these steps:

   a. Type the `WRKDEVBRM` command and press the Enter key. You see the Work with Device Information display with a list of the devices that BRMS/400 uses on your system.

   b. Press the Print key.

c. In the Opt column next to the first device, type `5` (Display). You see the Display Device Information display.

d. Press the Print key.

e. Page down to display additional information about the device.

f. Press the Print key again.

g. Press F12 (Cancel). You return to the Work with Device Information display.

h. If you have another BRMS/400 device, repeat steps c through g for the next device.

i. Retrieve your printout from the printer. Save it for use at the end of your upgrade process.

2. If you are using the side-by-side upgrade method, continue with step 4.

3. If your source system is part of a BRMS/400 network (sharing a media device with other systems, for example), you need to remove your system from the BRMS/400 network before you start the upgrade process. Complete the following steps:

    a. Locate your copy of *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171).

    b. To ensure that the other systems in the BRMS/400 network have current information from your system, type the following command:

        `DSPPFM QUSRBRM/QA1ANET`

        Press the Enter key. You see the Display Physical File Member display.

    c. If you see the `Selected member contains no record` message, continue with step e. If other systems in your BRMS/400 network are listed in the file member, you need to establish communications with those systems.

    d. Wait until communications is established. Then return to step a.

    e. Follow the instructions in *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) to remove your source system from your BRMS/400 network. Specify `*NO` for the Remove media records parameter.

4. To ensure that your source system has a critical PTF installed, use the Display PTF (`DSPPTF`) command. If your source system is running V2R3M0 or V3R0M5, type the command:

    `DSPPTF 5798RYT`

    If your source system is running V3R1 or a later release, type:

    `DSPPTF 57nnBR1`

    Replace *nn* with the appropriate number for your release.

5. On the Display PTF Status display, look for the appropriate PTF for your release:

    V2R3M0 - SF26727
    V3R0M5 - SF26727
    V3R1M0 - SF35187
    V3R2M0 - SF35188

6. If you do not have the appropriate PTF applied, order it and apply it. You *must* apply the PTF for your release before you begin the upgrade process.

11.2 BRMS considerations for saving user information

As part of the upgrade process, we strongly recommend that you use the Enhanced Upgrade Assistant tool to perform your save, prior to upgrading to your AS/400 system using PowerPC technology. After the upgrade is successful, you can continue using BRMS/400 for your normal operations.

Before you begin your save using the Enhanced Upgrade Assistant tool, you must complete the following tasks:

1. Sign on the system console or a workstation that is assigned to the controlling subsystem. Sign on with a user profile that has all the authorities that Enhanced Upgrade Assistant requires, such as QSECOFR. This ensures that you have the authority that you need to place the system in the necessary state and to save everything.

2. Make sure that Client Access is not active at your workstation.

3. If you plan to run the save procedure immediately, make sure that no jobs are running on the system. Use the `WRKACTJOB` command.

   If you plan to schedule the save procedure, send a message to all the users that informs them when the system will be unavailable.

4. If you use the LAN server, QNetWare, or Lotus Notes licensed programs, you *must* vary off the network server descriptions before you begin the save procedure.

5. If you are using MQSeries (5763-MQ1 or 5763-MQ2), you need to quiesce MQSeries for OS/400 before you save the system.

6. Mount the first tape.

> **BRMS considerations**
>
> - Do *not* use BRMS/400 to perform this save operation.
>
> - Perform the following steps to disable BRMS/400 from this system:
>   1. Type: `WRKPCYBRM *SYS`
>   2. Select option `1` (Change System Policy).
>   3. Change the Media Monitor parameter to `*NO`.
>
> - Do *not* use tapes that are enrolled in BRMS, contain active data, or are in a media library device. Ensure the tape volumes you use are scratch volumes, and label your tapes correctly.
>
>   **Note**: If you are using a shared media inventory environment with BRMS/400, the tapes you use to perform the save for the upgrade are not protected from being overwritten while the BRMS/400 media monitor is turned off.
>
> - This save operation does not affect the information that BRMS/400 stores for managing the process of saving changed objects.

7. If you are using a 3494, 9427, 3570, or 3590 media library device for the save, the media library device cannot be in random or library mode. The media library device must be in stand-alone, automatic, sequential, or manual mode. Refer to the *Operator's Guide* for your media library device for instructions on setting the correct mode.

8. After the save has completed successfully, you need to return to the original configuration for BRMS/400 and media library devices.

   a. Perform the following tasks to enable BRMS/400 after the save:

      i. Type: `WRKPCYBRM *SYS`
      ii. Select option `1` (Change System Policy).
      iii. Change the Media monitor parameter to `*YES`.

   b. Return the media library device back to random or library mode if you had changed it prior to the save operation.

11.3 Preparing BRMS/400 on your target system

To prepare BRMS/400 to run on your target system, complete the following steps:

1. Check the PSP document for your target release to determine whether you need to order and install any critical (HIPER) PTFs that affect BRMS/400 or automated tape libraries.

2. If you have not already updated license information for the BRMS/400 licensed program, complete the following steps:

   a. Type `WRKLICINF` and press the Enter key.

   b. On the Work with License Information display, locate product 5716BR1.

   c. In the option column next to 5716BR1, type `2` (Change) and press the Enter key. You see the prompt display for the Change License Information (CHGLICINF) command.

   d. For the Usage limit parameter, specify the value from your BRMS/400 license agreement. Press the Enter key. You see the CPA9E1B message `Usage limit increase must be authorized`.

   e. To respond to the message, type `G` and press the Enter key.

3. If you have media library devices, complete the following steps:

   a. Locate your printout of your BRMS/400 device information, which you printed in 11.1, "Preparing BRMS/400 on your source system" on page 209.

   b. To re-initialize your media library devices on your system (because of the differences in how they are handled on PowerPC AS compared to IMPI), type the following command:

      `INZBRM *DEVICE`

      Note: If your system has many devices, this command might run for a long time.

   c. To display the locations for media library devices, type the following command and press the Enter key:

      `WRKMLBBRM`

d. On the Work with Media Libraries display, check the values in the location column. Compare the information on this display to your printout from your source system and make changes if necessary. The location here needs to match the location on the WRKDEVBRM command and the WRKMEDBRM command. If necessary, use option 2 (Change) to make changes.

e. Press F12 (Cancel).

f. To update device information, type the following command and press the Enter key:

   WRKDEVBRM

g. On the Work with Device Information display, type 2 (Change) in the Opt column next to the first device. You see the Change Device Information display. Review the online information and *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) for help with new parameters. The following list contains some guidelines:

   • For the Auto enroll media parameter, specify *YES if you need to mount tapes manually and you want BRMS/400 to use the device.

   • For the Shared device parameter, specify *NO if your system is in a BRMS/400 network.

     Note: This is opposite of what you specified on your IMPI system because the system handles tape libraries different on PowerPC AS releases.

   • For the Shared device wait parameter, specify a value that is appropriate for your network environment. If you encounter wait problems, increase the value by 30 seconds.

h. Review the information in the PowerPC AS version of *Automated Tape Library Planning and Management*, SC41-5309. It describes the differences in how the IMPI and PowerPC AS releases handle media devices. If you want to arrange your tape libraries as a single location, you can order the following PTFs for your target release:

   • V3R6M0: SF33834, MF13080, MF12538
   • V3R7M0: SF35915, MF13404, MF13405, MF13406, MF13407

   On your target system, you need to understand the relationship between media library devices, tape resources, and tape devices. A *tape resource* represents a physical tape unit on your system. Only one device description (either the media library device or the tape device) can allocate a specific tape resource at any given time. Therefore, to use a tape device in stand-alone mode, you must vary off the media library device that has the tape device allocated. Similarly, you must vary off a tape device before you can allocate the tape resource to a media library device.

   On PowerPC AS releases, when you vary on a media library device, the system does not automatically vary on all of the associated resources. You must *allocate* the tape resources from the Work with Media Library Device Status (WRKMLBSTS) display.

   Notice also that the MLDD subsystem and the associated commands no longer exist on your RISC system. Media library functions are integrated in the Licensed Internal Code and OS/400. If you have CL programs or written procedures that use the IMPI commands, you need to update those programs and procedures to use the new media library commands.

i. To review the assignment of media, type the `WRKMEDBRM` command and press the Enter key.

j. Review the location information on the Work with Media display. If media is not assigned correctly, use option `8` (Move) to make corrections.

k. Press F12 (Cancel).

l. Type `WRKCTLGBRM` and press the Enter key.

m. On the Work with Backup Control Groups display, type `8` (Change attributes) in the Opt column next to the first control group.

n. On the Change Backup Control Group Attributes display, check the Backup devices field. If it has a tape device name, correct it to match your new library name. If it is set to *MEDCLS, you do not need to make changes.

o. After you make the changes, press Enter. You return to the Work with Backup Control Groups display.

p. On the Work with Backup Control Groups display, you can use option 2 (Edit entries) to set up your control groups to use new options. Consult the online information or the BRMS/400 book for more information.

q. Repeat steps m through p for any additional backup control groups.

r. Repeat steps m through p for *archive* control groups. Correct the tape library names if necessary.

s. To review your system policy, type `WRKPCYBRM *SYS` and press the Enter key. You see the System Policy menu.

t. Select option `1` (Change system policy).

u. On the Change System Policy display, change the devices to match the new library names (if necessary). Press the Enter key.

v. Use the following command to review and update your move policy (if needed):

    `WRKPCYBRM *MOV`

w. Use the following command to review and update your media policy if needed (the storage location, in particular):

    `WRKPCYBRM *MED`

x. If you have any CL programs that use the SAVxxxBRM commands, ensure that the programs specify the media library rather than the tape device.

y. If you have a 3494 tape library connected to a LAN, make sure that your PC library manager software is at 511.05 or a later level.

4. To update the maintenance information for BRMS/400, complete the following steps:

    a. Type `STRMNTBRM` and press the Enter key. Wait for the system to complete processing. Then continue with the next step.

        Note: When you run BRMS/400 maintenance, the system writes multiple files to your output queue.

    b. Type `INZBRM *REGMED` and press the Enter key. Wait for the system to complete processing. Then continue with the next step.

c. Type STRMNTBRM and press the Enter key. The system registers your BRMS/400 media on your upgraded system and rebuilds the BRMS/400 media tables.

5. If your target system is part of a BRMS/400 network, follow the instructions in Chapter 5, "BRMS/400 networking" on page 97, to connect your system to the network.

   Note: If your source system was previously part of the network, make sure that you follow the instructions for copying current media information into a new file. Also, you should create a backup copy of the QUSRBRM library on each system in the network before you begin.

6. If your target system is part of a BRMS/400 network that has both PowerPC AS and IMPI systems, do *not* use the networking feature that provides sharing of library-level information. If your network has *all* PowerPC AS systems, you can complete the following steps to share library-level information:

   a. Type WRKPCYBRM *SYS and press the Enter key.

   b. On the Work with Policy menu, select option 4 (Change network group).

   c. On the Change Network Group display, specify *LIB for the Set the receive media information parameter.

11.4 Re-synchronizing BRMS/400 after an upgrade

If you are performing your upgrades using the side-by-side upgrade method or the staged upgrade offering where both your source system and the target system are running in parallel, you need to re-synchronize the target system. This ensures that the data that has changed on the source system is duplicated on the target system. Because of the complexities involved during object conversion on PowerPC AS systems, and due to the changes that happen during the installation of the licensed programs, you *must* carefully plan how to perform this re-synchronization. Your first step is to follow the instructions documented in Chapter 29 in *AS/400 Road Map for Changing to PowerPC Technology*, SA41-4150. These instructions provide an overall view of the steps that need to be carried out.

To re-synchronize the BRMS/400 licensed program, complete the following steps:

1. On your *production system*, stop all activity that might place locks on objects in the BRMS/400 libraries. If you have scheduled jobs that use BRMS/400, you need to hold them.

2. Mount a tape that is compatible with the tape unit on your test system.

3. Type the following command:

   ```
   SAVLIB LIB(QBRM QUSRBRM) DEV(tape-device)
   ```

   Note: If you want, you can use save files and transfer the libraries electronically.

4. On the *test system*, complete the following steps:

   a. Stop all activity that might place locks on objects in the BRMS/400 libraries. If you have scheduled jobs that use BRMS/400, you need to hold them.

   b. Save BRMS/400 licensed program, so when you reinstall the licensed program, you do not have to go through applying PTFs again:

```
SAVLICPGM LICPGM(5716BR1) DEV(tape-device)
```

c. Delete the version of BRMS/400 that is on your test system. Type the following command:

```
DLTLICPGM LICPGM(5716BR1)
```

d. Mount the tape that you created in step 3.

e. To restore the BRMS/400 libraries, type the following command:

```
RSTLIB SAVLIB(QBRM QUSRBRM) DEV(tape-device)
```

f. Mount the tape to restore BRMS/400 licensed program saved in step b. If a save was not done, go to step g. Otherwise, type the following command:

```
RSTLICPGM LICPGM(5716BR1) DEV(tape-device)
```

Go to step p.

g. Load the IBM-supplied CD-ROM that contains your licensed programs.

h. Type `GO LICPGM` and press the Enter key.

i. From the Work with Licensed Programs menu, select option `11` (Install licensed programs).

j. On the Install Licensed Programs display, page down to locate BRMS/400.

k. Type `1` (Install) in the Opt column in front of BRMS/400 and press the Enter key.

l. Verify the information on the Confirm Install of Licensed Programs display. Then press the Enter key.

m. On the Install Options display, type the name of your optical (CD-ROM) device. Then press the Enter key.

n. Respond to any messages.

o. When the installation process is complete, re-apply any critical BRMS/400 PTFs.

p. To set up BRMS/400 again, repeat the procedures in 11.3, "Preparing BRMS/400 on your target system" on page 212.

11.5 Deleting the libraries for the media library device driver

If you had the Media Device Driver program (5798-RZH) on your source system, you would need the program to perform your save operations successfully. Therefore, you cannot delete it before your final save. However, the functions that 5798-RZH provided on your source system are included in the operating system on your target system. Therefore, you should delete the 5798-RZH libraries. Type the following two commands:

```
DLTLIB LIB(QMLD)
DLTLIB LIB(QUSRMLD)
```

Chapter 12. Planning for the hierarchical storage management archiving solution

This chapter and Chapter 13, "Practical implementation of hierarchical storage management archiving capabilities" on page 261, are taken from the redbook *Complementing AS/400 Storage Management using Hierarchical Storage Management APIs,* SG24-4450. Some updates have been made to address any BRMS/400 functional enhancements since the publication of the original redbook. The authors of this BRMS/400 redbook acknowledge the ITSO project leaders and the ITSO residents who were responsible for documenting this information.

We strongly recommend that you obtain a copy of *Complementing AS/400 Storage Management using Hierarchical Storage Management APIs,* SG24-4450. This redbook provides additional information regarding hierarchical storage management and contains sample code on how you can modify your applications to dynamically retrieve data that is archived using BRMS/400.

This chapter provides a description of how hierarchical storage management is implemented with BRMS/400 archiving (using save with storage freed) and Dynamic Retrieval. It then discusses various application design considerations that you should be aware of to aid in the design and implementation of your hierarchical storage management solution.

For information on the type of objects that you may consider for archiving and how to set up BRMS/400 to produce an operational Dynamic Retrieval solution, see Chapter 13, "Practical implementation of hierarchical storage management archiving capabilities" on page 261.

12.1 Archiving considerations

This section shows details of the points that you may need to take into account when planning your archive strategy. The discussion is limited to technical considerations that may affect the way in which archiving is performed.

For details about the types of data to archive and setting up retention periods, see Chapter 13, "Practical implementation of hierarchical storage management archiving capabilities" on page 261.

12.1.1 How archiving is done by BRMS/400

BRMS/400 uses standard OS/400 save and restore commands for its backup, archive, restore, and retrieve activity. To this end, the actual archiving of an object is achieved using a standard OS/400 save of the object with the Storage parameter set to *FREE. Within this publication, this is known as *save with storage freed*.

Objects selected to be archived are identified by the entire auxiliary storage pool, library, or as lists of objects (known as *archive lists*). The ASPs, libraries, or lists are then included in a BRMS/400 archive control group. Each control group has parameters that control such things as the amount of time the object must have been inactive to be selected for archive, whether save with storage freed is used, and so on. These parameters are known as the *control group attributes*. These details may also be set in the Archive Policy, which sets the defaults to use

unless they are specifically overridden at the control group level. More details of the BRMS/400 setup are found in 13.4, "Setting up BRMS/400 for archive with Dynamic Retrieval" on page 268.

When setting up archive policies for Dynamic Retrieval in BRMS/400, it is important to remember to set the control group entries to allow the objects to be saved with storage freed. This particular parameter can be set as a default value in the Archive Policy. It can also be set in each of the individual control group's attributes. This parameter is explained in more depth later.

The BRMS/400 archive control groups used for save with storage freed also defaults to saving the access paths of the file members. This is a performance consideration, and it may be changed by the user. It means that the object takes longer to save (archive) but eliminates the need for a potentially lengthy access path rebuild on restore (retrieve).

12.1.1.1 Why use save with storage freed?

The important characteristic of save with storage freed is that the object description is left on the system. This object description consumes very little storage space and acts as a place-holder for the object in the system while indicating that the data portion is on tape.

Figure 145 shows the makeup of an AS/400 object and how that object may look after being saved with storage freed. The object description contains only a small amount of data that describes the object, including object name, object type, library name, security information, and so on. This sort of information is found when you process such commands as DSPOBJD, DSPFD, and DSPFFD.

It is the data portion that contains all of the real data to be processed (for example, all of the records in a physical file). This data constitutes the majority of the object size. When objects are saved with storage freed, the data portion is deleted from the system after successfully completing the save. The object description is retained, and the details are updated to record the save date, time, and the media where the data is stored.
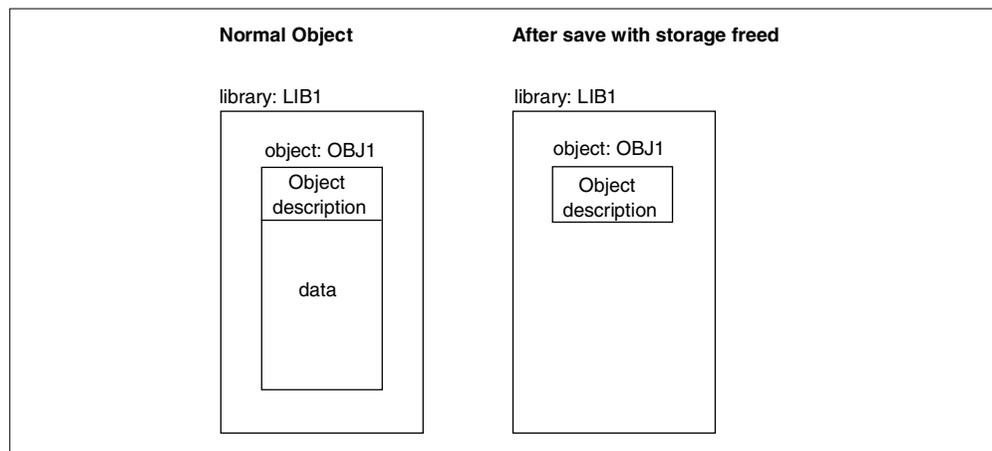
Figure 145. AS/400 objects before and after save with storage freed

Figure 145 shows the structure of an AS/400 object (note that the object description is typically much smaller than the data part) and how save with

storage freed affects an object. Even after save with storage freed, the object description remains in the original library for reference.

When you access the object, the system searches the job's library list or the library name referenced by the object. If the system finds that the data portion of the object is missing (object was saved with storage freed), BRMS/400 proceeds to check its inventory of archived objects to see whether it has indeed been archived by BRMS/400. If the object is found in the BRMS/400 archive inventory, the retrieve of that object can be invoked by BRMS/400.

> **Note**
>
> If an object has been saved with storage freed by any means other than BRMS/400, there is no inventory of archived objects to consult. In this case, BRMS/400 cannot locate and restore the object without manual intervention. The user receives the standard OS/400 CPF4102 message `File in library with member not found`.
>
> An example of this situation may be issuing a native OS/400 SAVOBJ command using the STG(*FREE) parameter. Dynamic Retrieval is not possible for this object through BRMS/400.

If the object that has been saved with storage freed is not one of the supported object types for the Dynamic Retrieval function, BRMS/400 is aware that the object has been archived and can assist an operator in locating the correct volume. However, the automatic initiation of a retrieve operation is not possible. The user or job that was attempting to access the unsupported object receives a standard OS/400 error condition (CPF4102) indicating that the object has been saved with storage free. The user or operator must consult the BRMS/400 archive inventory to locate the object and manually initiate its retrieval. This can also be done from BRMS/400 using the Work with Saved Objects (WRKOBJBRM) display or by using the Restore Object using BRM (RSTOBJBRM) command.

You can modify an existing application to support certain objects that are not supported for Dynamic Retrieval by BRMS/400. The additional application code needs to manage the types of OS/400 error messages returned for the objects required and to interrogate the BRMS/400 inventory and initiate a BRMS/400 restore operation.

12.1.1.2 What happens when archiving without storage freed

The save with storage freed solution is simple in its design and execution. The only alternative available to save with storage freed is to delete the object entirely. However, you should consider the following scenarios.

Library list search

Suppose you are running two similar environments for the same application. One is a development environment for testing new code releases, and the other is the live production environment with which you are running your business. For ease of migration and copying live data to your test environment, you may well decide to keep exactly the same file names for each environment but store them in different libraries. This way, a simple change of the library name order in your library lists causes a transition.

Suppose you have been running at a particular release for a while and suddenly some of your production environment file members begin to be archived (with an entire delete, no save with storage freed). Now when you come to access a particular production environment file member that has been archived, you cannot find the file member at all in the production library. The search through your library list continues until you now find a file member of the same name in the test library.

The file member you are now opening to access is not the one you need. It contains test data, which may be vastly different from your production data. The point of most concern is that you are not aware that this has happened.

Private authorities
When an object is deleted from the system and restored at a later date, the private authorities that are assigned to it are lost until a restore authority (RSTAUT) is run. Consider also that RSTAUT can only be run in a restricted state, and even then, it can only be run after a restore of user profiles has been executed.

Add this to the fact that you have to run RSTAUT for all user profiles on the system because you do not know which users had private authorities to that object. It quickly becomes clear that an ad hoc restore of an archived object that was deleted entirely from the system is not as simple as the storage freed implementation.

Restore performance
When restoring an object that has been saved with storage freed, OS/400 has less work to do because it does not need to completely build a new object for the restore of an object that has been deleted. As such, Dynamic Retrieval performs better in this case. This is more beneficial for smaller files because the "create" part of the restore is a larger percentage of the entire process.

For these reasons, and there are possibly others, it is considered impractical to use a solution that deletes the object entirely. The save with storage freed solution appears far more integral, secure, and simple.

Important

When the object is saved with the STG(FREE) option, the object headers cannot be saved again using the standard OS/400-supplied save commands as the system overlays new tape volume information. You receive the CPF3243 message `Member xxxxx already saved with storage freed` in your job log. This is *expected* since you do not want to overwrite the volume information in the object header, which provides the important link to where your data is.

One of the advantages of using BRMS/400 is that it uses the Media Storage Extension (MSE) to save the object headers. You can, therefore, migrate your data to another system. Without the MSE feature, you *cannot* transfer the object header information to another system. You have to first restore all your archived data, save the objects on SYSTEMA, restore on SYSTEMB, and then re-archive the objects.

12.1.2 The BRMS/400 double save for archiving

BRMS/400 implements its archiving of objects using a double save technique, which is explained here:

1. Save the objects to tape (no save with storage freed).

2. Update the BRMS/400 inventory to indicate that the objects have been archived.

3. Save the objects to a temporary save file with storage freed.

4. Delete the temporary save file.

> **Note**
>
> These steps are used for archiving objects while retaining the object description. For archiving where no object description is required to be retained, steps 3 and 4 change to delete the object. We concentrate on the save with storage freed implementation in this book because this is required for Dynamic Retrieval. See 12.1.1.2, "What happens when archiving without storage freed" on page 219, for reasons why BRMS/400 uses save with storage freed.

Why BRMS/400 uses the double save

The principle reason for the double save approach is that of data integrity. You must ensure that an object is saved successfully *before* you update your BRMS/400 inventory. And yet you must ensure that the BRMS/400 inventory update has completed successfully before you delete the object's data portion.

You must ensure that if the process fails at any point between the transaction boundaries, it can be recovered. The main limitation here is the difficulty of recovering a save with storage freed operation without significant manual intervention, for example, re-mounting the tape. Nor can you perform the updates to the BRMS/400 inventory before the save operation because BRMS/400 relies on the output file information from the OS/400 save operation to update its inventory.

To illustrate the point, consider a single save solution, which may work as shown in the following process (without a double save):

1. Save objects to tape with storage freed:

   a. Save object 1 to tape.
   b. Delete object 1 data portion.
   c. Save object 2 to tape.
   d. Delete object 2 data portion.
   e. Save object 3 to tape.
   f. Delete object 3 data portion.
   g. ... and so on ...
   h. Send the completion details to BRMS/400.

2. Update the BRMS/400 inventory:

   a. Update object 1 archive details.
   b. Update object 2 archive details.
   c. Update object 3 archive details.
   d. ... and so on ...

3. Commit the archive transaction.

Note: Step 1 can be a result of a multiple save operation such as:

```
SAVOBJ OBJ(FILEA FILEB FILEC) LIB(LIB1) DEV(TAP01) OBJTYPE(*FILE)
       FILEMBR((FILE1 (MBR1A MBR1B)) (FILE2 (MBR2C)) (FILEC))
       STG(*FREE)
```

Now consider the various *failure points* in this cycle:

- Any failure during the save with storage free operation (step 1) leaves the system with some objects saved to tape and their data portions deleted, but BRMS/400 does not know anything about this. The implication here is that the object data portion has effectively been "lost" by BRMS/400 for all of the objects processed so far.

- Any failure during the BRMS/400 update operation (Step 2) implies that BRMS/400 has "lost" all of the object data portions that have not yet been updated.

In both cases, you can only recover the operation if you can identify which tapes the storage freed objects were saved to, and then do a manual restore of these objects.

When the double save is implemented, you do not delete the data portion of the objects until you have completed the BRMS/400 inventory update. While this is a much more satisfactory solution, there are some considerations that must be taken into account when using archive with the save with storage freed option.

Consider these points due to the double save:

- **Performance**: If archiving becomes an extensive part of the system management processes, the double save impacts the performance that you should expect to see from archiving. Effectively, the times involved can be doubled. Typically though, the objects being archived are not in use, so this does not impact the availability of an application or the system.

- **Disk space**: It is possible that certain archive operations (for example, a group of large file members) can create a large temporary save file. The spare capacity of your DASD should be adjusted to compensate for this. The save file is created in the QTEMP library and is deleted should the job end abnormally. However, it still requires some space on disk when the job is active.

- **Journal entries**: If a file is being journaled when it is archived with save with storage freed, there are two save entries in its journal receiver. The second save (to the temporary save file) is actually sent with "update history" *NO. This should not affect your applying journal changes in a recovery situation, but the attentive user may notice these extra save entries in the receiver. If your recovery strategy includes removing journal changes, there are some considerations that apply, which are discussed in 12.11, "Applying journal changes to archived data files" on page 235.

- **Object locking between saves**: To provide data integrity between the two versions of the saves, each object that has undergone the first save is allocated (locked) to prevent updates occurring until the completion of the second save. The implication here is that objects being archived with save with storage freed are locked out for the entire three-stage process (save, update

BRMS/400, save). Under normal conditions, this should not affect an object's accessibility because the objects being archived by definition are not in use since that is why they are being archived.

12.2 Normal-aged file member archiving

It is intended that the typical use of the archive and retrieve function revolve around file members that have not been used for a significant amount of time. We refer to these file members as "dormant" file members. You can find more details about the types of files (and the applications that use them) that may apply for Dynamic Retrieval in 13.1.1, "Types of objects to archive for Dynamic Retrieval" on page 261.

12.2.1 Database file members

When planning the archiving of data files, you must remember that the support for Dynamic Retrieval is based at the file member level. The main points to consider include:

- How critical is the file member data to the successful operation of the business?

- What are the legal requirements for retention of the data in the file member?

- What is the size of the file member?

- How frequently is it accessed?

- What is the nature of the application (or applications) that uses this file member?

- What is the impact to the application of having to retrieve a file member from tape?

- What is the restore time for this file member?

- What type of access is required: read, update, or add?

- How long is a period of inactivity regarded as sufficient to mark this file member as dormant?

- How long should the file member be kept at all (that is, how long to keep the tape copy)?

- What security is required for the tape copy of the file member?

- What backup (duplication) of the file member tape copy is necessary?

Tabulating the answers to these questions is the first step in establishing the optimal system setup and BRMS/400 configuration.

The file members may be grouped according to common archive and retrieve characteristics and entered into archive lists within BRMS/400. These archive lists may, themselves, be grouped according to common parameters concerning the method of archiving them and entered into control groups within BRMS/400. The control groups' attributes are tailored, and the groups are scheduled to run on a regular basis. Archiving can be run to produce only an Archive Candidate report or to actually perform the archive itself. Whether you run the report first depends on the items in your archive lists and control groups. More details about BRMS/400 configuration is available in 13.3, "Using BRMS/400 for hierarchical storage management" on page 267.

Typical characteristics of database files depend on the application that uses them. A transaction-based application (for example, telephone order processing) can amass records as time passes. These records tend to become dormant at a certain point in time (for example, when the order has been fulfilled and payment received) and, therefore, become historical data for auditing purposes. There may even be a second level of dormancy once an auditing period is over (for example, at the close of the financial year). At each stage, the status of the data changes. A business decision based on knowledge of the volatility of the data at the various stages and access requirements must be made as to when the data becomes dormant.

This may be easier to perform at a record level. Further complications arise when records at different stages in their application life share the same file member. Archiving must be performed at the file member level. Further considerations connected with record level versus member level archiving are available in 12.16, "Application design considerations" on page 245.

An application with more random access characteristics (for example, an expert system to diagnose medical conditions) demonstrates a much different file access profile than that of a transaction based one. Typically, much of the data may already be collected and arranged (for example, symptom data) before the application was started. There may be a core of data frequently accessed (for example, the symptoms of the more common ailments) and a much larger set of infrequently used data. A large amount of the data may never be updated (that is, many ailments have a stable set of symptoms). There is a great opportunity here to amass an extremely large "dictionary" of information.

Many applications have a mixed environment of file usage characteristics. A warehousing application may have a fairly low volatile parts list entity since the parts stored may not change frequently. However, the stock level entity is highly volatile as new stock arrives and items are sent for delivery every day.

Section 13.1.1, "Types of objects to archive for Dynamic Retrieval" on page 261, lists and classifies the various file access characteristics in tabular form. It also suggests suitable configurations for archive and retrieval.

12.2.2 Source file members

Source file members are archived in exactly the same way as database file members. The differences occur in the questions you may need to ask when establishing the best method of implementation. The key differences are:

- Normal business applications do not directly use (open, read, update) source file members. Application development tools (which are applications in their own right) may be using source files for editing or compilation, but the usage patterns differ greatly from database files.
- It is less likely that queries are run over source file members.
- Access is typically interactive for update and batch for read only.

12.3 Application swapping

One use for archiving with Dynamic Retrieval is to move one application off of a system to make space for another. This can be done on a regular basis, swapping

back and forth every month, week, or even day. Typical scenarios for using such a function may include:

- **Outsourcing**: The outsourcing supplier may be able to deliver results to a different customer each week with a monthly cycle while only using one processor for all four customers.
- **Period end processing**: Other applications may be temporarily removed from the system at a period end to allow space for dedicated processing.
- **Overnight batch**: Working day applications can be suspended to allow for the comprehensive overnight batch runs that are needed.

Moving applications and their data is a complex operation. Some points to consider before you attempt anything of this scale are:

- The movement of data to and from tape consumes a significant amount of time and processor resource.
- As the amount of data copied to tape is increased, so is the risk of exposure to data loss through media errors and tape or disk hardware failures.
- Capacity planning for a system with constantly changing application portfolios is difficult.
- Controlling unwanted access to applications that should be off-line at the time may be difficult.
- Although Dynamic Retrieval ensures that no unnecessary data is restored to the system at the application switch-over point, it gives rise to extensive start-up times while waiting for restore operations.
- The concept of Dynamic Retrieval is not designed with such heavy use in mind. The queuing of disparate individual ad hoc restore requests results in a much slower restore time compared to a complete uninterrupted sequential restore of the equivalent volume of data.

For these reasons, we *do not* recommend that you attempt to implement such a scenario.

12.4 Logical files

It is hoped that most logical files are significantly smaller in size than the physical files over which they are built. In cases where this assumption is true, it is satisfactory to avoid archiving logical files even if the physical files on which they are based have been archived to tape.

There are times when the size of a logical file may grow to a significant level compared to that of the physical. In this case, it is desirable to archive the logical file if it becomes dormant.

> **Note**
>
> Saving a logical file with storage freed does not free any storage space. Doing so performs a save of the object. None of the access path information is deleted from the logical file since this is part of the object description; there is no actual data component to be freed. When we refer to archiving logical files in these sections, we mean archiving with total object deletion. The retrieval of the logical file is not an automatic one, although BRMS/400 can be used to assist with the location of the tape and restore operation.

There are some scenarios where it seems of little point to keep a logical file on the system:

- The logical file has not been used for so long that it may be regarded as disused (for example, test files that were never deleted or files that supported previous releases).

  In this case, the file is simply archived by deleting the object description. It is assumed that Dynamic Retrieval is not needed for this file.

- The physical file on which the logical file is based has been archived.

  In this case, it might be appropriate to archive *all* of the logical files connected with this file. However, consider the following points:

  - Some of the logical files may be so small that there is little to be gained from archiving them.

  - Because the physical file may be restored to the system with the Dynamic Retrieval function (and the logical may not), the archive parameters need to be set differently. That is, you have to be *very* sure that the logical file is not needed for a longer time than for the physical file.

  - For multiple format logical files (over multiple physical files), it is possible that a logical file may not access *all* of the physical files to which it is attached for any one request operation. If this is sustained over a length of time, one of the physical files may be archived, but not the others. In this case, you need to keep the logical view online. Note that this does not apply to *join logical files*.

In extreme cases where the migration of logical files is needed, it may be appropriate to archive them by deleting with BRMS/400, but assign a much longer inactivity period to the group of logical files. This ensures that the logical files are indeed dormant for an extended period of time and perhaps even disused, therefore, minimizing the impact of their ineligibility for Dynamic Retrieval support.

> **Performance of multi-format and join logical files**
>
> Access through a multiple format or join logical file may cause the retrieval of several physical file members. Each physical file member retrieve operation is performed separately and independently of any other operations. You notice a logical file access path rebuild for each physical file member that is retrieved. Therefore, you may create a situation where a string of access path rebuilds is performed when one final rebuild would have sufficed. You cannot override the access path rebuild to *DELAY because you cannot predict which physical file members (if any) are retrieved unless you are retrieving in *DELAY mode and you are using the Resume Retrieve using BRM (RSMRTVBRM) confirm display. See 12.8, "Retrieval methods" on page 231, for more information.
>
> You should be aware of the performance implications of the multiple access path rebuilds that are caused by archiving physical files under either multiple format or join logical files.

12.5 Duplicating your archive tapes

The implication of archiving an object is that it is saved and deleted or storage freed in one operation. Therefore, the ability to check whether the save to tape is successful before you delete it is reduced. Despite the extensive error checking and correction routines of modern tape device technology, the only true test of a successful save is to check whether the object can be read successfully in its entirety.

Also, it is possible that eventually all other copies of an object that have been saved in the normal backup procedure will expire, leaving only one copy (on tape) of the archived object. This is the most up-to-date copy.

The data loss exposure created by data archiving is two-fold:

• There is limited verification of a successful save before deletion.
• There is eventually only one copy of the object in existence.

For these reasons, we recommend that you duplicate immediately *tape copies of archived data* and move the duplicate copy to an off-site storage location. The following recommended procedure may be followed to address these issues.

12.5.1 Archive tape duplication process

Follow these steps for the tape duplication process:

1. Execute the normal regular backup procedure.

   This may be the daily, weekly, or monthly save.

2. Immediately after the backup has completed, initiate the archive process.

   Ensure that the archive coincides with the backup of the same frequency. That is, if archiving is done on a weekly basis, start the archiving procedure after the weekly backup. This means that there are at least two copies of the objects on tape, one from the backup and another from the archive in case of a media error.

It is also important to ensure that for every item on the list of candidates for the archive that is being run, that the inactivity period for qualification is *longer* than the period since the last guaranteed save of that object. That is, if you know that object A has definitely been saved within a month of today, and it cannot qualify for archiving unless it has been inactive for at least a month, you can be sure that the object has not changed since the last save. This ensures a back-out path in case the object was archived to a tape that subsequently has a media error.

It is acceptable to perform the archive while the system is active since objects that happen to be locked at the time of archival are, by definition, not eligible for archive because they are in use. The exceptions to this rule revolve around the definition of "in use". A file may be allocated but not actually opened, although this has no common practical application.

If the inactivity period set within BRMS/400 is zero days, there is a chance that the object can be in use. In this case, these archive jobs should be run at a time when the object is not likely to be in use.

3. Duplicate all of the archive tapes that were just produced.

   This is normally performed with BRMS/400. You may use option 14 on the Work with Media (WRKMEDBRM) display or use the Duplicate Media using BRM (DUPMEDBRM) command.

   This procedure also verifies the original archive tape copy since it must read the files successfully to duplicate them.

4. If the duplication fails, you can restore the affected objects from the last backup.

   You can use BRMS/400 to list the objects on the affected tape with the WRKMEDIBRM VOL(volid) command, where *volid* is the volume ID of the damaged tape. Option 9 for each library shows the object detail. Write down the object names.

   You can locate the current backup copy tapes for each object using the WRKOBJBRM OBJ(objname) command and select option 7 to restore the "lost" object. This assumes that you have saved object-level details with your backups. Without this, you need to use the WRKMEDIBRM LIB(libname) command, and type option 7 next to each library with a second option 7 to enable you to type in the object name.

   When you have recovered the objects lost on the damaged tape, go back to step 2, and run an archive for the objects that were lost from the original "bad" archive tape.

5. Move the duplicate tapes off-site.

Important

If an archive tape fails during duplication, it may be quicker to restore a complete library from a backup tape rather than several objects individually from the same library. Be careful in this case to ensure that *every* object within that library has not been changed since the backup. You may lose important data if this is not the case.

12.6 Re-archiving retrieved objects

In some cases, a collection of data that has been archived and retrieved may subsequently need to be re-archived differently to data that has not been archived at all.

> **Example**
>
> You have a parts inventory system and archived the parts list file from last year because your catalog of parts has been refreshed for this year. The old catalog is rarely used again. However, while you are running down your stocks from the old catalog, you may want to keep it online. After a continuous 90 days of inactivity, you can be sure that it is not used and it can be automatically archived. A customer calls and asks for a discontinued part. Your system tells you that it is discontinued. The customer is desperate for this part, and you decide to check last year's catalog to see if any of these really old parts are still lying around.
>
> At this point, the old catalog file is retrieved. Having performed the search using the old catalog, you are confident that you probably do not need this catalog unless some really exceptional circumstances occur again. Why wait another 90 days for it to archive? Why not allow this *retrieved file* to be re-archived after five days of inactivity?

BRMS/400 supports archiving at multiple levels based on the last used date, the last change date, or both (whichever is the later).

If you want to enable such a function, you have to create your own program that interfaces with the BRMS/400 retrieve exit point to generate a list of retrieved objects. You may have your own special archive control group that has a different inactivity level specified from the regular control group. The list of retrieved objects is used against a list of candidates objects for this special treatment to generate the list of objects to be included in your special control group.

You may also attempt to create a method of differentiating between objects that have been retrieved for read-only purposes and those retrieved for update. Once again, BRMS/400 does not currently differentiate between these conditions. If you are sure that the file member has not been updated, you may consider freeing the storage of the file member after the necessary alternative dormancy period has elapsed. This requires a save to a temporary save file with STG(*FREE) option and deleting the save file. To be sure of this, you need to establish an instant lock on the file member to allow read only transactions or set authority so that no one can update it. This is clearly not a simple task. The last updated date cannot be used because it is changed by the restore operation when you retrieved the file member. Also, because it is only a date (and not a time), there is no way of judging whether an update took place on the same day as the restore.

12.7 Retrieval considerations

This section contains details on the technicalities involved in performing an on-demand retrieval and lists some of the considerations that you need to take into account when planning your Dynamic Retrieval solution.

For details on setting up BRMS/400 to optimize your retrieve operations, see 13.7, "Using BRMS/400 for Dynamic Retrieval" on page 277.

12.7.1 How BRMS/400 does Dynamic Retrieval

The Dynamic Retrieval process is explained in the following sequence:

1. An operation on an object is requested:

   This is any operation that requires the interrogation of an object (see 12.9, "Operations that invoke retrieval" on page 233).

2. A search for an object is performed:

   The library list for the current job is searched to locate the object description, or the file is located because the request for the file qualifies with the library name. If the object description cannot be found, the process is ended here with an escape message.

3. The object description is found. However, the requestor requires the data portion to be present, and it is not.

4. The retrieve function is invoked:

   See 12.9, "Operations that invoke retrieval" on page 233, for the types of operations that invoke the retrieve function. This is performed using the optional Media and Storage Extensions (MSE) feature of OS/400.

5. The object type is checked for validity:

   Only *FILE objects are currently supported for the Dynamic Retrieval function at V3R1 or later. This is also performed using the MSE feature of OS/400.

6. The BRMS/400 archive inventory is checked:

   MSE passes control to BRMS/400, and a search of the list of archived objects is performed. If the object is not found, the original OS/400 message is sent to the requestor.

7. Requestor is notified:

   Depending on the retrieve method (see 12.9, "Operations that invoke retrieval" on page 233, for more details) and the type of job running, the user or the system operator message queue is notified of the intention to restore the object.

8. The tape archive copy of the object is located:

   The BRMS/400 inventory is searched to locate the tape to which the object has been archived.

9. Mounts are issued:

   If a tape library is present and operational, the tape may be loaded automatically. Otherwise, an operator must respond to a mount message from BRMS/400.

10. Restore takes place:

    The file member is restored in the normal way under BRMS/400 control.

11. The requestor operation continues as though the object had always been on the system:

    If the retrieve operation is completed immediately, the requestor may continue business as usual (with only a slight delay). Opening the file *in the program* is

automatically retried by OS/400. This is done with the aid of the MSE feature. This time, it works as normal.

If the retrieve is delayed or submitted in batch, the requestor is notified (effectively failing the operation) and must retry the operation at a later time.

Note

If the operation fails because the object type is not supported by BRMS/400 (for example, it is a *PGM type object that has been archived with storage freed), or it is not in the BRMS/400 archive inventory (if perhaps the user performed a save with storage freed outside of BRMS/400), the user is sent the standard OS/400 message for this condition (message ID varies depending on object type). It is not apparent that BRMS/400 has been consulted at all. This situation requires standard application "object has had its storage freed" error processing.

There are some circumstances where a *FILE object that has been archived by BRMS/400 may fail. This can be in the situation of a restore failure (media error or operator takes the cancel reply to the tape mount message), or if BRMS/400 submits the retrieve to batch, or it is delayed to occur later. In these cases, the CPF4102 message is relayed to the application. Your application needs error handling to hide this from the user so that it can recover gracefully from these conditions to allow a retry of the operation later when the completion message is sent.

12.8 Retrieval methods

There are several different modes of operation for performing a retrieval with BRMS/400. This section describes these modes and their application. The retrieval policy and the Set Retrieve using BRM (SETRTVBRM) command support options for separate batch and interactive controls:

- ***VERIFY**: By default, this value causes a program message to be sent for confirmation before continuing with the restore operation. Responses to the message allow the user to cancel, delay, proceed with the request, or submit the request to batch.

  If the retrieval operation occurs in an interactive environment, a message is sent to the user. If in batch, a message is sent to the message queue used for notification, as determined by notification controls in the BRMS/400 system policy (by default, QSYSOPR).

  The message that is sent identifies the file member that is being retrieved, its size, the number of the ASP to which it is restored, and the ASP utilization before and after the restore.

  This option is best used for interactive applications where the users want to retain some sort of control of system resources. Typically, the user needs some knowledge of the system on which their applications are running to make informed decisions. Batch applications that may retrieve large files can benefit from this option. In this case, the system operator needs to understand the implications of confirming a retrieve operation.

  A user exit program can be written to customize the message display shown and the processing that occurs if the *VERIFY option is used. For additional

information on this user exit, see *Complementing AS/400 Storage Management using Hierarchical Storage Management APIs,* SG24-4450.

- ***NOTIFY**: Using this value causes the restore request to be executed with minimum operator involvement. For example, if a batch job attempts to open an archived file member, the file member is automatically retrieved (restored) with no delay or operator involvement, except as needed to inform the user (or system operator if batch operation) that the retrieval is occurring, and to notify as necessary for mounting media or indicating failure.

  This option allows maximum seamlessness when implementing Dynamic Retrieval. The user or operator is simply made aware of the fact that a restore is taking place by a message on the last line of the display for interactive users or on the BRMS/400 notification message queue for batch jobs. No decisions need to be made by an application user. This option is best used when you are sure that there will not be a significant number of retrieves performed that may impact total system performance.

  The *NOTIFY option is ideal when a tape library is available so operators do not need to be involved in tape mount operations. Additionally, it is good for less knowledgeable users who are not comfortable with making a decision when they are presented with the *VERIFY message display.

- ***DELAY**: In the retrieval policy or the SETRTVBRM command, *DELAY can be specified so that when an archived file is encountered, the file is "marked" to be restored at a later time. In addition, when using any of the other retrieve modes, if a restore exceeds the ASP threshold, it is disabled and the retrieve is processed as an implicit *DELAY. In either case, the BRM1823 message is sent to the user indicating that the restore has been delayed and that the file cannot be used until it is restored. The application needs to handle the CPF4102 condition generated when opening the file. The unretrieved file is tracked by BRMS/400. The Resume Retrieve using BRM (RSMRTVBRM) command and the Resume Retrieve display can be used to easily identify files whose retrieve mode is *DELAY, and the user can request that the retrieval operation for one or more of them should be performed or cancelled. Once the files are restored, a message is sent to inform the user.

  The delay mode can be used for users of applications who have lower priority or who perhaps submit a lot of batch transaction processing (for example, large queries that are not business critical).

- ***SBMJOB**: This is for interactive users only. This mode indicates that the retrieval operation is to be submitted as a batch job. The BRM1823 message is sent to the user indicating that the restore has been requested and that the file cannot be used until it is restored. The application needs to handle the CPF4102 condition generated when opening the file. Once the file restored, a message is sent to inform the user.

  This option is particularly useful for users of applications that deal with large files and have multiple functions. If a user requests an operation and the file to be retrieved is large, the batch submission of this retrieve job allows the user to temporarily abandon the request and move on to process a similar request with different data or a totally different function. This option may help improve the general productivity of application users (and, therefore, the overall performance) over *NOTIFY or *VERIFY modes.

- ***NONE**: This allows you to bypass retrieve processing.

Beginning with V3R2 and V3R6, BRMS/400 allows you to specify an *object retention* value for the number of days you want to keep the retrieved object on the system. By default, the object is kept on the system indefinitely. You can specify the number of days that retrieved objects should remain available before their storage is freed by the STRMNTBRM (BRMS/400 maintenance) command. The number of days can range from 1 to 9999.

12.9 Operations that invoke retrieval

The basic rule of thumb for understanding what type of operation initiates the retrieve function revolves around what is known as a "database open". The function must be operating on a database or source file (object type *FILE) and must be attempting to access (or prepare for access of) the data portion of the object. Typically, this includes:

- **Database Open**: Any type of database open, whether explicit (for example, the execution of the CL command OPNDBF) or implicit (for example, starting an RPG program). If the operation includes activity that sets up a database file for read or update by setting up an open data path in the job's process access group, this qualifies. OPNDBF is the easiest method to force a file to be retrieved. Many of these can be set up in a simple CL program with corresponding CLOF commands if you want to retrieve a number of files together before an application starts.

  A database open that uses a DDM file qualifies for Dynamic Retrieval on the remote (target) system. However, it initiates a Dynamic Retrieval operation based on the Retrieve confirmation for a *batch* operation. *VERIFY sends a message to the BRMS/400 notification message queue on the remote system. *NOTIFY causes the retrieve to happen immediately. *DELAY works as described, which means that the DDM file open request ends in error the first time it is run. *SBMJOB is not valid for the batch option; therefore, it is not suitable for a DDM file request.

- **Query/400**: Either the "Specify File Selections" part of defining a query or the actual running of that query over a file initiates a retrieval.

- **Open Query File**: Processing the OPNQRYF command causes a database open and, therefore, initiates a retrieval.

- **SQL/400**: File selection during an interactive SQL query set up or executing SQL statements on a file initiates a retrieval.

- **DSPPFM**: The display physical file member command attempts to display the file record data and, therefore, initiates a retrieval.

- **DFU**: The data file utility initiates a retrieval when performing file selection during a temporary or permanent DFU program build or while starting a DFU program.

- **Journal changes**: Applying and removing journal changes to a file causes a file open and, therefore, initiates a retrieval.

- **CRTDUPOBJ**: The create duplicate object command attempts to access member data even when the "duplicate data" parameter is set to *NO.

- **Client Access/400 file transfer**: Client Access/400 (formerly known as PC Support) file transfer invokes a normal database open prior to the transfer of records down to the PC. However, it initiates a Dynamic Retrieval operation based on the Retrieve confirmation for batch operation. *VERIFY sends a

message to the BRMS/400 notification message queue. *NOTIFY causes the retrieve to happen immediately. *DELAY works as described, which means that the file transfer request ends in error the first time it is run. *SBMJOB is not valid for the batch option; therefore, it is not suitable for a file transfer request.

- **CPYF**: Because the Copy File command is most often used to copy the records in the file, this causes the member to be opened and initiates a retrieval.

- **Network file transfer**: SNDNETF sends the object description as well as the data records so this initiates a retrieval.

- **SAVxxx ACCPTH(*YES)**: When saving using SAVOBJ or SAVLIB, or with any BRMS/400-managed save where the access path parameter (ACCPTH) is set to *YES, this invokes a retrieve operation. If you are using ACCPTH(*NO), the Dynamic Retrieval function is not invoked.

- **CRTxxxPGM**: Program source code in a source file member requires access to the source statements and is retrieved if a compile is performed on it.

12.10 Operations that do not invoke retrieval

Operations that you might think invoke retrieve but, in fact, do *not* include:

- **DSPOBJD**: Displaying the object description only touches the description part of the object and, therefore, does not attempt to access the data part that is freed.

- **CHGOBJD/OWN/AUD**: Changing of the object description, owner, or audit level only affects the object description.

- **CHGPFM**: Changing the member information only affects the file description.

- **DSPFD and DSPFFD**: Displaying the file description or file field description only fetches file description data.

- **RNMOBJ/M**: Rename does not invoke a retrieval because it does not touch the object data portion. However, renaming may prevent a retrieval from ever happening again because BRMS/400 only uses the object and member names to reference for retrieve operations. Renaming breaks the link between the object description on the system and the object data on the tape. See 12.15, "Renaming and moving objects" on page 243, for more information.

- **CHKOBJ**: Check object only checks the object's existence and verifies the user's authority to the object before trying to access it. This does not involve reading any data records.

- **MOVOBJ**: Object movement commands do not cause a database retrieval, although similar restrictions apply when using MOVOBJ with archived objects as with RNMOBJ/M.

- **ADDPFM and RMVM**: Adding or removing members only affects the member attributes of a file that are stored in the file description. A file member that is removed no longer initiates a Dynamic Retrieval operation if an open is attempted for it.

- **Start/end journaling**: Starting or ending journaling of a file does not touch the data at all. Only the receiver, journal, and object description are updated.

- **CHGPF**: Changing physical file attributes only affects the object description.

- **DLTF**: When deleting a file, all members are removed and no retrieval is necessary. Of course, this means that if access to this file is attempted later, it will fail.

- **RCLSTG**: The reclaim storage operation requires access to the file member but bypasses the retrieve operation.

- **DSPLOG**: Even though it seems logical that the system history log files are needed when using the DSPLOG command, any of these files that have been archived with storage freed are simply bypassed as if they did not even exist. This may change in a future release to support Dynamic Retrieval.

- **Options from PDM**: When using the Programming Development Manager (PDM) product, options from its Work with displays that perform actions on file members have additional checking that prevents a Dynamic Retrieval from occurring. An error message is displayed on the last line of the display. This may change in a future release to support Dynamic Retrieval.

- **CRTxxxPGM**: Any program compile that references an archived database file does not actually access the data. The field descriptions (the only part needed by the compiler) are held in the object description, and therefore, no Dynamic Retrieval is done.

12.11 Applying journal changes to archived data files

When you apply or remove journal changes to or from an archived file, this file is automatically retrieved at the first attempt to apply or remove. It is not necessary to open the file in preparation.

The only consideration is when the journal entry for the storage free operation is included in the block of sequence numbers to be processed in the apply or remove. Typically, this occurs during a RMVJRNCHG operation where the Starting sequence number parameter contains *LAST and the Ending sequence number parameter contains a number that is related to the point in time to which the file changes must be rolled back. The journal entries in this range include the BRMS/400 archive (and storage free) operation. A RMVJRNCHG command cannot roll back this type of operation and will fail. You need to perform a DSPJRN (display journal) command to select a range of journal entries that do not include the storage free operation.

For example, the following output is created from the DSPJRN command for a file that is updated and then archived. The code for a storage free operation is MF.

```
Seq   Code   Type   Object     Library    Job        Time        Comments
  9    F      OP     PAYROLL1   PAYROLL    PAYROLL    15:26:07    Open
 10    R      UB     PAYROLL1   PAYROLL    PAYROLL    15:26:12    Update 1
 11    R      UP     PAYROLL1   PAYROLL    PAYROLL    15:26:12
 12    R      UB     PAYROLL1   PAYROLL    PAYROLL    15:26:19    Update 2
 13    R      UP     PAYROLL1   PAYROLL    PAYROLL    15:26:19
 14    R      UB     PAYROLL1   PAYROLL    PAYROLL    15:26:24    Update 3
 15    R      UP     PAYROLL1   PAYROLL    PAYROLL    15:26:24
 16    R      UB     PAYROLL1   PAYROLL    PAYROLL    15:26:26    Update 4
 17    R      UP     PAYROLL1   PAYROLL    PAYROLL    15:26:26
 18    R      UB     PAYROLL1   PAYROLL    PAYROLL    15:26:29    Update 5
 19    R      UP     PAYROLL1   PAYROLL    PAYROLL    15:26:29
 20    R      UB     PAYROLL1   PAYROLL    PAYROLL    15:26:32    Update 6
 21    R      UP     PAYROLL1   PAYROLL    PAYROLL    15:26:32
 22    F      CL     PAYROLL1   PAYROLL    PAYROLL    15:26:36    Close
 23    F      CL     PAYROLL1   PAYROLL    PAYROLL    15:26:36
 24    F      MS     PAYROLL1   PAYROLL               15:27:54    Save
 25    F      MS     PAYROLL1   PAYROLL               15:28:32    Save with
 26    F      MF     PAYROLL1   PAYROLL    PAYROLL    15:28:34       storage free
```

```
OP = member opened
UB = update - before image
UP = update - after image
CL = member closed
MS = member saved
MF = storage for member freed
```

The RMVJRNCHG command with default parameters is coded as:

```
RMVJRNCHG JRN(PAYROLL/PAYROLL) FILE((PAYROLL/PAYROLL1)) FROMENT(*LAST)
TOENT(*FIRST)
```

This causes the following messages to be issued:

```
CPI7001 Remove failed. 0 entries removed from member PAYROLL1.
CPF7049 Cannot perform operation beyond journal entry 26.
```

To roll back changes to a storage freed file member, you need to issue the RMVJRNCHG command as follows:

```
RMVJRNCHG JRN(PAYROLL/PAYROLL) FILE((PAYROLL/PAYROLL1)) FROMENT(23) TOENT(17)
```

The following messages are issued:

```
CPC3727 1 objects restored. 0 objects excluded.
CPC7050 2 entries removed from member PAYROLL1.
```

Note: The receiver entry range from 17 to 23 did not include the MF (free storage) entry.

12.12 Member level changes to files

Performing member level changes to a file with archived members is straight forward. When members are retrieved, they are retrieved individually and independently of the other members within the file. The file structure is not affected, and no data is compromised.

- **ADDPFM**: When adding a new member, the new member's description joins the others within the file because they have not been deleted by the archive with save with storage freed. A retrieval of other members does not affect any new ones.

- **RMVM**: When removing a member, the member description is deleted, and BRMS/400 can no longer retrieve it because the reference (by name) in BRMS/400 to the archived tape copy no longer exists.

- **RNMM**: Renaming a member creates problems when trying to retrieve the member that has been renamed because BRMS/400 references its archive inventory by name. See 12.15, "Renaming and moving objects" on page 243, for more details.

12.13 Retrieval performance

The performance of the retrieve function varies according to what you retrieve and how you retrieve it.

12.13.1 Saving access paths when archiving

When using BRMS/400 to archive data (using archive with save with storage freed), the option to save the access paths of the file defaults to *YES. This is to

avoid lengthy access path rebuilds at the time of retrieve to attempt to optimize the retrieve function performance. Having this parameter set to *YES is particularly important when you use the *NOTIFY and *VERIFY retrieve modes as if it were set to *NO. The access path rebuild time can add to the user wait time.

While the save access path parameter may still be overridden, we suggest that you leave it at *YES to save the access paths and improve the retrieval performance.

12.13.2 File size

The retrieval of large files naturally takes longer than smaller files. It may be appropriate to break your large files into several smaller ones. Choosing how to divide the file may not be easy. You must address the following points:

- Where are the logical boundaries?

  You may be able to break down the file into groups of records with a common theme. But how do you re-introduce a group of records to the main file?

- How transaction-based is the application?

  If the records tend to expire in groups, you may have an opportunity to establish break points.

- Can the application stand a file name change?

  Should you group common records in different files?

- Can the application stand a member name change?

  Should you group common records in different members within the same file?

- How normalized are the data entities?

  Can you reduce the size of the file by further normalizing its structure, that is, by splitting the record fields into different files?

Be careful to split files appropriately. This solution may be a problem if you have to retrieve of all the files that were split to satisfy a single data request. You have to perform multiple restores, possibly from multiple volumes that may be stored in different locations. All the pre-processing, post-processing, and tape mounting tasks add to the overall time and complexity to retrieve an object. Additional considerations for application customizing are discussed in 12.16, "Application design considerations" on page 245.

12.13.3 Multiple physical files behind a logical file

You should take note of the following points where a join logical file causes the retrieval of multiple physical files for a single database request:

- **Fragmentation**: If the various file members under the logical file have been archived at different times, the archived tape copies may be spread across many different volumes. The requested operation may need separate tape mounts, not to mention all the pre-restore and post-restore processing for each file member restore. This impacts performance.

- **Predicting retrieval size**: The nature of the retrieve function is to handle one file member restore operation at a time. Therefore, as one retrieval is being handled, BRMS/400 cannot look forward to predict the next retrievals that are processed, not even if they are obvious to the application designer. BRMS/400

cannot display *any* application knowledge to predict the incoming retrieve operations. This discussion continues in 12.14.1, "Predicting which objects are retrieved" on page 241. The result is that for a given complex (multiple file) operation, you cannot predict either the total size of all of the members to be restored or the time it takes to complete. Therefore, the performance is not predictable.

- **Access path rebuild times**: Access through a multiple format or join logical file may cause the retrieve of several physical file members. As each physical file member retrieve operation is performed separately and independently of any other operations, an access path rebuild for each physical file member retrieved is experienced. Therefore, a situation can occur where a string of access path rebuilds is performed when one final rebuild would suffice. BRMS/400 cannot override the access path rebuild to *DELAY because it cannot predict which physical file members, if any, are retrieved unless BRMS/400 is retrieving in *DELAY mode. BRMS/400 uses the RSTRTVBRM confirm display. See 12.8, "Retrieval methods" on page 231, for retrieve mode details.

  You should be aware of the potential performance implications of the multiple access path rebuilds that are caused by archiving physical files under a multiple format logical file.

12.13.4 Which retrieve mode to use for interactive applications

Certain interactive applications may be critical to your business. They may also be *performance critical* to your business. It is logical to assume that the best performance for your interactive application can be achieved by using the *NOTIFY mode for retrieving objects. This way, a retrieval is performed immediately at interactive priorities without waiting for a reply to a message.

This is certainly true for an application with a fixed logical flow of activities that must be performed to complete a unit of work. If any of the sub-units of this piece of work are temporarily stalled, the user has no option but to wait for completion of that sub-unit.

For example, the unit of work may be the processing for a customer placing an order. The first sub-unit may be to retrieve the customer's details, the second to retrieve the stock details of the item required, and the third to create an order.

The following assumptions may apply to this simplified scenario:

- The order cannot be created (third sub-unit) until stock data can be retrieved for the part (second sub-unit) required because there must be some in stock to honor that order.

- The order cannot be created until the customer data can be retrieved for the customer (first sub-unit) because you need their details to fill in certain parts of the order.

- Sub-unit one and sub-unit two are totally independent of one another.

- You cannot actually place an order until the order file member is online.

- You do not know which order file member to open until you have the customer details, and you do not know whether to bother opening an order file until you have the part details.

The logical flow of the unit of work implies that you cannot start sub-unit three until both one and two have completed. It also implies that there is nothing else that can be done while waiting for the order file to be retrieved. Therefore, it seems sensible to use *NOTIFY for creating the order.

However, if sub-unit one causes a retrieve operation, it makes sense to move on with something else while the retrieve is being performed; that is, use the *SBMJOB mode to submit the retrieve to batch and then attempt an execution of sub-unit two. Similarly, a retrieval from sub-unit two can be submitted to batch in the *SBMJOB mode while you move on with sub-unit one.

Of course, it is not that simple. The logic of the application may have to be changed to allow backing out of sub-units to return to them later.

The performance (productivity) penalties for *SBMJOB include:

- The user may not return to a sub-unit as soon as the retrieve completion message is sent.
- Retrieve jobs may run in lower priority.

It is possible to create a special batch environment for retrieve jobs to speed their performance. BRMS/400 uses the job queue named in your job description. You can create a special job queue and reference it in your job description to change it from the default associated with the user profile.

The retrieve mode used is typically set at the job level. It is possible to alter the retrieve mode for the entire job by issuing the SETRTVBRM command before each file open operation. This may have unexpected results on other activities within your job, such as group jobs. It also requires changes to your application.

You may, however, decide that you are not impacting performance at all by allowing sub-unit three to be submitted to batch. In this case, you may set the mode for this entire job to *SBMJOB.

In summary, you can conclude that it is not always best for general user productivity to use *NOTIFY. In some cases, *SBMJOB may be more appropriate.

12.13.5 Using the *VERIFY retrieve mode for batch jobs

While the *VERIFY mode offers the best control of your system resources by forcing a decision to be made for every possible retrieve operation, there are a couple of points you need to consider:

- In general, you must be sure that the people who have to respond to the *VERIFY messages are informed enough to make the correct decisions. For example, they need to have a good idea about the system size, ASP maps, the size of your object, which types of files are important, what applications are doing, and which applications are important.
- For *VERIFY in *batch mode*, you must be sure that the system operator message queues are monitored frequently. A batch job waiting for an operator message reply is a frequent cause of batch throughput problems.

12.14 Managing your disk space

An important issue with any automated procedure for adding and removing data from your disk storage is the setting of precautionary checkpoints to avoid storage overflow. The key to managing your storage lies in the balance between the in-flow (retrieve) and out-flow (archive) of data.

Some key factors that influence in-flow (retrieve) include:

- **System activity**: The more files that are accessed in a job, the more likely it is that a required file is offline. That is, increasing file access activity statistically decreases the chance of the required file being on disk. This correspondingly increases retrieve activity.

- **ASP threshold limits**: All retrieve operations use BRMS/400 inventory data to predict the size of the retrieved data item when residing on disk. If the result of the retrieve exceeds the ASP threshold, the retrieve is not performed.

  Setting the threshold high allows more data to be brought online. Setting it low reduces the chances of a retrieve being completed. This can be changed using the Start system Service Tools (STRSST) command.

- **Retrieve mode**: The differing methods of retrieve allow greater control:

  - *NOTIFY increases the in-flow because users do not have the option to cancel or defer the retrieve.

  - *VERIFY allows independent user decisions to moderate the in-flow.

  - *DELAY allows a more informed decision to be made by using the RSMRTVBRM display to obtain a system-wide picture of the retrieval activity. This may help reduce in-flow activity.

Some key factors that influence out-flow (archive) include:

- **Dormancy criteria on archive**: The number of days of inactivity that a file undergoes is one of the qualifying parameters for an object to be archived. Increasing the required dormancy period reduces the outflow of data. Decreasing the dormancy period increases the outflow of data.

  This parameter must be balanced against application performance in the case of a retrieval being requested. If you decrease the dormancy period too much, the out-flow increases to a point that the natural activity of the system causes a corresponding increase in in-flow. As soon as the system becomes clogged up with a constant stream of archive and retrieve operations, performance can be degraded.

- **Volume of archive lists**: Increasing the number of archive object lists and the number of objects on each list increases the chances of an object being archived.

- **Frequency of archive runs**: Shortening the time gaps between each archive run also increases the chances of finding a qualifying archive candidate. If the qualifying dormancy periods are short, we advise that you have shorter time gaps between archive runs.

12.14.1 Predicting which objects are retrieved

For any given data operation or request, any number of file members may be needed to be retrieved to complete that request. The BRMS/400 retrieve function

operates independently on each of the required members that have been archived. Each file member is processed separately. Retrieval is performed one file member at a time. This makes it difficult to predict which file members are retrieved to enable successful completion of your data request without some sort of application knowledge.

12.14.1.1 Using *NOTIFY or *VERIFY

The retrieve function handles one file member restore operation at a time as dictated by the file opens in a program. The retrieve operation cannot look ahead to predict the next retrieves that need processing. BRMS/400 cannot display *any* application knowledge to predict the incoming retrieve operations. The result is that for a multiple file retrieve operation, you cannot predict either the total size of all of the members to be retrieved or the time it takes to complete.

As a user responding to a *VERIFY mode message, you do not know whether you can wait for the retrieve operation or even whether the retrieve operation is forced to terminate because of an ASP overflow. This is despite the fact that for each individual member, you receive a message informing you of the total restore size. It is the number of other members that are needed for this request that you do not know until they occur.

12.14.1.2 Using *DELAY

With the delayed option, you can improve the predictive ability by using the Confirm Retrieve display with the RSMRTVBRM command. This display lists the sizes of all of the objects awaiting retrieval and the ASPs into which they are loaded. You may perform the necessary calculations before actually submitting any of the retrieve jobs. You may select the appropriate objects to be retrieved, cancel inappropriate ones, and leave the low priority ones for later.

Not every application can operate in delayed mode. There is definitely a need to balance performance requirements against the storage capacity control requirements.

12.14.2 Predicting the size of objects to retrieve

As indicated in 12.14.1, "Predicting which objects are retrieved" on page 241, in the *NOTIFY or *VERIFY mode, a message is sent for each retrieve operation as it is initiated indicating the size and ASP of the object to be retrieved. This is done sequentially. There is no predictive information about future objects that may be retrieved.

If you use the *DELAY mode and the RSMRTVBRM command with the confirm parameter set to *YES, you can choose which objects are to be retrieved. The information on the Confirm Retrieve display may be used to total the sizes of the objects for each ASP.

12.14.3 Predicting the time to retrieve objects

Predicting the size of the current object to be retrieved is relatively straight forward because BRMS/400 records this information at the time the file member is archived. Predicting the time it takes to retrieve the object, however, is not possible.

A number of factors influence the restore time, including:

- The object type (each object type has different restore characteristics)
- AS/400 system model performance
- Other jobs running on the AS/400 system that affect the performance
- Tape drive speed
- The speed of the IOP to which the tape drive is attached
- The use of compression (or not) during the save and the type of compression
- Waiting time for other jobs already using the available drives
- Time for mount requests to be honored
- Where on tape the actual object is located, that is, how much searching must be done to find the start of the object

While BRMS/400 gathers data on some of these factors, there is no simple formula that can be used to calculate the restore time.

12.14.4 Can an ASP overflow occur?

The retrieve function always checks whether the threshold of the recipient ASP is exceeded as a result of the restore operation. If so, the retrieve does not take place. It fails with an error status of *STORAGE and enters into a delayed status. The failed retrieve operation may be restarted at a later time by using the RSMRTVBRM command.

The retrieve function uses data stored in the BRMS/400 archive history to determine the size of an object when it is retrieved. It is based on the size of the object when it last resided on disk. The ASP threshold is derived from the standard system ASP threshold that is set by the STRSST command. On a well-managed system, it is unlikely that any retrieve operation will overflow an ASP. An ASP overflow may occur if:

- The ASP threshold is set high (90% or above).
- Other independent create or restore operations (for example, CRTDUPOBJ or RSTLIB) begin after the retrieve has started but before it has finished. This may lead to an overflow as the retrieve continues its restore operation.
- The object size information is incorrect:
  - The BRMS/400 data could have been corrupted.
  - The object may be restored to a different operating system release that may effectively change the required space needed for the object.

See *Backup and Recovery - Advanced*, SC41-4305, for information on managing ASP overflows.

12.15 Renaming and moving objects

The BRMS/400 archive history is a name-oriented inventory. If a file's description was retained when the file was archived, and the storage freed file is later renamed or moved to a different library, or the library containing the file is renamed, BRMS/400 *cannot* automatically retrieve its data.

A rename operation does not invoke a retrieval prior to effecting the name change because it does not touch the object data portion. However, renaming may prevent a retrieve from happening again since BRMS/400 uses the library, object, and member names to reference retrieve operations. Renaming breaks the link that BRMS/400 uses between the object description (on the system) and the object data (on tape).

12.15.1 Renaming file members

When renaming a file member, a solution to this problem may involve manually retrieving the object before it is renamed. The steps that are required are listed here:

1. Manually retrieve the object.

   Open the file member with the OPNDBF command or display the physical file member with the DSPPFM command. This invokes the retrieve operation.

2. Perform the file member rename with the RNMM command.

3. Update the entry for the file member in the BRMS/400 archive lists.

   If the file member was included under a generic entry, you may or may not need to change this entry. If you change a generic entry, such as MEMB* to MEM*, check that other members are not affected.

   If the file member was included as an *ALL entry, you do not need to alter the BRMS/400 list unless you also changed the file name or library name.

   Use the WRKLBRM command if the object was in an archive list. If you are adding a new list, use the WRKCTLGBRM *ARC command to add the new list to your archive control group.

4. Leave the member to be archived in the normal way.

   If you want to re-archive this member instantly, you need to create a temporary archive list and control group with inactivity set to zero days. You can use the STRARCBRM command to archive the objects defined in the temporary control group.

5. Optionally, delete the archive history for the old member name.

   Use the WRKOBJBRM command with the appropriate parameters to select the file in which the renamed member existed and remove the history data. It is possible that you no longer need the data, so delete the BRMS/400 archive history to save space. If not, it is deleted when the expiration date is reached.

12.15.2 Renaming files

If you rename a file, you must retrieve all of the members within that file, rename the file, and alter the BRMS/400 archive lists to reflect the change. The required steps are outlined here:

1. Manually retrieve all of the members in the file.

   Open all the file members within the file by using the OPNDBF or DSPPFM commands. This invokes the retrieve operation for each member. You need to know all of the member names to do this. You have to open each member, one at a time.

2. Perform the file rename with the RNMOBJ command.

3. Update the entry for the file in the BRMS/400 archive lists.

   If the file was included under a generic entry, you may or may not need to change this entry. If you change a generic entry, for example FILE* to FIL*, check that other files are not affected. You do not need any unwanted includes or unanticipated excludes.

   If the file member was included as an *ALL entry, you do not need to alter the BRMS/400 list unless you have also changed the library name.

   Use the WRKLBRM command if the object was in an archive list. If you are adding a new list, use the WRKCTLGBRM *ARC command to add the new list to your archive control group.

4. Leave the file members to be archived in the normal way.

   If you want to re-archive these members instantly, you need to create a temporary archive list and control group with inactivity set to zero days. You can use the STRARCBRM command to archive the objects defined in the temporary control group.

5. Optionally, delete the archive history for the old member name.

   Use the WRKOBJBRM command with the appropriate parameters to select the file in which the renamed member existed and remove the history data. It is possible that you no longer need the data, so delete the BRMS/400 archive history to save space. If not, it is deleted when the expiration date is reached.

12.15.3 Renaming libraries

Renaming a library can be done, but is time consuming. If you rename a library, you have to follow these steps:

1. Manually retrieve all of the members in all the files in the library.

   Open all the file members within *every* file in the library with the OPNDBF or DSPPFM commands. This invokes the retrieve operation for each member. You need to know the names of all of the members of every file in the library to do this and open each member one at a time.

   It may be worth considering writing a special program that creates a list of all members in all files in a given library and proceed to open them all one-by-one. There are some file opening limitations within OS/400 and CL that you may run into if there are too many.

2. Perform the library rename with the RNMOBJ command.

3. Update the entries for the all of the members in all of the files in the BRMS/400 archive lists and archive control groups.

   If the file was included under a generic entry, you may or may not need to change this entry. If you change a generic entry, for example LIBR* to LIB*, check that other libraries are not affected.

   Use the WRKLBRM command to check whether the library name appears in any archive lists. Use the WRKCTLGBRM *ARC command to change all occurrences of the library name in your archive control groups.

4. Leave all of the file members within the library to be archived in the normal way.

If you want to re-archive these members instantly, you need to create a temporary archive control group with inactivity set to zero days. Use the STRARCBRM command to archive the objects defined in the control group.

5. Optionally, delete the archive history for the old member name.

   Use the WRKOBJBRM command with the appropriate parameters to select the file in which the renamed member existed and remove the history data. It is possible that you no longer need the data, so delete the BRMS/400 archive history to save space. If not, it is deleted when the expiration date is reached.

12.15.4 Moving a file

Moving a file to a different library (with MOVOBJ) has the same effect as renaming that file. Follow the procedure for renaming a file by replacing the RNMOBJ command with the MOVOBJ command.

12.15.5 Creating a duplicate file

The creation of a duplicate file with the CRTDUPOBJ command automatically retrieves the file members before copying begins.

12.16 Application design considerations

In 12.13, "Retrieval performance" on page 237, and in 12.14, "Managing your disk space" on page 240, we hinted at the types of changes that you may need to make to our applications for more effective use of Dynamic Retrieval. We talked about splitting files up for performance reasons and changing retrieve modes to improve productivity.

This section concentrates on the methods of handling the data that you want to archive. It discusses the methods in which our data structures may be changed to accommodate Dynamic Retrieval or improve it. It also discusses the type of customizing that an application may need to adapt to the altered file structures.

12.16.1 Member-level archiving

The BRMS/400 Dynamic Retrieval function operates at file member level. Archiving involves the save with storage freed of a file member. Retrieve involves the "on-demand" location and restoring a file member to disk.

This section is about achieving the best from your file member-level archive and the application considerations that go with it.

12.16.1.1 Applications suitable for member level archiving

It may be that your application is already suited for the use of archiving at file member level. Typical features of such an application include:

- **Using multiple files**: The mass of data used by each functional part of the application is split into many small files. Each file may be related to another file or files, but each application transaction may not necessarily require access to all files. Typically, a file is related to some sub-function of the application's main function.

  For example, an order processing application may have a file for customer details, a file for part details, a file for stock levels, a file for part prices, and so on.

- **Using multiple members within those files**: Each file has a set of different members. Each member consists of a group of related records. The completion of the function (or sub-function) related to that file involves the selection of the particular member required within that file based on a particular item of information.

  For example, the part detail file may have a different member for each catalog of parts, each catalog may change each month, and there may be a different catalog for each supplier of parts. The member selection is based on supplier name and current month.

- **Databases fully normalized**: Full normalization of data entities implies that there is no redundancy of data, and that the database is broken down into many files. This allows you to go directly to the actual piece of data you need without touching other data at the same time and, therefore, falsely instructing the system that this other data is also active.

  For example, as a result of a database design using full normalization techniques, you have a part order file that does not contain direct values of each part's description or price. These are referenced with a part identification number and derived from a separate part details file and part price file. At the time you print the order, you access all three files (orders, part descriptions, and part prices). However, months later, you may perform a manufacturing output analysis where all you need is the part's description (part detail file) and the number of parts sold (order file). This way, you do not touch the price data (part price file) and may leave it in its archived state if already archived, or at least not disturb its dormancy rating.

- **Effective design of logical files**: Similar to the argument for normalizing databases, having done all of the hard work in normalizing using multiple members and multiple files, you must ensure that the design of logical files does not lead to the unnecessary inclusion of unwanted or unneeded data.

  For example, in the previous order file example, you may design a month-end manufacturing analysis report (to report on numbers of parts manufactured) that uses a logical file already created for a sales analysis report. Therefore, you are saving on design cost, complexity, and access path maintenance by re-using an existing logical file. However, the existing sales analysis logical file also accesses the parts price file to obtain sales figures, but the manufacturing analysis report does not need this information. You are, therefore, accessing the parts price file unnecessarily and restricting its chances of being archived.

- **Groups of records with commonality spread across multiple members**: If multiple members within each file contain records with no common theme, it is difficult to control access to these members. Data requests may result in sequential searches through each member instead of directly opening the correct one. This is an indexing problem. There is little to be gained from setting up multiple members if the access to these members is to be of an entirely random nature.

  For example, the customer details file can consist of many members, each with 200 customer records. As new customer information is entered, a member fills up. When a member is full, a new one is created. There is no order to this arrangement and every time the customer detail file is queried, all of the members must be searched. However, if the file was split into 26 members and grouped by the first letter in the customer name, a search on customer name only accesses one member.

- **Transaction based records**: If a record entered into a database is equivalent to a transaction, and that transaction eventually expires through the simple passing of time, you may archive that record with confidence that it does not need to be retrieved. Furthermore, if you can collect these expired records as time passes and a collection of records expire in the same way and at approximately the same time, you can group these records in a file member and archive them at file member level.

  For example, collect the order records in the order file using a member for each financial year. When the financial year end reports are all completed, you may be reasonably confident that the file member for the past year is not needed again and it may be archived.

If these characteristics *are found* in your application, it is possible that you may not need to make any changes to derive full benefit from the implementation of archiving with Dynamic Retrieval.

If these characteristics *are not found* in your application, it may be worth considering the sort of changes that may need to be applied to achieve this. The main points to consider are:

- To break your large files down into multiple files and make good use of normalization, you need to:

  1. Re-design your database, including indexing and cross-referencing.
  2. Change the naming of your files.
  3. Alter the name references in your application source code.
  4. Change the application logic that accesses your databases.
  5. Change the inquiry logic to reflect the preceding steps.
  6. Rebuild and recompile your files and programs.

- To make good use of multiple members with common record level characteristics within your files, you may need to:

  – Design an indexing structure around the members in each file. This involves all of the re-designing, renaming, logic updating, and re-compiling that was previously described.

  – Use a member list structure that lists the names of the members present in a file and the order in which they should be searched. This requires an exit program to be used in place of the member open statements within your programs that finds the right member and opens it. It may also require the repositioning of the open statements to a point in the program logic where the relevant search data is available.

- To make better use of logical files, you may need to create additional logical files and change the names of the files opened in some programs.

- To split members off at time intervals to enable the migration of blocks of historical data, you need to establish a naming convention for the members and change the search logic to access the most recent members first.

12.16.2 Work-around for less suitable applications

When an application is not suitable for member level archiving, you may need to make some changes. The options are:

- Leave it as it is. You can only make limited use of archiving with Dynamic Retrieval.

- Change the application design to reflect the characteristics described in 12.16.1.1, "Applications suitable for member level archiving" on page 245.
- Design a work-around solution that minimizes changes to the application, but uses special exit programs to intercept database requests, and to manage files and their members.
- Design a work-around at record level that minimizes application change. See 12.17, "Pseudo record-level archiving" on page 254, for a discussion on this.

The remainder of this section concentrates on the design of a member level work-around for database access and file member management and the considerations that go with this approach.

12.16.2.1 Splitting data in your files
The grouping of data records is the chief method by which you may break down your previously unmigratable files into blocks of possibly migratable data. You can split the data both vertically and horizontally.

12.16.2.2 Vertical splitting
This involves breaking up the record formats into several smaller formats. You have to use the fields of a large record to create several smaller records consisting of a few fields each from the single large record. This is often seen as the result of *database normalization*. Figure 146 shows a typical result of vertically splitting data by breaking a record into several smaller records.

The single large record:

RECORD1

| FIELDA | FIELDC | FIELDD | FIELDE | FIELDF | FIELDG | FIELDH | FIELDJ |

Vertically split into several records:

RECORD2

| FIELDA | FIELDE | FIELDI |

RECORD3

| FIELDB | FIELDC | FIELDD | FIELDH | FIELDJ |

RECORD4

| FIELDF | FIELDG |
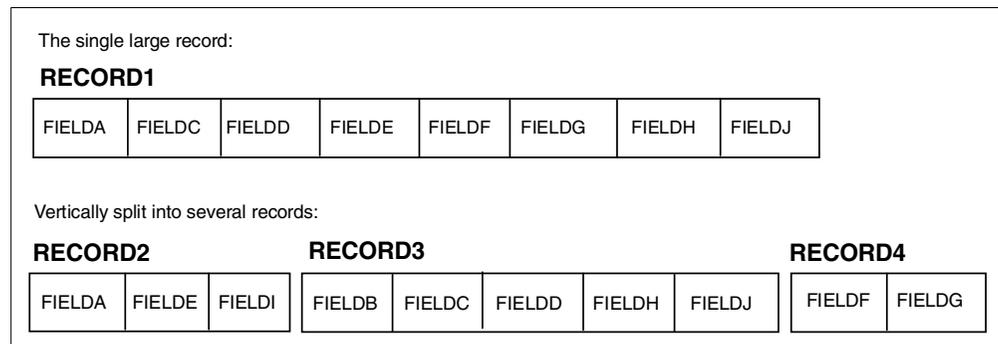
Figure 146. Vertical data splitting

> **Note**
>
> The full normalization process may also involve the introduction of additional identification fields in each new record format to aid indexing and cross-referencing between records, such as customer number, part number, and so on.
>
> The key result of vertical data splitting is the creation of new files within your application. The original file, with its single large record format, is converted into several smaller files. Each small file has its own smaller record format. Logical views may still be constructed to simulate the old record format using multiple formats or joined record formats. The logical views help reduce the impact on code changes. However, if *all* of the new records are always accessed for every transaction, you may have not gained any enhanced ability to archive some of the less active fields.

12.16.2.3 Using vertical splitting

Vertical data splitting should be used if possible. If records contain redundant data, the traditional normalization techniques may help here. You may also want to attempt to split records into groups of fields according to their statistical usage. If there are clearly certain fields that are hardly ever used (assuming that they should be there at all), they may be split off into a separate record format, therefore, creating a brand new file.

Once again, pay attention to the statistical variation of the use of these fields with time. Only if it can be shown that certain fields are being used less as time goes on, is it appropriate to remove these fields from the file.

An example is a change in the use of an application over time. Suppose that the record format of the database in your payroll application included several fields of information for the clerk that processed each pay check. These fields are there because the clerks used to manually process part of the paperwork before the entire process became computerized. They are still used infrequently when a manual correction is needed. It is possible, therefore, that the usage statistics for these fields are decreasing as time goes on and the accuracy and competency of the payroll application increases. These fields may be vertically split off and placed in a separate file, and that file is archived to tape.

Grouping your fields

The grouping of fields is a process of balancing three aspects of the application design:

1. Migrate low volatility fields.
2. Reduce data redundancy (by normalization).
3. Increase data access performance.

All three may conflict. While it is possible that normalization and vertical splitting for migration may have similar targets, it is also possible that the choice of which fields to split off may differ significantly. Sometimes vertical splitting may be an extension to the normalization process.

Performance of database access can sometimes be reduced by opening multiple files, using join logical files, and other match and join techniques built into the application code. This is in direct conflict with normalization and vertical splitting.

Application changes

The application changes needed when creating new record formats and files include:

- Redesigning the data description specification (DDS) source for all included data files.

- Redesigning the data description specification (DDS) source for all included screen files.

- Designing new logical files over new physical file record formats.

- Redesigning application display handling code.

- Changing file names and record formats and record handling in application database access code.

- Re-compiling all involved files, displays, and program modules.

Note

When using DB2/400 to access records in a file, it only allows you to open one member at a time. Other members can be accessed with DB2/400, but only after issuing the OVRDBF command to select the member required. This is important to understand if you are considering using horizontal splitting.

12.16.2.4 Horizontal splitting

This involves the grouping of records within a file into separate members. Normally there is some implicit (or possibly explicit) indexing of the records that allows us to split the records into different members based on breaks in the primary (or perhaps even secondary) key. Figure 147, Figure 148, and Figure 149 on page 252 show examples of this. In Figure 147, you see an entire, unsplit file that is keyed on two fields: a primary key and a secondary key.

Primary key	Secondary key	Other fields
ALPHA	ALPHA	ADIRGJLSGSGSLKGJSLVNSDLKNVLSDNVLSDNVLSVNSL
ALPHA	ALPHA	QWERJHGJKBNFSDBKLJNELKGNSJLKNSKJNCVSKJVNS
ALPHA	BRAVO	SDKGSLDGNSLDHSDLHSDHSDJLHSDFGHSDBSKLBASVL
ALPHA	BRAVO	LKSDJGKLSDHLSDHSDKHSDKGHBSKHFKADHFKADBFKA
ALPHA	BRAVO	LSKDNFGKLSJHJKLASDHDSBKSDFJBGKSDJBSDJKGBS
ALPHA	CHARLIE	WDGHKSDFSJDFNSDFNSDAKBSDKJSDFSKDJBKSJDBFD
BRAVO	ALPHA	KJSDFJKASDBFASDJKBFDJKABFAKBBFKADBFADKFBBF
BRAVO	ALPHA	LKSDJFLSDNLSDHGSLDGHGHDHSLJKDFHSLDFHSKADH
BRAVO	ALPHA	KSDFKLSFLASDNSGBNDGJSGBNSBGJSDKSDBFGKSJSD
BRAVO	ALPHA	JAFAFAKDJFHKAJFHAKBAKFBAKBFAKBFAKJKAS
BRAVO	CHARLIE	LKSHDFLKSHSDLGHSDKGHSDKLJHSDKHSDGKJSDFHDJ
BRAVO	FOXTROT	LKJSDFGLSKGSDGSDLGHLSDGHSDLGHSGLJHSDFSDDF
BRAVO	FOXTROT	LKSDJGLKSDNLNGSJKLDGSGKLJSGNBSDJBGKJSDFHD
BRAVO	FOXTROT	KKSNDFLSKJHSGIUKURFSBNVSVBSIGUCVSKEJFSDUD
CHARLIE	BRAVO	LKSDJFLSDFLSDHSDJKLHKJFHSDKGHSDGJKHSDJDSF
CHARLIE	ECHO	LKSDFLKSDLNSLFGSLJGNSDLJNFALFNASLFNBSAJKL
CHARLIE	ECHO	KJSNVJSVNKSAJVDKSAJDNVKSJADVNKSJAVNKJSVSD
CHARLIE	ECHO	LKSDHFKSJAFKSDGKJBASDKJBASDVJVKJSKJSADVKS

Figure 147. Horizontal data splitting

Figure 148 shows an example of horizontal data splitting by primary key. The single member file is split into multiple members using the change in the primary key as the boundary for each member. In this case, the primary key becomes redundant.

MEMBER1

Primary key	Secondary key	Other fields
ALPHA	ALPHA	DIRGJLSGSGSLKGJSLVNSDLKNVLSDNVLSDNVLSVNSL
ALPHA	ALPHA	QWERJHGJKBNFSDBKLJNELKGNSJLKNSKJNCVSKJVNS
ALPHA	BRAVO	SDKGSLDGNSLDHSDLHSDHSDJLHSDFGHSDBSKLBASVL
ALPHA	BRAVO	LKSDJGKLSDHLSDHSDKHSDKGHBSKHFKADHFKADBFKA
ALPHA	BRAVO	LSKDNFGKLSJHJKLASDHDSBKSDFJBGKSDJBSDJKGBS
ALPHA	CHARLIE	WDGHKSDFSJDFNSDFNSDAKBSDKJSDFSKDJBKSJDBFD

MEMBER2

Primary key	Secondary key	Other fields
BRAVO	ALPHA	KJSDFJKASDBFASDJKBFDJKABFAKBBFKADBFADKFBBF
BRAVO	ALPHA	LKSDJFLSDNLSDHGSLDGHGHDHSLJKDFHSLDFHSKADH
BRAVO	ALPHA	KSDFKLSFLASDNSGBNDGJSGBNSBGJSDKSDBFGKSJSD
BRAVO	ALPHA	JAFAFAKDJFHKAJFHAKBAKFBAKBFAKBFAKBFAKJKAS
BRAVO	CHARLIE	LKSHDFLKSHSDLGHSDKGHSDKLJHSDKHSDGKJSDFHDJ
BRAVO	FOXTROT	LKJSDFGLSKGSDGSDLGHLSDGHSDLGHSGLJHSDFSDDF
BRAVO	FOXTROT	LKSDJGLKSDNLNGSJKLDGSGKLJSGNBSDJBGKJSDFHD
BRAVO	FOXTROT	KKSNDFLSKJHSGIUKURFSBNVSVBSIGUCVSKEJFSDUD

MEMBER3

Primary key	Secondary key	Other fields
CHARLIE	BRAVO	LKSDJFLSDFLSDHSDJKLHKJFHSDKGHSDGJKHSDJDSF
CHARLIE	ECHO	LKSDFLKSDLNSLFGSLJGNSDLJNFALFNASLFNBSAJKL
CHARLIE	ECHO	KJSNVJSVNKSAJVDKSAJDNVKSJADVNKSJAVNKJSVSD
CHARLIE	ECHO	LKSDHFKSJAFKSDGKJBASDKJBASDVJVKJSKJSADVKS

Figure 148. Horizontal data splitting by primary key

Figure 149 on page 252 shows horizontal data splitting by all keys. The single member file is split into multiple members using changes in any key as the boundary for each member. In this case, both the primary and secondary keys become redundant.

MEMBER1

Primary key	Secondary key	Other fields
ALPHA ALPHA	ALPHA ALPHA	DIRGJLSGSGSLKGJSLVNSDLKNVLSDNVLSDNVLSVNSL QWERJHGJKBNFSDBKLJNELKGNSJLKNSKJNCVSKJVNS

MEMBER2

Primary key	Secondary key	Other fields
ALPHA ALPHA ALPHA	BRAVO BRAVO BRAVO	SDKGSLDGNSLDHSDLHSDHSDJLHSDFGHSDBSKLBASVL LKSDJGKLSDHLSDHSDKHSDKGHBSKHFKADHFKADBFKA LSKDNFGKLSJHJKLASDHDSBKSDFJBGKSDJBSDJKGBS

MEMBER3

Primary key	Secondary key	Other fields
ALPHA	CHARLIE	WDGHKSDFSJDFNSDFNSDAKBSDKJSDFSKDJBKSJDBFD

MEMBER4

Primary key	Secondary key	Other fields
BRAVO BRAVO BRAVO BRAVO	ALPHA ALPHA ALPHA ALPHA	KJSDFJKASDBFASDJKBFDJKABFAKBBFKADBFADKFBBF LKSDJFLSDNLSDHGSLDGHGHDHSLJKDFHSLDFHSKADH KSDFKLSFLASDNSGBNDGJSGBNSBGJSDKSDBFGKSJSD JAFAFAKDJFHKAJFHAKBAKFBAKBFAKBFAKBFAKJKAS

MEMBER5

Primary key	Secondary key	Other fields
BRAVO	CHARLIE	KSDFKLSFLASDNSGBNDGJSGBNSBGJSDKSDBFGKSJSD

MEMBER6

Primary key	Secondary key	Other fields
BRAVO BRAVO BRAVO	FOXTROT FOXTROT FOXTROT	LKJSDFGLSKGSDGSDLGHLSDGHSDLGHSGLJHSDFSDDF LKSDJGLKSDNLNGSJKLDGSGKLJSGNBSDJBGKJSDFHD KKSNDFLSKJHSGIUKURFSBNVSVBSIGUCVSKEJFSDUD

MEMBER7

Primary key	Secondary key	Other fields
CHARLIE	BRAVO	LKSDJFLSDFLSDHSDJKLHKJFHSDKGHSDGJKHSDJDSF

MEMBER8

Primary key	Secondary key	Other fields
CHARLIE CHARLIE CHARLIE	ECHO ECHO ECHO	LKSDFLKSDLNSLFGSLJGNSDLJNFALFNASLFNBSAJKL KJSNVJSVNKSAJVDKSAJDNVKSJADVNKSJAVNKJSVSD LKSDHFKSJAFKSDGKJBASDKJBASDVJVKJSKJSADVKS

Figure 149. Horizontal data splitting by all keys

Horizontal data splitting tends to create new members within the same file because the record format for each group of records is identical.

12.16.2.5 Using horizontal splitting

Horizontal splitting is best used when you have a large number of records in your database and there is a clear and obvious key to use to mark the divide. This key must have these properties so that when the records are grouped by the breaks in the key, the resulting members have independent (and preferably different) activity characteristics.

For example, you may consider keying all entries in an accounts payable file by the purchase date and breaking the entries at the change of each month. As the records become older, they are less frequently used. This implies that entire members may become eligible for archive as each member contains records from within the same month.

However, if you decide to key your customer detail file by the customer name and break this down by the change in the first letter, the result is 26 members all with the same approximate activity levels. While you may find differences in the activity of the "X" member to the "B" member, neither member changes significantly with respect to the time that has elapsed. That is, you probably do not find that the "X" member's relative activity has decreased after six months have elapsed any more than the relative activity of the "B" member. In short, the statistical activity of each and every member in this file does not vary with time.

Grouping your records

To create new members, you must group records in collections that share common statistical activity variations with time. To do this, you must:

1. Establish the key:

   You must try and balance the two (sometimes opposing) requirements for the key:

   - Most common searches by the user:

     It makes sense that the key you use is aligned to the type of searches and access requests that the database needs to honor, either directly or indirectly, as a result of user requests.

   - Index breaks separate statistical groups of records that have activity patterns that vary with time:

     Putting it simply, the breaks in the keys must try to split active sets from dormant sets of records.

2. Choose the break level:

   You need to choose at which level of the key you want to break (primary, secondary, and so on) and how you want to specify the break. This depends on:

   - Size of large file
   - Number of records in large file
   - Size of required members
   - Number of records required in each member
   - Predicted activity patterns for each member

Application changes

The key changes you need to make in your application to deal with horizontal data splitting include:

- Setting up a member search list, listing the names of members to search for a hit, and the order in which you search them. Include the most active ones first and the most dormant last. You may have different lists for different sub-functions on the same file.

- Coding the changes needed to deal with the member search list to maintain and update it.

- Coding the changes needed to use the list to have a successful search while minimizing the need to retrieve archived data.

12.17 Pseudo record-level archiving

This section concentrates on methods for minimizing changes to our current applications while delivering the most effective possible Dynamic Retrieval solution. It talks principally about the use of special programs to perform the transfer of individual records to and from the application's main files. This section is primarily concerned with making records available for migration without changing the file structure of the main application and explaining how to retrieve those records when they are required.

The main benefit from this approach is the successful archiving and Dynamic Retrieval of records for applications that do not normally lend themselves to this type of solution while also minimizing the impact of changes to that application. Some questions that you need to answer during this process include:

- How are the records to be copied to another file for migration and what indexing data should we maintain for searches?

- When are they to be copied? What triggers the process?

- Which records should be selected for migration?

- How are the archived records to be retrieved?

- What triggers the process for retrieve?

- What search criteria can we use for accessing records and when do we decide to search the archived data (instead of just the online data)?

- How can we group the records (index them) into groups with common statistical activity?

- What direct code changes must we make?

- How much database "get" intercept code do we need?

> **Note**
>
> You should be principally concerned with horizontal data splitting, but, in this case, you are performing the splitting actively (and in an ongoing manner) by constantly moving records to and from tape. The previous section concentrated on splitting the data in the design stages by redesigning the file structures, members, and the application itself.

12.17.1 Moving records to an archive file member

The principle method for archiving records is by copying selected records to a different file or file member and allowing this file member to be archived. This

method effectively removes these records from the active scope of the application. Part of our discussion focuses on how to do this.

You need to consider the following points when you design your record migration function:

- What programs perform the migration?

  The user application may be modified to include a set of statements to select, copy, and delete certain records within the main files. These statements are best coded to be as flexible, generic, and re-usable as possible.

  This migration is performed by a background job. This job acts as a database manager that starts at predefined intervals, performs a transfer, and goes back to sleep. Alternatively, this job can constantly monitor the file activity and prepare certain records for transfer.

- How are the migration programs triggered?

  Whichever way the migration is performed, you need to establish clear triggering criteria for migration activity. The triggering should depend on the type of file activity and granularity required. It can be based on:

  - When a file member reaches a certain size
  - Repeated at fixed times (for example, 2:00 a.m. every day)
  - At user request
  - When a certain volume of migratable records accumulates

  The last option is a more intelligent triggering mechanism, but relies on the ability to time-stamp each record individually, which is not part of the OS/400 database function.

- Which records does the migration programs select?

  This is really a process of *active* horizontal splitting. The data splitting is performed real-time. You need to index the records and select certain records based on their key values. Once the first migration is performed, the indexes and selection criteria are fixed. The only way of changing them is to retrieve all archived records first. If each record is time stamped, you may be able to index on the time stamp and select the oldest records for migration. See 12.16.2.5, "Using horizontal splitting" on page 253, for more considerations about horizontal splitting.

- How do we arrange the migration files?

  Do you need to create a new member every time you archive more records? If you create a new member each time, you must establish a naming convention for each member and a chain of members. This is much the same as the chain of receivers that you set up for journaling. Each member name contains a generic part and a sequence number part, such as ARCMEM0001, ARCMEM0002, and so on. You also need an index of these members to keep the chain intact and to provide an order in which to sequence them. This is similar to the journal object itself that tracks the receiver chain that it feeds. The archived member chain list can also be used as a type of member list with which a search is initiated for a record. This is the same principle with which OS/400 may search for an object using a library list.

  If you insist on using the same member for each archive operation, you must either delete all of the previously archived records each time a new group is archived, or retrieve the previously archived records and append the new

ones to this member and re-archive the member. If you choose to delete the previously archived records, you really mean *delete* them (that is, expire the tape on which they reside so that they really are gone forever, no copies on disk, tape, or anywhere).

If you decide to append to the archive member, you should be aware that this forces a retrieve of all of the records ever archived every time you want to append. This almost defeats the purpose of archive and retrieve except for situations where this archive process is only performed infrequently and there is enough temporary disk space to accommodate the retrieved member. You may also need to temporarily clear out the really old records from this member, since you can never expire the tape (on which it resides as a whole) because this loses all of the archived records, including freshly archived ones.

- In what form do the copied records remain in the main file?

  Once you have selected the records in the master file and copied them to the archive file, what do you do with them? You have three options:

  – Delete them entirely:

    In this case, you have no direct reference to indicate whether a record is archived or simply does not exist. Therefore, if a non-existent record was requested, the search may have to go through all of the archived records to find out that this record does not exist. This results in retrieving all records for every unsatisfied query to the main file.

    The effect of this is reduced by establishing a list (or chain) of archive members through which the search can interrogate. If the records are keyed by a time stamp, it is possible to place a time scope within which the search must remain. A less sophisticated version of this involves naming the last allowable member in the chain that is searchable.

    You may want to combine the idea of searching through a chain of archived members with the *VERIFY retrieve mode allowing the user to stop the search at any point (by member) by cancelling the retrieve operation.

  – Keep record stubs in the main file:

    You can delete all field information relating to a record except for its keys fields. This leaves a stub that uniquely identifies that record and can be used to check the record's existence without querying any archived files. This works similarly to a save with storage freed, and you call it "save record with storage free".

    You may need to add a special flag field to each record to indicate whether it has been archived or establish a special condition to indicate migration status.

    You only save disk space if the record consists of multiple formats and parts of the joined format can be totally deleted from their own physical files. If the record sits in one large record format, all you can achieve is to blank out a number of fields that do not conserve storage space. Another opportunity is to use variable-length records. This way, only the key data takes up space, and the less active data can be removed. Therefore, the file makes more efficient use of storage.

  – Create an index file:

    You can create a separate physical file containing a record format that includes only the key information from the main application file, a migration

status flag, and a name of the member that contains the record (if archived). This is, in effect, creating a home-made access path. For every record that is in or has been in the main file, there is an entry that either points back to the main file (online) or to the archived member that contains the record (and perhaps even the relative record number within that member).

This has the advantages of definitely saving storage space, only accessing the archived members that are absolutely necessary, and never performing a retrieve for requests for non-existent records. However, there is a maintenance issue in that you must reflect in the index file, every change made to the main file by any job at any time. You may need to restrict access to the file through your formal record handling programs.

12.17.2 Retrieving records and integrating into the main file

Depending on your migration approach, the retrieval and subsequent use of archived records can be difficult. It may be easier to tabulate the retrieval suggestions based on the migration methods. Considerations for Dynamic Retrieval and integration into the main file of database records from a list of archive members is shown in Table 5.

Table 5. Dynamic Retrieval of records into main file of database records

Action to be taken	Records are deleted from the main file	Records are saved with files freed	Homemade access path
Trigger: How is the search started?	Any record get request, such as read or chain, is intercepted by a special record management program.	Any record get request, such as a read or chain, is intercepted by a special record management program.	Any record get request, such as a read or chain, is intercepted by a special record management program.
Locate: How is the record found?	A simple search through the members in the list.	Search key fields in the main file.	Search through the special index.
Search path: Which members are searched?	Start at the online member, and progress offline until it is found. Follow the list.	Only the main file (online).	Only the special index.
Retrieve: How is the record brought back?	All searched members are retrieved until the required record is online.	If a record does not exist, all searched members are retrieved until the required record is online.	Only the member containing the record required is retrieved.
Read: How is the record read?	Read directly from the retrieved member.	Read directly from the retrieved member.	Read directly from the retrieved member.
Update: How is the record updated?	Added to the main file and updated.	Copied to main file (add extra data in other record formats) and updated.	Is added to the main file, updated, and index modified.
Result: What happens to the record in archived member after update?	Deleted	Deleted	Deleted
Migration: What happens to the retrieved member in the main file?	Archived if it is updated, and deleted if it is read only.	Archived if it is updated, and deleted if it is read only.	Archived if it is updated, and deleted if it is read only

Action to be taken	Records are deleted from the main file	Records are saved with files freed	Homemade access path
Note: The headings refer to method of dealing with records in the main file that have been copied to an archived member.			

The first column in Table 5 represents action items involved in a retrieval situation. The remaining three columns show the various approaches that are taken when you use one of the three methods of searching for records described in 12.17.1, "Moving records to an archive file member" on page 254.

Other points to note are:

- The table assumes that the record required is eventually found to have been archived. The two options of *read only* and *update* for that record are then investigated.

- Record positioning commands, such as the RPG/400 SETLL command, cannot be expected to work on a differing key than that which controls the archiving, unless the positioning is in some way restricted such as online records only.

- It is possible that a retrieved record is validly re-archived immediately. In this case, an update to a record should be reflected in the archived or retrieved member and not in the main file.

- If the retrieved member is not re-archived immediately, the special record management program can mark this member as online and automatically include it in the online part of the search until it becomes archived again.

- A further option for the retrieved member is to be integrated in full, back into the main file, and then deleted in its entirety.

12.17.3 Application changes

The following application changes are required to manage pseudo record-level archive requests for data:

- Divert all record fetch, update, and add requests to a special record management program that uses the member list to search for the record. Database triggers may be an efficient way to implement this.

- Possibly add logic to decide whether to access the archived records rather than letting a user decide.

And that's it! But remember, all of the work is in customizing the solution, involving designing the record handling program, creating archive members and indexes, and all of the other things previously mentioned.

12.17.4 Running queries over archived records

We touched several times on the idea of setting boundaries for record search or usage. This applies particularly to the running of query type applications over a file. You must specify up front which records are to be used for the query to gain sensible and satisfactory results.

The types of options that you may consider are:

- ***ONLINE**: Search records on disk only.
- ***ALL**: Search every record (including all archived ones).

- **Date range**: Search for records in the specified range only.
- **Member**: Search up to this member in the chain.
- **Member *ONLY**: Search only this member.
- ***ARCHIVED**: Search only archived records.

Suitable processing to retrieve the correct records must be performed before running the query. You need to create your own programs to achieve this.

If you do not know the status of your records (that is, those that are archived), it may not be appropriate to use the *ONLINE or *ARCHIVED options. You may need access to all records that are changed or created since a certain date. This requires individual time stamping of every record in the database and indexing based on that time stamp.

The retrieval of archived records requires merging some records back into the main file. You may choose whether you merge complete members or select specific records to merge. Either way, you must avoid duplicating records and use the following routine for all of the records accessed:

1. Select a record.
2. Copy the record to a main file.
3. Delete the record from the archive file.

Needless to say, if you find that merging archived members is happening frequently (perhaps global queries are needed quite often), you must question the validity of archiving them in the first place.

Perhaps one unexplored method of performing queries over large amounts of archived data is that of direct tape input/output (I/O). Because of the read-only nature of queries, this may be an excellent approach. See 12.17.5.1, "Using direct tape I/O" on page 260, for more details. Of course, if you perform a query over archived records only (*ARCHIVED), there is no need to merge the records into the main file. You may run the query directly over the retrieved member and re-archive it.

12.17.5 Time stamping every record

It has been discussed that for effective record level archiving, record time stamping is essential. This involves the addition of a time/date field to the record format. The time-stamp field may be updated every time the record is updated, read, or both, and used to establish a selection criteria for moving certain records into a file member ready for archiving.

You need to make the following changes:

1. Update the record format for the file to include a date/time stamp field.

2. Add logic to the application code to stamp each record as it is used.

3. Set up security so that only the approved applications with time-stamping logic are allowed to access the file.

4. Recompile programs and files.

You may be able to construct a database request intercept program (perhaps using triggers) that replaces your normal database record fetches for your application files. This program can handle the time stamping of all of the records.

12.17.5.1 Using direct tape I/O

Direct tape input/output (I/O) is where a user program writes records directly to tape or reads them directly from tape. No save or restore CL commands are used. This is different from Dynamic Retrieval, which uses a basic save/restore interface. Direct tape I/O may be an alternative solution for read-intensive operations on archived data. You can use a tape file to write records directly to tape. The record key must be set before you write the block of data, and it is not possible to insert or add records to the initial block.

However, with the use of the BRMS/400 fast search facility for tape drives, such as the 3490, 3590, and 3570, you may be able to locate the beginning of the tape file quickly and perform intensive read only sequential operations such as running a query. The BRMS/400 inventory stores the starting block ID on tape of a tape file and fast forwards the tape directly to that position instead of searching sequentially through the entire tape.

Note: This does not mean Query/400. Tape file I/O means a program reading from or writing sequentially to tape. The records must be read and a *FILE object created from them before Query/400 is used over them.

The fast search implementation is part of the BRMS/400 product. If you want to take advantage of this facility, you must perform all of your tape input and output under BRMS/400 control. To do this, you need to use the Set Media using BRM (SETMEDBRM) command. For further information, refer to *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171).

Chapter 13. Practical implementation of hierarchical storage management archiving capabilities

This chapter deals with the what and how of Dynamic Retrieval with BRMS/400. The first part discusses the types of data that you may consider for archiving. The second part contains details on how to set up and use the BRMS/400 functions, groups, and policies provided to enable Dynamic Retrieval.

13.1 What to archive

This section lists some of the types of data that you may find useful to archive with retrieval and tabulates suggested implementations for some of the discussed cases.

13.1.1 Types of objects to archive for Dynamic Retrieval

We already stated that the support for Dynamic Retrieval covers file members only. We also discussed a handful of cases where certain types of file members (or objects that can be in some way copied or converted to file members) are suitable for archive and retrieval. We attempted to classify a type of file member by the function or purpose it serves, for example, the type of application that uses it and what the application does with it.

This is not intended as an exhaustive list. Neither is it intended to be a list of the only officially supported cases. It is a starting point for discussion that may assist you in the design of a working implementation.

13.1.1.1 Output file data
This is a simple isolated file member that holds a set of records and has no relationship with any other files. Typically, it is a file created by running an OS/400 command with output file support. The results are used once or twice, and the file is forgotten. These file members may sometimes be significant in size.

13.1.1.2 Temporary data files
This is an isolated data file that has been created for a one-time task and is forgotten. The original use may have been anything from copying some records to a backup file during application testing to using it as a file transfer recipient for downloading to a PC.

13.1.1.3 Disused test data
When a new application is implemented on a system or a new release is installed, we often witness extensive testing of the new or updated package. Part of this testing involves creating special test environments with non-critical test data residing in test libraries. When testing is complete, the application typically moves as a whole to the production environment, leaving the test data dormant. It may be useful to remove the test environment from the system with archiving, but save the effort of re-creating it by retrieving it. Certain fragments of that test environment may also be usefully retrieved if it is found necessary to re-test certain components of the package following the application of a fix, for example.

13.1.1.4 Data file with transaction-based members

A transaction-based application (for example, telephone sales recording of orders) amasses records as time goes by. These records become dormant at a certain point in time (for example, when the order has been fulfilled and payment is received). The records, therefore, become historical data for auditing purposes. There may even be a second level of dormancy once some period of auditing is over (for example, at the close of the financial year). At each stage, the status of the data changes. A business decision based on knowledge of the volatility of the data at the various stages and access requirements must be made as to when the data becomes dormant. If the application uses different members using a time-based key to allocate records to a file, this is a particularly suitable package for this implementation of hierarchical storage management.

13.1.1.5 Data file with transaction-based records

If an application is transaction based but does not use a time-based division of records among separate file members, a different approach must be taken. Archiving can only be performed at the file member level. Thus, when records at different stages in their application life share the same file member, you must develop a more sophisticated solution. Further considerations with record-level versus member-level archiving is found in 12.16, "Application design considerations" on page 245. If you implement pseudo record-level archiving, you must synchronize your record movement activity (run by a separate program) with your archiving activity (run by BRMS/400). See 12.17, "Pseudo record-level archiving" on page 254.

13.1.1.6 Statistically random access data files

An application with more random access characteristics, when referring to the age of the records, demonstrates much different file access profiles than that of a transaction-based one (for example, an expert system to diagnose medical conditions). Typically, much of the data may already be collected and arranged before the application was started. There may be a core of data frequently accessed such as the symptoms of the more common ailments and a much larger set of infrequently used data. A large amount of the data may never be updated. For example, many ailments have a stable set of symptoms. There is a great opportunity here to amass an extremely large "dictionary" of information.

Before you begin the process of archiving, you may need to break the data files down into members (horizontal data splitting) according to typical usage characteristics. This involves a certain amount of statistical analysis of each record and its subsequent placing in a file member dependent on its anticipated usage. You have to place *frequently* accessed data into the frequently accessed members. You place the *infrequently* accessed data into the infrequently accessed members and archive the infrequently accessed members. If the application manages this, it is suitable for archive with Dynamic Retrieval.

13.1.1.7 Random access based record access

For random access file activity when the file members are not arranged suitably or where the application does not manage the suitable use of file members, you need to implement pseudo record-level archiving and synchronize the record movement with the archiving. See 12.17, "Pseudo record-level archiving" on page 254, for more information.

13.1.1.8 Mixed characteristic data files

Many applications have a mixed environment of file usage characteristics. A warehousing application may have a parts list with fairly low volatility since the parts stored may not change frequently. However, the stock level entity is highly volatile as new stock arrives and items are sent for delivery every day.

Moreover, the parts inventory may have random access characteristics with respect to record age, but the parts order file may have lots of transaction-based activity.

Archiving with Dynamic Retrieval should be approached on a file-by-file basis for such mixed characteristic applications.

13.1.1.9 Source file members

Source file members are characterized by their contents. Typically, this is data that is updated by programmers and system designers and read for program or database compilations. They tend to be of fixed flat record format. They are different from data file members:

- Normal business applications do not directly use (open, read, update) source file members. Application development tools (which are applications in their own right) may be using source files for editing or compilation, but the usage patterns differ greatly from data files.
- It is less likely that queries are run over source file members.
- Access is typically interactive for update (editing) and batch for read only (compile).

Source physical file members offer great potential for archiving with Dynamic Retrieval because they are typically not used for long periods of time and are split into separate file members with each member having its own independent usage statistics and age.

13.1.1.10 Digital libraries

With the advent of hierarchical storage management on the AS/400 system, you begin to see the emergence of true library type applications. You can store large amounts of information with the understanding that any small portion of your library's data is required at any time, but never the entire data at once. Examples of such applications include patient health records, finger-print files, accounting history, cartographic databases, and so on. These applications should be designed from scratch to capitalize on the use of Dynamic Retrieval. Typically, you may expect to see information broken down into libraries, cases, shelves, books, chapters, topics, sub-topics, and paragraphs. Depending on the typical size of any one of these divisions, you may see chapters, topics, or even sub-topics stored in their own file members.

13.1.1.11 Historical data

Some applications may need to keep certain data for extended periods of time. This is often a legal requirement (for example, in accounting applications, you may be required to keep all basic accounting data for at least seven years). It is not usually a business requirement to have all this historical data online. Moving the data to microfiche or some other means of mass storage may be inappropriate because of possible access requirements or even expense.

If the historical data is grouped in clearly-defined sets, and if these sets are correspondingly arranged in different file members, the Dynamic Retrieval function may be used to good effect. In this case, the application is responsible for "off-loading" the historical data into historical file members and the subsequent management of these file members. An example of such an application could be year-to-year accounts.

13.1.1.12 Active data sets

There are cases where specific data sets are part of a regularly used application function and do not appear to require archiving. However, it may require a detailed understanding of the application functional structure to predict the activity levels of each individual file member. It is possible that a global inclusion of all of the data sets in a BRMS/400 archive list is feasible as the truly active file members never become archived. This allows for archiving some of the less active parts of the data structure.

Use care when setting the dormancy levels for the archive group to avoid repetitive archive and retrieval cycles. The impact of retrieval delays should be studied in detail. If the application function is of a highly performance critical nature, the gains derived from archiving are outweighed by the performance hit of a single retrieval operation. The choice of retrieve mode is also critical. See 12.7, "Retrieval considerations" on page 229, for more information.

13.2 Suggested implementations of Dynamic Retrieval

When you are planning to archive data files, you must remember that the support for Dynamic Retrieval is based at the file member level. The main points to consider include:

- How critical is the file member data to the successful operation of the business?
- What are the legal requirements for retention of the data in the file member?
- What is the size of the file member?
- How frequently is it accessed?
- What is the nature of the application (or applications) that uses (or use) this file member?
- What is the impact to the application of having to retrieve a file member from tape?
- What is the restore time for this file member?
- What type of access is required: read, update, add?
- How long a period of inactivity is regarded as sufficient to mark this file member as dormant?
- How long should the file member be kept (how long to keep the tape copy)?
- What security is required for the tape copy of the file member?
- What backup (duplication) of the file member tape copy is necessary?

Tabulating the answers to the preceding questions is the first step in establishing the optimal system setup and BRMS/400 configuration. Remember that BRMS/400 supports a hierarchical policy structure, which therefore, allows you to

set global control group attributes through the System Policy and the Archive Policy. You may want to establish a set of most commonly-used attributes and set the policies with these attributes with corresponding overrides of these values at the control group level.

For example, you may decide that the most commonly-used dormancy criteria is that of one year. Set this in the Archive Policy. Then, for every control group that requires a different value, override the value in the control group's attributes.

> **Note**
>
> A more prudent approach may be to use the *most safe* value for the Archive Policy. In this example, you may have a dormancy period of five years set in the Archive Policy. That way, when you create your Archive Control Groups, if you forget to override the dormancy value, the impact is limited. In this case, you do not suddenly archive every object in the archive control group because the Archive Policy dormancy is set to one day.

The file members may be grouped according to common archive or retrieve characteristics and entered into archive lists within BRMS/400. These lists may themselves be grouped according to common parameters related to the method of archiving them and entered into control groups within BRMS/400. The control group parameters are tailored and the groups scheduled to run on a regular basis. You can find more details on *how* to set up the BRMS/400 configuration in 13.3, "Using BRMS/400 for hierarchical storage management" on page 267.

The preceding structure should be used at all times when planning your implementation of hierarchical storage management. You should examine each data set in detail and derive the most appropriate settings for your BRMS/400 setup. Take into account:

- Overall business objectives
- Individual "user class" requirements
- Agreed service levels
- Application design constraints
- System constraints
- BRMS/400 function

Table 6 on page 266 lists the data set types previously mentioned and suggestions for the necessary design points.

> **Note**
>
> This table is, by no means, exhaustive or conclusive. It is meant as a reasonable test and nothing more. You should always plan your particular implementation thoroughly, examining each data set individually. A keen understanding of your own business and the applications that you use is vital and should be exploited fully.

Table 6. BRMS/400 Dynamic Retrieval guidelines

Data type	Typical application or use	Business criticality (H/M/L)	Dormancy level for archive qualifications	Retention period for tape copy	Retrieve mode	Notes
Outfile Data	Query the results of CL commands.	L	3 months	1 year	*DELAY	Some applications may use outfile support. Do not include these files in your archive lists. The application should manage them independently. If archived, they should be part of application archive.
Temporary Data Files	Temporary backup, record copies, file transfer, and so on.	L	1 month	3 years	*DELAY	Retrieval of certain portions should be useful.
Data File with Transaction Based Members	Typically order entry, accounting sales analysis, and so on.	M	1 to 3 years	5 years and up: Depends on business or legal requirements	*VERIFY (small) or *SBMJOB (large)	*SMBJOB may actually improve performance in some cases.
Data File with Transaction Based records	Typically order entry, accounting sales analysis, and so on.	H	Immediate	5 years and up: Depends on business or legal requirements	*VERIFY	The archive should be performed immediately after the movement of records to the special archive member. Using the *SBMJOB retrieve mode may actually improve performance in some cases.
Data File with Random Access Members	Typically stock control, medical analysis, customer files, and so on.	H	1 to 3 years	5 years and up: Depends on business or legal requirements	*VERIFY (large) or *NOTIFY (small)	*SBMJOB may actually improve performance in some cases.
Data File with Random Access Records	Typically stock control, medical analysis, customer files, and so on.	H	Immediate	5 years and up: Depends on business or legal requirements	*VERIFY	The archive should be performed immediately after the movement of records to the special archive member. Using the *SBMJOB retrieve mode may actually improve performance in some cases.
Data File with Mixed Characteristics	Example: Customer order application: generating order is transaction, fetch customer data is random access.	H	1 to 3 years	5 years and up: Depends on business or legal requirements	*NOTIFY (performance critical)	You may even analyze each individual data set within the application and allocate separate archiving and retrieval conditions for each one.
Source file members	Source editing applications and compilers.	M	1 year	5 to 10 years	*SBMJOB	The value of the intellectual property within the source files must not be lost by discarding the archive copy early.

Data type	Typical application or use	Business criticality (H/M/L)	Dormancy level for archive qualifications	Retention period for tape copy	Retrieve mode	Notes
Digital Libraries	Reference information applications	H	2 weeks	10 years and up	*NOTIFY	Typically small chunks of the massive library are retrieved, and therefore, *NOTIFY is probably appropriate.
Historical Data	Transaction-based applications	H	Immediate (coincide with period end)	5 years and up: Depends on business or legal requirements	*VERIFY	Archive should take place as soon as the historical data is placed into the archive members.
Active Data Sets	Any business application	H	18 months	10 years and up	*NOTIFY	18 months dormancy is a reasonable period to determine if data needs to be archived since it was last used.

13.3 Using BRMS/400 for hierarchical storage management

This section provides an overview on the basic functions needed to set up an implementation of hierarchical storage management with BRMS/400. Where appropriate, we give detailed specific actions to take with the BRMS/400 product. For a full understanding of BRMS/400 and how this particular topic fits in to the overall BRMS/400 structure, you must be familiar with the contents of *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171).

13.3.1 Review of the BRMS/400 structure

The parts of BRMS/400 that you need to use to set up a working Dynamic Retrieval environment are:

- **Archive Lists**: WRKLBRM *ARC
- **Media Classes**: WRKCLSBRM *MED
- **Move Policies**: WRKPCYBRM *MOV
- **Media Policies**: WRKPCYBRM *MED
- **Control Groups**: WRKCTLGBRM *ARC
- **Archive Policies**: WRKPCYBRM *ARC
- **Retrieve Policies**: WRKPCYBRM *RTV
- **Job Scheduling**: WRKJOBSCDE
- **BRMS/400 Logs**: DSPLOGBRM *RTV
- **Resume Retrieve**: RSMRTVBRM
- **Set Retrieve**: SETRTVBRM
- **Set Media**: SETMEDBRM

See *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) if you need additional information on the commands and the parameters.

The process we adopted is outlined here:

1. Identify data sets suitable for archiving.

2. Establish suitable archive criteria for each data set.

3. Group the data sets by common characteristics.

4. Identify the jobs associated with the various data sets.

5. Build BRMS/400 archive lists (one for each group or sub-group of data sets).

6. Incorporate the archive lists into control groups.

7. Create any required special media classes for archive.

8. Create any required special media movement policies for archive.

9. Create media policies for each group of data sets.

10. Establish an archive policy.

11. Build an archive control group for each group of data sets.

12. Adjust each archive control group's attributes where they vary from the archive policy.

13. Establish a retrieve policy.

14. Build alternative retrieve policy settings for any jobs that require different retrieve modes. These can be implemented using the SETRTVBRM command in the user's initial program.

15. Add the archive jobs to the scheduler (if required).

Ideas and suggestions for the first four steps are included in the previous sections of this publication. This chapter deals with the practicalities of setting up BRMS/400. This includes the remaining steps. We also deal with:

- Checking the BRMS/400 logs for results from the archive run.
- Controlling retrieve operations from the RSMRTVBRM display.

13.4 Setting up BRMS/400 for archive with Dynamic Retrieval

This section deals with the practicalities of setting up the necessary archiving details in BRMS/400 to implement Dynamic Retrieval. The next section deals with the retrieval part.

13.4.1 Archive lists

The first part of archiving for Dynamic Retrieval is the identification of candidate file members that you want to archive. This is done at four levels, depending on how granular you want to be. The four levels are:

- ASP level
- Library (or generic library) level
- Object (*FILE) level
- Member level

The ASP and library levels give you the opportunity to specify a large number of candidate file members without much typing. You can specify an ASP number as a special value in the archive control group (for example, *ASP03 or a library name such as PAY*). When specifying these values, BRMS/400 checks all of the file members in ASP 3 or in all of the libraries beginning with the characters "PAY". However, it is rare that you want to actually *archive* at these levels. They are useful in producing Archive Candidate reports to assist in estimating potential space savings.

Typically, an object and member level archive candidate selection is most often used. With these, you must group these candidate file members into lists of objects with something in common. You may make good use of the generic selection facilities within BRMS/400 if, for example, the file members are all in the same file.

Each list of objects may be entered into a BRMS/400 archive list. These lists are placed into a BRMS/400 archive control group. It is the control group that specifies the archiving parameters such as dormancy levels and media policies. Therefore, it is feasible to split groups of objects that currently have similar archive or retrieve characteristics into several individual archive lists to allow additional flexibility for future changes.

To work with BRMS/400 lists, enter the WRKLBRM command. You must create your archive list with *ARC for the Use value and *OBJ for the Type value. You can also select *FLR to archive folders or *SPL to archive spooled files.

Important

Be aware that neither folders or spooled files currently have Dynamic Retrieval support.

The Add Object List display is shown where you may proceed to enter the objects required for the archive. Simply type in a sequence number, library name, object name and type, and whether this is an include or exclude selection as shown in Figure 150. The archive processing takes place in the order shown on the display.

```
                          Add Object List                        SYSTEM04

 Use . . . . . . . . . . :   *ARC
 List name . . . . . . .     ARCLIST
 Text  . . . . . . . . .     Main List for Archive with Retrieval


 Type choices, press Enter.
                                                    Selection
   Seq      Library       Object        Type        *INC/*EXC
   60       KARY          SOURCE        *FILE          *EXC
   10       QGPL          *ALL          *FILE          *INC
   20       RBOWEN        MYFILE        *FILE          *INC
   30       KARY          *ALL          *ALL           *INC
   40       RBOWEN        BIGFILE       *FILE          *INC
   50       RBOWEN        SOURCE        *FILE          *INC

```

Figure 150. Adding objects to an archive list

When you complete your archive list, press the Enter key once more to save the list. If you press F3 or F12, you lose all of the changes you just entered!

Continue to create as many lists as you need. You use these lists later in the various archive control groups that you create.

> **Note**
>
> If you want to include a complete library of objects as candidates, it is easier to enter that library name as an entry in an archive control group rather than including it in an archive list. Either way, for retrieval purposes, remember that if you include generic values, or even whole libraries or ASPs, you can easily archive object types such as programs, logical files, journal receivers, and so on that are not supported for Dynamic Retrieval. These objects may archive without problems. However, you do not realize what you have done until it becomes time to retrieve an unsupported object, at which time the system simply reportes that it is saved with storage freed and the user program ends in error. As mentioned earlier, the ASP and library-level values are good for creating Archive Candidate reports.

13.5 Media classes for archive

In general, you do not need to create separate media classes for archive. You only need to create them if you want to use different tape drives for archiving, or use a different tape format, or not even share your archive tapes with other systems or backup jobs.

Use the WRKCLSBRM *MED command to create a new media class, and change the necessary parameters in the Add Media Class display shown in Figure 151.

```
                           Add Media Class

  Type choices, press Enter.

  Media class . . . . . . . . . . . .    ARCMED       Name
  Density . . . . . . . . . . . . . .    *FMT3490E    *FMT3480, F4 for list
  Media capacity  . . . . . . . . . .    *DENSITY     *DENSITY, Number nnnnn.nn
    Unit of measure . . . . . . . . .    _            1=KB, 2=MB, 3=GB
  Mark for label print  . . . . . . .    *NONE        *NONE, *MOVE, *WRITE
  Label size  . . . . . . . . . . . .    1            1=6 LPI, 2=8 LPI, 3=9 LPI
  Label output queue  . . . . . . . .    *SYSPCY      Name, *SYSPCY, *PRTF
    Library . . . . . . . . . . . . .    _____    Name, *LIBL
  Shared media  . . . . . . . . . . .    *YES         *YES, *NO
  Text  . . . . . . . . . . . . . . .    Special archive media
```

Figure 151. Add Media Class display

13.5.1 Move policies for archive

You undoubtedly want to create special move policies for your archive-with-retrieve tapes. It is unlikely that these tapes can cycle through the locations in the same way as regular save tapes or even non-retrieve type archive tapes. You may need to create several move policies. We recommend at least two move policies.

The first move policy should be used for the "active" tapes that contain the "active" data that has been archived and can be required for retrieval at any moment. This set is the copy of the original archive set. Because the duplicate set was created after the original set of tapes, BRMS/400 regards these tapes as the

latest versions. You must use the duplicate set as the "active" set and retain them close to the drives, for example, within your tape library device or a tape rack. This move policy should keep the tapes close at hand, that is, near to the tape drives that are used for retrieve operations. If you have an automated tape library device, you may even set the move policy so that the tapes remain in the library at all times. You must try not to compromise the security of these tapes against accessibility. Remember that leaving them out in open racks exposes live business data to potential theft and to damage from accidents, fires, floods, and so on.

The second move policy should be for the original tapes that we recommend you make a duplicate of after every archive operation. You should send these tapes immediately to a different site from the site in which the "active" archive copies are stored.

You may repeat this pairing of move policies for each different physical location in which archive tapes are likely to be stored.

To create a move policy, use the WRKPCYBRM *MOV command, and create a move policy such as ARCMOV. Define the sequence and duration of all of the locations to be visited on the Create Move Policy display shown in Figure 152.

```
                          Create Move Policy                    SYSTEM04

Move policy  . . . . . . . . . .   ARCMOV
Home location  . . . . . . . . .   *SYSPCY       Name, *SYSPCY, F4 for list
Use container  . . . . . . . . .   *NO           *YES, *NO
Confirm moves  . . . . . . . . .   *YES          *YES, *NO
Calendar for working days  . . .   *ALLDAYS      Name, *ALLDAYS, F4 for list
Calendar for move days . . . . .   *ALLDAYS      Name, *ALLDAYS, F4 for list
Text . . . . . . . . . . . . . .   Archive tapes only


Type choices, press Enter.


  Seq      Location      Duration
  40       RACKS         *EXP
  10       ATL01         180
  20       OFFSITE       180
  30       VAULT         30
```

Figure 152. Create Move Policy display

13.5.2 Archive media policies

You need to create a separate archive policy for every different retention period you want to use for your archived data. The retention period indicates how long a piece of data on a tape should stay active from the day that the data was written to that tape. You can find approximate reasonable-test figures for this value in Table 6 on page 266. When the retention period is exceeded, the data on the tape is expired; the tape becomes a scratch tape and is available for any new backup or archive operation.

You may set retention by the number of elapsed days, the number of versions to keep, permanent (keep data for ever), or for a fixed date. We make the following recommendations for these options:

- **Permanent**: This is generally unsuitable because if a data item is retrieved, it may be changed and re-archived at a later date. Therefore, the original version is now redundant but continues to occupy its tape forever.

  However, since version control at the member level is not currently supported, the permanent option may be the only way to keep your archived data indefinitely. If you implement this, be aware that every time you archive a data item with permanent retention, you say good-bye to that tape forever. It is unlikely that you are in a position to manually expire the tape because you have no idea whether the items archived to it have since been retrieved.

- **Date**: It is unlikely that you need to discard all of the archived data on a certain date, especially if you have no idea when it may be retrieved.

  Use this option with caution. If you specify an expiration date, you may need to modify existing policies or create new policies and control groups as time passes. An example may be a tax analysis application where the data must be kept for seven years or more, regardless of the number of times that this data was retrieved. Therefore, you may have a control group for 1994 (called "TAX94") that listed the 1994 tax files and a 1994 media policy (called "TAX94") that expires all of the data on January 1, 2002 (seven years after the end of 1994). Every time a 1994 tax file was retrieved and subsequently re-archived, the expiration is always in January 2002. The consequence of this system is that you must create new archive control groups (and possibly new archive lists) and new media policies each year (but you should only need seven of each).

- **Versions**: Version control is currently unsuitable for archiving because the versioning algorithm works at a *tape file* level as opposed to a *file member* level. Consequently, you may have several file members archived in a single save with storage freed operation, producing a single tape file with a label based on the name of the data file. When a group of different file members within the same data file are subsequently archived, you create what appears to be a second version of the same file members, but it is not. Currently, BRMS/400 prevents us from using versioning with archive control groups.

  If version control for archive at a member level ever become available, it will offer an elegant way of permanently keeping your archive data on tape but expiring older versions of members that have since been retrieved and re-archived to another tape.

- **Days**: The number of days elapsed is by far the simplest method for retaining our archived data tapes.

The retention period is important. If you set it too short, you may completely lose important data far too soon. Expiration of a tape with archived data is effectively deleting that data. If you set the period too long, you experience a degree of data fragmentation on your tapes. Every time an object is retrieved, it is restored from tape and used on the system. At a later date, it is archived again and the original copy becomes redundant or "expired". For a tape that contains several archived objects, as time passes, more and more of the archived objects "expire". This is all wasted space on the tape and can only be reclaimed when the entire tape is expired by BRMS/400. In extreme cases, *all* of the archived data might have become redundant (and, therefore, the entire tape is redundant), and the tape is still not expired (and, therefore, re-usable) by BRMS/400.

In the media policy, you also establish the link to the media class that you want to use (possibly created in 13.5, "Media classes for archive" on page 270) and the move policy that is appropriate (created in 13.5.1, "Move policies for archive" on page 270).

If you are using an automated tape library, you may also specify the name of the required library location in the Storage location parameter when you create a media policy. This helps BRMS/400 select the correct tape drives to use when performing archive or retrieve operations.

Use the `WRKPCYBRM *MED` command to create a media policy. On the Add Media Policy display, set the parameters according to the results of your implementation planning work completed in 13.1, "What to archive" on page 261.

After you create the necessary media policies and archive lists, you can create the required archive policy and base your control groups on all three.

13.5.3 Archive policy

The archive policy is the system-wide default set of controls that governs the behavior of all archive control groups when being executed. Any of the parameters in the archive policy can be overridden within each individual control group (using the control group's attributes), but the archive policy serves as a system standard and a sort-of "good practices" guide.

You can access the archive policy directly by using the `WRKPCYBRM *ARC` command, and you can change the parameters to meet your requirements.

A full functional description of all of the parameters shown is available in *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171). However, for the purpose of Dynamic Retrieval, we take particular note of the Include, Save access paths, and Default weekly activity parameters.

Note

The following recommendations are intended for all archive control groups that archive objects for use with Dynamic Retrieval. If you do not perform any other kind of archiving, it may be appropriate to follow these recommendations for the archive policy and allow all of your archive control groups to default to the archive policy. If non-retrieve archive control groups also exist, you use take care with this approach. It may be best to specifically set all of these parameters within each archive control group and leave the archive policy as general as possible.

13.5.3.1 Inactivity limit
This is the dormancy criteria that is used to qualify each object for inclusion in the archive. It is specified as the number of elapsed days since the object was last *used* or *updated*, whichever is the more recent. This is the column headed "Dormancy Level for Archive Qualification" in Table 6 on page 266.

13.5.3.2 Archive date for *FILE objects
For file objects, you may be more specific about the date that you want to use for dormancy qualification. This parameter allows you to specifically only use either

the last used date or the last changed date as the checkpoint for the dormancy duration. BRMS/400 may still use both as described in the previous paragraph.

This facility allows you to, at the control group override level, have two control groups with the same file objects listed, but different dormancy criteria for the last update and last used. Using this approach, you may want to set a longer period to wait for archive if the file has recently been updated, and a shorter wait until archive if the file has only been read. You can also use this approach to differentiate between active data files (recently changed) and files that have simply been retrieved for a small number of reads (recently used), although this is not a watertight assumption to make.

13.5.3.3 Objects able to be freed
To use the BRMS/400 Dynamic Retrieval, function you must specify *YES to this parameter to enable saving the objects with storage freed.

13.5.3.4 Retain object description
Again, you must specify *YES to this parameter if you want to use the Dynamic Retrieval as this is the parameter that initiates the save with storage freed operation. If *NO is specified, the object description is deleted after it has been saved to tape.

13.5.3.5 Objects not able to be freed
We advise you specify *NO for this parameter because this ensures that it is less likely that you will archive an object that cannot be retrieved dynamically. But remember that there still may be a significant number of objects that can be saved with storage freed but are not supported by the BRMS/400 Dynamic Retrieval function.

13.5.3.6 Save access paths
We recommend that you specify *YES to this parameter for all objects that may be retrieved. This is so that the performance of the retrieve operation, especially if it is in the *NOTIFY or *VERIFY mode, is not inhibited by a lengthy access path rebuild phase.

13.5.3.7 Default weekly activity
The Default weekly activity parameter controls the days on which archiving may take place. Enter an asterisk (*), or whichever character you defined if you tailored the BRMS/400 presentation controls, in the days that you want an archive to run. You may choose to run the archives less frequently than your backups to increase availability of the system or to increase the amount of data that is likely to be archived in one operation. You do not necessarily need the system in a quiesced state to perform archiving. By definition, the objects to be archived are not in use, but there may be special conditions which apply. For example, immediate archive or an exclusive lock on the entire library prevents objects from archive.

> **Note**
>
> The more data that is archived in one run (and, therefore, on a single set of tapes), fragmentation is more likely to occur. If you keep archiving frequently, you only have a few objects on each tape. This, in turn, could lead to a great deal of tape space being wasted.

Our main recommendation for your archive activity plan is that you *start archive immediately after your backups have completed*. This minimizes the impact of archive media errors because a backup copy of the data exists. You can also use the DUPMEDBRM command to create duplicates of your archived media for safety reasons.

13.6 Archive control groups

Having created your archive lists, you are in a position to build archive control groups. You have set your archive policy to reflect the most desirable run-time options for all of your archive control groups. If the only archiving you are performing is archiving for Dynamic Retrieval, it is possible that you have set the archive policy to be most suitable for all of your archive control groups.

Use the `WRKCTLGBRM *ARC` command to create an archive control group. Specify the names of the archive lists that you created earlier, or enter the names of the libraries that you regard as suitable candidates for archiving. An example is shown in Figure 153.

```
                     Edit Archive Control Group Entries          SYSTEM04

Group . . . . . . . . . . : MAINARC
Default activity . . . . . *ARCPCY
Text  . . . . . . . . . . . Archive Control Group


Type information, press Enter.


                           Weekly    Save
           Archive    List Activity  While
Seq        Items      Type SMIWTFS   Active
60         *ASP03     ____
10         ARCLIST    *OBJ *DFTACT   *NO
20         SALESLIST  *OBJ *DFTACT   *NO
30         MYLIB      ____  *   *    *NO
40         STOCKLIST  *OBJ * * * *   *NO
50         ARC2LIST   *OBJ *DFTACT   *NO
```

Figure 153. Edit Archive Control Group Entries display

Note that F19 key allows you to display a list of libraries to choose from. In each case, you are simply listing available *candidates* for archive. The selection of objects that actually are archived is performed at run time using the list of archive candidates and the *Include Criteria* specified in the control group attributes or the archive policy.

You may also want to specify a different archive weekly activity for each library or list at this point. If you leave this field, it defaults to *DFTACT, and the activity is taken from the default activity, which is a control group attribute, and can also be

entered at the top of the display. Remember that each of the control group's attributes may also default to the archive policy, and some of these may also default to the system policy.

After creating the archive control group, you can change any of the attributes such as tape device to use or the dormancy criteria. Refer to *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) if you need more information on individual parameters. There is also a discussion on some of the more relevant parameters in 13.5.3, "Archive policy" on page 273.

You may also change the list of subsystems to end if there are some jobs that interfere with the archive processing. At the end of the archive run, the subsystems are automatically re-started. Similarly, you can also specify a list of job queues to be held during the processing of the archive control group.

As a final check, you may use the Start Archive using BRM (STRARCBRM) command with the *REPORT option to print a report a report of the available candidates for archiving within the control group. The report may not be printed if none of the files in your lists are dormant yet. In this case, you receive a message saying that the report did not contain any data.

13.6.1 Scheduling the archive

The easiest way to schedule running an archive control group is to use option 6 from the Work with Archive Control Groups to schedule the archive job as shown in Figure 154.

```
                    Add Job Schedule Entry (ADDJOBSCDE)

 Type choices, press Enter.


 Job name . . . . . . . . . . . . > QBRMARC        Name, *JOBD
 Command to run . . . . . . . . . > STRARCBRM CTLGRP(*ARCGRP) OPTION(*ARCHIVE) S

 BMJOB(*NO)
 _____
 _____
 _____
 _____
 _____
 _____
 Frequency  . . . . . . . . . . . > *WEEKLY        *ONCE, *WEEKLY, *MONTHLY
 Schedule date, or  . . . . . . . > *NONE          Date, *CURRENT, *MONTHSTR...
 Schedule day . . . . . . . . . . > *ALL           *NONE, *ALL, *MON, *TUE...
                + for more values
 Schedule time  . . . . . . . . . > '00:01'        Time, *CURRENT
```

Figure 154. Add Job Schedule Entry display

By default, option 6 invokes the standard OS/400 job scheduler.

You can set the archive job to run daily, several times a week, weekly, or monthly. To specify daily, set the Frequency parameter to *WEEKLY and the Schedule Day parameter to *ALL. The other combinations are self explanatory.

We advise you to set the time for the run to start immediately after the backup runs have completed. You can achieve this by choosing a time when you are confident that the backup run has shut the system down to a restricted state;

therefore, the archive is initiated as soon as the backup has completed and the subsystems are brought back up. You may choose to simply queue the archive jobs behind the backup jobs in the same job queue. Be careful with this approach if you run multiple backup or archive jobs concurrently. You may even write a simple CL program that initiates the backups, and on completion, initiates the archive. This program may be scheduled to run within the OS/400 job scheduler instead of submitting each individual backup or archive job separately. Use the Work with Job Schedule Entries (WRKJOBSCDE) command or the Add Job Schedule Entry (ADDJOBSCDE) command to achieve this.

You may want to use an alternative job scheduler (for example, one that has a dependency function built into the scheduling algorithm, perhaps using parent and child relationships). You can instruct BRMS/400 to use the scheduler of your choice with the CHGSCDBRM command. See *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) for more details.

13.7 Using BRMS/400 for Dynamic Retrieval

This topic describes the day-to-day activities that can help you control the BRMS/400 Dynamic Retrieval function to suit your needs. You can find details on *what* to do with retrieve policies in 12.7, "Retrieval considerations" on page 229. This section concentrates on *how* to retrieve your data dynamically.

13.7.1 Setting retrieve policies

The key to retrieving your objects is the BRMS/400 retrieve operation. This operation is initiated once for each file member that has been opened and found to be saved with storage freed. The retrieve operation is guided by the retrieve policy within the BRMS/400 policy structure. This retrieve policy governs many attributes that control the way in which a retrieve is performed and it takes effect across *the entire* system.

Obviously, not all applications want to retrieve their data in the same manner (or *mode*, as we call it). For additional flexibility, you may use the SETRTVBRM command to override the system wide retrieve policy settings at the job level. When you issue the SETRTVBRM command, the new settings apply for all retrieve operations initiated after that point and until the job ends or another SETRTVBRM command is issued. The SETRTVBRM command is explained further in 13.7.1.2, "Setting the retrieve controls for a particular job" on page 279.

13.7.1.1 Setting the retrieve policy
The retrieve policy can be changed by using the WRKPCYBRM *RTV command. The Policy Administration (BRMPCY) menu also contains an option for the retrieve policy. The following options are supported for the change in the retrieve policy:

- **Media device**: The device (or group of devices) used for the retrieve operation. *MEDCLS has the usual meaning and uses any device compatible with the format of the media on which the required data resides. This is called *device pooling*. This is the *recommended value*. You may choose a device name from a list of the currently available ones by pressing F4 with the cursor in this field. A display similar to the example in Figure 155 on page 278 is shown.

```
                        Change Retrieve Policy                     SYSTEM04


   Type choices, press Enter.



   Retrieve device  . . . . . . . . . . . *MEDCLS     Name, F4 for list
   Retrieve confirmation:               .......................................
     Interactive operation  . . . :        Select Device                : DELAY...
     Batch operation  . . . . . . :                                      : OTIFY
   Retrieve authorization . . . . :   Type options, press Enter.         : *UPD...
   End of tape option . . . . . . :        1=Select                      : UNLOAD
   Option . . . . . . . . . . . . : Opt  Device                          : *FREE
   Data base member option  . . . :   _    *MEDCLS                        : , *OLD
   Allow object differences . . . :   _    TAP02                          :
   Object Retention . . . . . . . :   _    TAP03                          :
                                     :   _    TAP04                        :
                                     :   _    TAP05                        :
                                     :                            More... :
                                     : F9=Work with devices               :
                                     : F12=Cancel                         :
   F3=Exit    F4=Prompt    F5=Ref   :                                    :
   F12=Cancel                       :.....................................:
```

Figure 155. Selecting a device for your retrieve policy

> When media containing the file is located in a media library device, BRMS/400
> limits its choice of *MEDCLS devices to those that are at the media library
> device location.

- **Retrieve confirmation**: You may specify the retrieve confirmation (or retrieve
  mode) for batch and interactive jobs separately and independently.

  A full description of each of these parameters is found in 12.8, "Retrieval
  methods" on page 231. Further discussion on the best uses of each mode is
  found in 12.7, "Retrieval considerations" on page 229.

- **Retrieve authorization**: The authority option tells BRMS/400 what level of
  authorization to a file is necessary before the accessing user can retrieve the
  file. This authorization level is checked and, if met, the retrieve operation is
  performed. If it is not met, the BRM1823 message is sent indicating that the
  file was not restored and that it cannot be used until restored. The unretrieved
  file is tracked by BRMS/400 to indicate that an *AUTHORITY failure occurred.
  Through the RSMRTVBRM command and the Resume Retrieve display, the
  user can easily identify files that were unable to be retrieved due to authority
  failures and can request that the retrieve operation for one or more of them is
  performed or cancelled.

  For many enterprises, users only have use or update authority to files. If the
  authority level is set at *UPD at open time, BRMS/400 automatically retrieves
  the archived file member for those users that have at least update authority to
  the file. In doing so, BRMS/400 allows the file to be retrieved without having to
  grant users who access the file *OBJEXIST authority to enable Dynamic
  Retrieval.

  Allowable values are a subset of those allowed on the OS/400 CHKOBJ
  command for the AUT parameter such as *OBJEXIST, *OBJMGT, *OBJOPR,
  *ADD, *DLT, *READ, *UPD, and *ALL. The default value is *OBJEXIST.

You may decide to downgrade the user's required authority level for a restore, for example, to *OBJOPR. This effectively grants a user limited existence or creation rights to certain objects under certain conditions when they previously were only able to use the object. There is an inverse relationship here. The lower you specify the required authority, the more authority you are effectively granting.

- **End of tape option**: This is identical to the OS/400 standard save/restore end of tape option parameters. The default is *REWIND.

  If you are using an automated tape library or even a drive with an automatic cartridge loader, it increases the level of automation if you specify *UNLOAD, because this removes the current cartridge from the drive leaving it available for the next operation.

- **Option**: This is the restore option. This option controls how BRMS/400 invokes the RSTOBJ command. The values supported are exactly the same as those for the RSTOBJ command's OPTION parameter such as *ALL, *NEW, *OLD, and *FREE.

- **Allow object differences**: This parameter is used to indicate if object differences are to be tolerated during a restore operation. The values of *NONE and *ALL are supported and have exactly the same meaning as they have for the RSTOBJ command's ALWOBJDIF parameter. The default value is *NONE.

- **Object retention**: This parameter was new in V3R6 for RISC systems and in V3R2 for CISC systems. The default for this parameter is to keep the retrieved object on the system for an indefinite period (*NOMAX). You can change the default and specify the number of days you want to keep the retrieved object on the system before it is deleted, provided it has not changed. At the end of the retention period, BRMS/400 maintenance job performs a save with storage freed to a temporary file and deletes the temporary file afterwards. If the object has changed, you have to follow the normal archive procedures to re-archive the updated object.

It should be noted that *all* retrieve operations are constrained by the Storage Threshold (a high water mark for Auxiliary Storage Pool (ASP) utilization) as expressed through the System Service Tools (STRSST) ASP threshold. See *Backup and Recovery - Advanced*, SC41-4305, for more details.

BRMS/400 does not restore a file if doing so causes the ASP's storage threshold to be exceeded. If the storage threshold were to be exceeded, messages are sent indicating that the file was not restored and that it cannot be used until restored. The unretrieved file is tracked by BRMS/400 to indicate that a *STORAGE failure occurred. Through the Resume Retrieve using BRM (RSMRTVBRM) command and the Resume Retrieve display, the user can easily identify files that were unable to be retrieved due to DASD space constraints and can request that the retrieve operation for one or more of them be performed or cancelled.

13.7.1.2 Setting the retrieve controls for a particular job

You may want to override the values set by the Retrieve Policy (for the entire system) for a particular job. To do this, you must issue the Set Retrieve Controls for BRM (SETRTVBRM) command within the job that you require the override to take effect.

The controls you specify with the SETRTVBRM command remain in effect for your job until they are reset, for example, when the job ends, or otherwise is changed with another SETRTVBRM command. To see control values that are currently in effect, use the SETRTVBRM command. A display appears similar to the example in Figure 156.

```
                    Set Retrieve Controls for BRM (SETRTVBRM)

 Type choices, press Enter.

 Retrieve Device  . . . . . . .    *MEDCLS      *SAME, *MEDCLS, TAP01...
 Retrieve Confirmation:
   Interactive Operation  . . .    *VERIFY      *SAME, *RTVPCY, *VERIFY...
   Batch Operation  . . . . . .    *NOTIFY      *SAME, *RTVPCY, *VERIFY...
 Retrieve Authorization . . . .    *OBJEXIST    *SAME, *RTVPCY, *OBJEXIST...
 End of Tape Option . . . . . .    *REWIND      *SAME, *RTVPCY, *REWIND...
 Option . . . . . . . . . . . .    *ALL         *SAME, *RTVPCY, *ALL, *NEW...
 Allow Object Differences . . .    *NONE        *SAME, *RTVPCY, *NONE, *ALL
 Object Retention . . . . . . .    *NOMAX       *SAME, *RTVPCY, 1-9999, *NOMAX
```

Figure 156. Set Retrieve Controls for BRM display

The parameters shown are exactly the same as those found in the retrieve policy. You may review the descriptions listed in 12.8, "Retrieval methods" on page 231, for more information.

The SETRTVBRM command can be inserted into the initial program for certain users or into the controlling CL program for your batch jobs. You may even build it into your application if you need to change retrieve modes depending on the functions being performed. You must be careful about allowing users to change their retrieval controls themselves. See 13.9.3, "Securing the retrieve policy" on page 287, for further discussion on this matter.

13.7.2 Responding to a retrieve operation

This section contains details of the messages that you may see while witnessing a retrieve operation. It also includes any responses that you may need to give to inquiry messages received as part of that retrieve operation.

13.7.2.1 *VERIFY

By default, a program message is displayed to the user as shown in Figure 157 through Figure 159. The first display is shown, and the Additional Message Information display is only shown if the user presses the Help key. The more knowledgeable user becomes familiar with the options and most often makes a decision from only the Display Program Messages display. Important additional information is included in the second display including object size and ASP utilization, which may influence the user's decision to initiate the retrieve immediately.

```
                   Display Program Messages

Job 016022/KRIS/KRISLUJ  started on 10/31/00 at 11:33:06 in subsystem QINT
Retrieving PAYMASTFIL in library PAYROLL. (C G I S)
```
```
Type reply, press Enter.
  Reply . . .   _____
_____

F3=Exit   F12=Cancel
```

Figure 157. Retrieve *VERIFY messages (Part 1 of 3)

```
                  Additional Message Information

Message ID . . . . . . :   BRM1822       Severity . . . . . . . :   99
Message type . . . . . :   Inquiry
Date sent  . . . . . . :   11/02/00      Time sent  . . . . . . :   18:14:51

Message . . . . :   Retrieving PAYMASTFIL in library PAYROLL. (C G I S)
Cause . . . . . :   Access to suspended object PAYMASTFIL member PAYDEC94 in
  library PAYROLL type *FILE is requesting that the object be restored to the
  system. The size of the object is 51.798 megabytes. The object will be
  restored to ASP 1 which is currently 84.53 percent utilized. When complete
  the approximate ASP utilization will be 89.14 percent.
Recovery  . . . :   Type a valid reply for the restore of the object.
Possible choices for replying to message . . . . . . . . . . . . . . . :
  G -- Continue the operation.
  C -- Cancel the operation.
  I -- Ignore the request and delay the retrieve operation. To resume a
    delayed retrieve operation at some later time use the RSMRTVBRM command.
                                                                  More...
```

Figure 158. Retrieve *VERIFY messages (Part 2 of 3)

```
                  Additional Message Information

Message ID . . . . . . :   BRM1822       Severity . . . . . . . :   99
Message type . . . . . :   Inquiry

  S -- Submit the retrieve operation for batch processing. The current job
    will receive an indication that the object's data was not found.
Technical description . . . . . . . . :   Access to a suspended object has
  caused BRMS to attempt to retrieve the object from archives. If the object
  is a physical file then only the requested member for that file will be
  restored.
```

Figure 159. Retrieve *VERIFY messages (Part 3 of 3)

You many want to customize the messages shown during retrieve processing or automate the action to be taken under certain circumstances. For additional information and an example of an alternative interface that can be coded by the system administrator to take the Dynamic Retrieval function one step further, see *Complementing AS/400 Storage Management Using Hierarchical Storage Management*, SG24-4450.

The valid responses to the program message display are:

G   Go: The retrieve begins immediately and the application is suspended waiting for it to complete. You should not use the End request (System Request, option 2) function during this time.

C   Cancel: This option returns two main messages. BRM1823 is added to the job log indicating that the object was archived and the BRMS/400 retrieve request was cancelled. Also, the standard OS/400 CPF4102 message is sent to enable the application to respond.

S   Submit Job: The retrieve request is submitted to the job queue specified in the user's job description. Again, the same two messages are sent for the application to handle. A message is later sent to inform the user that the retrieve operation is complete.

I   Ignore and Delay: The retrieve request is added to the list of file members to be retrieved at a later time. Again, the same two messages are sent for the application to handle. A message is later sent to inform the user that the retrieve operation is complete.

13.7.2.2 *NOTIFY

A status message is shown on the last line of the display that is shown in Figure 160. The job waits until restore is complete. As for the immediate (Go) option with *VERIFY mode, the user should not use the End job (System Request, option 2) function during this time.

For *NOTIFY and the immediate (Go) option of *VERIFY, such errors as media errors and tape mount messages are reported to the system operator or the BRMS/400 notification message queue. If an error is severe and the operation is cancelled, all messages are added to the user's job log including those responded to by the system operator. The original OS/400 CPF4102 message is sent to the application.

```
                                                                    Bottom
 Parameters or command
 ===> dsppfm PAYROLL/PAYMASTFIL


 F3=Exit         F4=Prompt          F5=Refresh          F6=Create
 F9=Retrieve     F10=Command entry  F23=More options    F24=More keys
 Retrieve object PAYMASTFIL for library PAYROLL in progress.
```

*Figure 160. Retrieve *NOTIFY message*

13.7.2.3 *SBMJOB

The BRM1824 message is added to the user's job log to inform the user that the retrieve job is submitted. The open request (the application) is sent the CPF4102 message to handle as an error and enable the user to retry the function at a later time.

When the batch job is complete, the user is informed with the status of the restore. If the restore fails, the application has already reacted, so the user knows simply not to try that function again until the cause of the error is fixed.

13.7.2.4 *DELAY

The BRM1823 message is added to the user's job log to inform the user that the retrieve job is submitted. The open request (the application) is sent the CPF4102 message to handle as an error and enable the user to retry the function at a later time.

When the retrieval is resumed later, the user is informed with the status of the restore. As for the *SBMJOB option, if the restore fails, the application has already reacted, so the user knows simply not to try that function again until the cause of error is fixed.

13.7.3 Failed retrieve operations

In general, if a retrieve operation fails due to exceptions other than *STORAGE or *SECURITY, it is the submitter's responsibility to retry the retrieve. There is no implication that the failed retrieve is converted to a *DELAY type retrieve.

Frequently checking the BRMS/400 log is recommended. Use the *RTV option to check on retrieve operations.

13.7.4 Using the BRMS/400 log

The primary method of auditing all BRMS/400 activity is through the BRMS/400 log. This is accessed through the Display Log using BRM (DSPLOGBRM) command.

The DSPLOGBRM command supports the display of log entries that record the occurrence, success, and failure of BRMS/400 operations. The same log concept that is used throughout BRMS/400 can also be used to track retrieve operations. Log entries are categorized by type to show which operation caused the log entry. The entry type *RTV is supported for retrieve type operations and is used to record whether these are successful or unsuccessful. A user can search all BRMS/400 log entries using type *RTV to audit retrieve operations.

Issue the DSPLOGBRM *RTV command to list all of the available log entries for retrieve operations.

13.8 Controlling retrieve operations using the RSMRTVBRM command

A retrieve operation may fail or not even be started because of authority problems or ASP overflow. Other retrieve operations may be initiated later in the *DELAY retrieve mode. In any of these cases, the retrieve operation enters into a deferred state. Further control of these deferred retrieves is needed.

The Resume Retrieve using BRM (RSMRTVBRM) command facilitates the recovery of delayed or otherwise unsuccessful retrieve operations. This command allows the administrator to work with or print a list of files for which retrieve operations are pending. This may be due to the following reasons:

- Retrieve policy, user, or system operator specified that the retrieve operation be delayed.

- ASP to contain the retrieved file has exceeded its storage utilization limit.
- User accessing the archived file did not have appropriate authority to perform a retrieve operation.

See *Backup Recovery and Media Services for OS/400* (part of the IBM Online Library SK2T-2171) for additional information on the RSMRTVBRM command.

If you specified *YES for the Confirm Retrieval parameter and are assuming that this is not a batch operation, the confirm display in Figure 161 is shown.

```
                              Confirm Retrieve                        SYSTEM04

   Retrieve select . . . :   *ALL

   Type options, press Enter.   Press F16 to confirm all.
     1=Confirm     4=Remove      5=Display

   Opt    Library    Object     Member     Volume   Asp  Size (M)   User

   __     QUSRSYS    MYFILE     MYFILE     V00001   01     1.05     BILL
   __     GLLIB      LEDGER     LEDGER     V00888   02   225.55     TONY
   __     PAYLIB     PAYROLL    PAYROLL01  V00999   01    15.05     JIM
```

Figure 161. Confirm Retrieve display

The Confirm Retrieve display shows a list of files for which retrieve operations were delayed or unsuccessful. It allows the user to select and retry, ignore, or cancel the retrieve operation for one or more of the files listed. Use option 1 (Confirm) to select and retry the retrieve operation. Use option 4 (Remove) to cancel the retrieve operation. Leave the option column blank to ignore the retrieve operation and leave it for execution at a later time.

13.8.1 Using the RSMRTVBRM command

There are many different ways in which you may approach the use of the RSMRTVBRM command. You may schedule the command to be run every night automatically in batch. Or you may have an operator use the confirm display every twelve hours to initiate valid retrieve operations.

13.8.1.1 Messages sent after retrieves

The RSMRTVBRM function sends a completion message to the initiator of the delayed retrieve. Messages are also sent to the requestor for batch submitted retrieves (*SBMJOB). In this section, we refer to retrieves in *DELAY mode or retrieves that were suspended due to potential storage threshold overflows or security violations.

13.8.1.2 Multiple retrieve requests for the same file member

When a retrieve operation is in delayed mode, a flag associated with the file member in question is set. The RSMRTVBRM command scans the BRMS/400 records to find all files that are "marked" for delayed retrieve. If a file member is set for delayed retrieve and a second request to retrieve it (in delayed mode) is sent, BRMS/400 checks that file member, establishes that it is already set for retrieve, and adds the user profile name of the second requester to its "users to notify" list. A second request for a delayed retrieve does not cause a second entry in the RSMRTVBRM display even if it is generated by an authority or storage

exception. When the file member is eventually retrieved, all requesters are notified.

If the second retrieve request is actually a successful *NOTIFY, *VERIFY, or *SBMJOB operation, BRMS/400 marks that file member as having been retrieved and removes the file member from the list of file members to be resumed at a later time. The names of the users on delay list are notified that the successful retrieve operation has occurred.

13.8.1.3 RSMRTVBRM submitted to batch

To increase automation, you may want to schedule the submission of the RSMRTVBRM command to occur regularly. We recommend that you choose a time when there is little use of the tape drives and other system resources such as processor and memory.

The automatic submission of this command to batch implies that you do not use the confirm display. You must decide which retrieve operations you want to select for initiation at the time that you submit the command to the scheduler. You may want to consider the following suggestions for inclusion criteria:

- **Library *ALL**: Unless you know exactly which libraries contain archived file members, we recommend that you use the *ALL option. If you require extra peace of mind by specifying library names, you need to submit a separate RSMRTVBRM command for each library. This may involve writing a simple CL program.

- **Auxiliary Storage Pool ID**: You may have an application that you know resides in a specific ASP. By specifying this ASP number, you are ensuring that you do not automatically start any unusual or unexpected retrieve operations. In general, however, we recommend that you specify *ALL.

- **Retrieve Select *DELAY**: In most cases, we recommend that you only automatically initiate retrieve operations that were purposefully delayed. Using the *ALL parameter includes retrievals that have been halted because of storage or security considerations. In both of these cases, further operator or administrator action may be required before these retrievals can take place.

When you submit the RSMRTVBRM command in batch, we advise you to have someone check for other file members that may be waiting to be retrieved. These include file members that you did not include in your selection criteria in the batch submission of the command and any "failed" retrievals due to authority or storage exceptions. We do not recommend that you include these in the batch submitted command. For example, if you regularly run the RSMRTVBRM *DELAY *RETRIEVE *NO command, there may be other file members waiting to be retrieved that are not retrieved such as those that have *STORAGE or *SECURITY conditions. An interactive "double-check" needs not be performed as regularly as the automatic scheduling of the batch command. In addition, further action may be needed before retrying the failed retrievals such as ASP clear up or security adjustments. You can use the *REPORT option of the RSMRTVBRM command to print any pending retrieves *after* the *DELAY retrieve operation has been run in batch.

Scheduling the batch submission may be performed for your entire system. If you choose to set the system-wide Retrieve Policy to use a retrieve mode of *DELAY, you are effectively queueing up most of the system retrieve requests until a suitable time for significant tape activity. This approach is useful for good

balancing of system resources, in particular, your tape devices. However, it reduces the responsiveness of the retrieve system. Note that it can also lead to stocking up a large number of retrieve requests and the time window for completing all of them may affect other necessary tape activity.

13.8.1.4 Using RSMRTVBRM interactively

If you plan to use the RSMRTVBRM command interactively, you may or may not choose to use the confirm display.

Without the confirm display, you remove the necessity to make decisions for each file member. However, you still need to specify your include parameters. We recommend you use the same ones listed for the previous batch submission. However, by invoking this command interactively without the confirm display only buys you a possible improved performance, which you can also set up by creating a special high priority batch job. This approach ties up an interactive session for an indefinite time period.

With the confirm display, you gain much more flexibility. You may choose to perform any of the following options:

- Use the display to understand which retrieve operations have been delayed due to storage or security exceptions and take the necessary action to resolve these issues and retry the retrieves.

- Use the information on the confirm display to help you roughly estimate the restore times and storage level effects of retrieving certain file members, and on this basis, choose which ones to initiate.

- Identify which file members should not even be retrieved and take action to prevent this from occurring, ranging from simply cancelling the retrieve to removing or excluding the file member from your BRMS/400 archive lists.

In each of these cases, you must have an administrator who is qualified to make such decisions and take appropriate action to run the RSMRTVBRM command with the confirm display.

13.9 Administration considerations

Throughout this chapter, we referred to the setup of the BRMS/400 configuration and how to start with Dynamic Retrieval. Once BRMS/400 is set up and running with the Dynamic Retrieval function, you may consider a few methods of preserving the configuration that you have and controlling the use of the retrieve function.

13.9.1 Retrieve authority

We have seen that the retrieve policy allows us to set the authority level requirements for a user to initiate a retrieve. This parameter (Retrieve authorization) is also found in the SETRTVBRM command. Therefore, any user with authority to the SETRTVBRM command may choose to alter the value of this retrieve authority parameter for their job.

For example, if the user chooses to alter the parameter to allow users with *USE authority to an object to retrieve that object (by setting the parameter to *USE), that user may "create" objects (through retrieve) that they normally are only able to read.

If the administrator wants to attempt to restrict the use of the retrieve function, the SETRTVBRM command itself must be restricted. This can be done in the usual way using standard OS/400 security access controls for the command object (type *CMD). However, this also restricts a user's ability to change other retrieve controls such as the retrieve mode to use. When you restrict authority to the SETRTVBRM command, you should also restrict authorities to the WRKPCYBRM command to inhibit users from changing the retrieve policy. See 13.9.3, "Securing the retrieve policy" on page 287, for more details.

13.9.2 Restore options

When restoring a file member as part of a retrieve operation, you want to protect your system from importing incorrect versions of a file member or overwriting a recreated file member. Remember that the BRMS/400 retrieve function works with a name-orientated inventory. Therefore, renaming file members or deleting and recreating file members may cause unpredictable results.

One way to reduce the chances of retrieving inappropriate data is to use the restore options supplied in the retrieve policy and the SETRTVBRM command.

The Allow object differences parameter helps prevent the restoration of deleted and subsequently recreated file members. If you set the parameter to *NONE, the create time stamp and owner information are cross-checked before allowing the restore. Therefore, if a delayed retrieve is finally submitted after a member has been deleted and re-created, the restore operation cannot succeed.

13.9.3 Securing the retrieve policy

Effective change management is an important part of every Information System department's quality process. As part of the tight administration controls that you may need to enforce across your entire backup, recovery, archive, and media management system, you need to secure the retrieve function. This may help you manage and control your disk capacity and your tape activity.

You must consider the following points:

- Secure the WRKPCYBRM command:

  To prevent users from adjusting the system-wide Retrieve Policy, you must use the standard OS/400 security facilities to restrict authority to the WRKPCYBRM command (object type *CMD). This rejects all attempts at using any part of the command by any unauthorized user.

  You may consider implementing this as part of a global restriction to all BRMS/400 commands. Remember to identify the key personnel that require access to these commands before you revoke the authority.

- Secure the SETRTVBRM command:

  Revoke authority of all non-BRMS-administrative personnel from the SETRTVBRM command. Remember that this also removes their ability to alter other parameters such as the retrieve mode.

- Set up users with an initial program:

  Where specific users need retrieve parameters set differently from the Retrieve Policy, you may consider the following points:

– Include SETRTVBRM in the initial program for the required users.

– When compiling this initial program, set the run authority of the program to *OWNER. This adopts the authority of the program object's owner. You may change this parameter after the compile with the CHGPGM command.

– Compile the initial program under a user profile that has authority to the SETRTVBRM command. You may change this parameter after the compile with the CHGOBJOWN command.

– As an extra measure, you may restrict the authority to the program object itself.

Appendix A. Summary of changes

This appendix summarizes the enhancements and changes that you should be aware when migrating from release to release. The release that are covered here include:

- V3R6 to V3R7
- V3R1 and V3R6
- V3R1 to V3R2

A.1 Summary of changes for V3R6 to V3R7

This section highlights the changes that you should be aware of when migrating from V3R6 to V3R7.

A.1.1 Backup/recovery enhancements

Some of the backup/recovery enhancements include:

- Console monitoring:

  A display has been added that requires you to enter a password to end console monitoring.

- New special value *LINK for integrated file system backups:

  A new special value, *LINK, has been added. *LINK saves all objects not in /QSYS.LIB and /QDLS directories. *LINK is now one of the default entries in *BKUGRP (default backup control group) replacing the LINKLIST entry.

- Change to the Select Recovery Items display processing for objects:

  In previous releases, when you selected option 7 (Specify object) on the Select Recovery Items display, you were taken to the Specify Object display. In this release (V3R7), the Specify Object display has been replaced with native OS/400 restore commands, depending on the type of object that you have selected to restore.

- Change to the Select Recovery Items display for folders:

  Option 7 (Specify document) has been added to the Select Recovery Items display. When you use this option, you are taken to the OS/400 Restore Document Library Object (RSTDLO) command.

- Restore into folder field added to recovery displays:

  A new field, Restore into folder, has been added to the Recovery Policy and to the Restore Command Defaults display. This field allows you to specify the name of the folder in which the restored folders and documents to be restored are placed.

- Enhancement to control group copy:

  When you copy a control group (backup or archive) to create a new control group, the job queues to process and subsystems to process are now copied to the new control group from the control group that you are copying.

A.1.2 Media management enhancements

Some of the media management enhancements include:

- Automatic duplication of media:

    The DUPMEDBRM command is enhanced to allow specification of the special value, *SET, in the FROMVOL parameter. This special value can be used when copying a media set interactively and is required when copying a media set in batch.

- Enhanced support for third-party media libraries:

    In previous releases, you can specify up to seven commands for third-party (*USRDFN) media libraries that you add to BRMS/400. Four commands have been added to the list of commands that you can specify for a third-party media library.

    – Allocate Device command
    – Deallocate Device command
    – Start of Media Movement command
    – End of Media Movement command

- New option on Work with Media display:

    A new option 20 (Expire set) has been added to the Work with Media display. This option allows you to expire all members of a set rather that expiring each volume individually.

A.1.3 Command enhancements

Some of the command enhancements include:

- New parameter for the STRRCYBRM command:

    – A new special value (*LNKLIST) has been added to the OPTION parameter in the STRRCYBRM command to allow you to specify an integrated file system list for recovery. The new special value works in conjunction with a new parameter, LIST, where you can specify the name of the list that you want to restore or all integrated file system lists.

    – The default special value for the OMITLIB parameter has been changed from *NONE to *DELETE. This change allows the user to choose whether to restore deleted libraries rather than assuming that they want to restore deleted libraries.

- New parameter for the CHGSCDBRM command:

    A new special value (*IJS) has been added to the TYPE parameter in the CHGSCDBRM command to allow you to use OS/400 job scheduler. By using this new special value, you do not have to specify the commands (for example, the Add Job command) used in OS/400 job scheduler in the CHGSCDBRM command.

- New choice for the Restore Object using BRM (RSTOBJBRM) command:

    A choice has been added to the OBJ parameter in the RSTOBJBRM command. You can now specify generic object names that you want to restore.

- New parameters for the Restore DLO using BRM (RSTDLOBRM) command:

    Two new parameters have been added to the RSTDLOBRM command:

– Restore into folder (RSTFLR):

Specifies the name of the folder in which the restored folders and documents to be restored are placed. The folder must exist on the system or when *ALL is specified on the Document library object prompt (DLO parameter, the saved folder must exist on the media.

– New object name (RENAME):

Specifies the new user-assigned name for the restored document.

- Tape unit choices displayed on the INZMEDBRM and ADDMEDBRM commands:

The choices of tape units are now displayed on the INZMEDBRM and ADDMEDBRM commands. The tape units that are displayed are those that are set up in BRMS/400.

- New Dump BRM (DMPBRM) command:

The Dump BRM (DMPBRM) command dumps a copy of BRMS/400 to assist in problem determination. You can specify various levels of detail and one or more jobs to dump. This command produces a file that is used in problem determination by your technical representative. Processing this command should be done in conjunction with this representative.

- New special value in the Start Recovery using BRM (STRRCYBRM) command:

A new special value, *NONE, has been added to the CTLGRP parameter in the STRRCYBRM command. If you select *NONE for this parameter, this indicates that you want to restore data that is not associated with any control group.

- Enhancements to the CHKEXPBRM command:

The CHKEXPBRM command has been enhanced to allow you to specify multiple control groups (up to 50) or *ALL in the CTLGRP parameter. You can now evaluate the amount of expired media available for multiple media class and location combinations.

A.1.4 Reports

Report enhancements include:

- New Reports menu (BRMRPT) added:

A new Reports menu has been added to the BRMS/400 main menu. The Reports menu contains commonly used reports.

- Enhancements to the Recovery Volume Summary report:

The Recovery Volume Summary report now includes duplicate volumes where appropriate.

A.1.5 General

Other general enhancements include:

- New user profile QBRMS:

A user profile called QBRMS is now created during installation for you on your system if it does not already exist. This user profile is used for internal BRMS/400 purposes and should not be deleted. This change provides the

BRMS/400 database with more security in that changes can only be made to the database through BRMS/400 functions or APIs unless the user has a higher assigned authority such as QSECOFR.

- Change in default in Archive Policy:

  In the archive policy, the default value for the "Retain object description" field has been changed from *NO to *YES.

- New field in System Policy:

  A new field, Tape exit trace, has been added to the system policy. You can indicate whether you want to record tape exit information for problem diagnosis by IBM support personnel. The default for this field is *NO and should remain *NO unless instructed otherwise by IBM support personnel.

- New choices in control groups and save commands:

  Two new choices for the OBJDTL prompt have been added to the SAVLIBBRM and SAVOBJLBRM commands. You can now specify *OBJ for object information with no member information or *MBR with object and member information. The choice *MBR is the same as *YES. These two new choices have also been added to the Backup Control Group display, Retain object detail field, and the associated F13 (Change Defaults for Items Added display) key.

- Change to Archive Control Group:

  The save-while-active feature used in the archive control group has been eliminated.

- Optimum block size field added to the device displays:

  A new field has been added to the Add Device, Change Device, and Display Device displays. The field is Use optimum block size. The default value for this field is *NO. You should review the online help information for restrictions when you specify *YES. The Optimum block size field can be a performance enhancement for various device types, for example, device type 3590.

A.2 Summary of changes between V3R1 and V3R6

The following list contains enhancements and changes that you should be aware of in upgrading from V3R1 to V3R6.

A.2.1 Backup enhancements

Some of the backup enhancements include:

- File systems support:

  You can now use BRMS/400 to save and restore integrated file system objects. A new type of list, *LNK, has been added to allow you to enter integrated file system directories and objects that you want to save. Integrated file system backup support allows you to specify directories that are not only in your AS/400 network, but also on attached PCs or other types of systems.

- Forecasting media required in backup operations:

  A new command, Check Expired Media (CHKEXPBRM), has been added to calculate the amount of media available for a save operation. The media that it calculates is compared to a number of expired volumes required in the media

policy or in the command. If the number calculated equals or is greater than the value in the media policy or the command, the operation continues.

- Console monitoring:

  Option 4 (Start console monitor) has been added to the Backup menu. This option allows you to start or suspend the console monitor. When the console monitor is started, the console is in a monitored state. By entering the proper password, you can suspend console monitoring and enter system commands. After you are through entering commands, you can return to console monitoring.

- Improvement in subsystems to end:

  The subsystems to end function has been changed to the subsystems to process. This allows you to start or end subsystems. You can end a subsystem at the beginning of control group A and not restart it until the end of control group B.

- Improvement in job queues to hold:

  The job queues to hold function has been changed to the job queues to process. This allows you to hold or release job queues. You can hold a job queue at the beginning of control group A and not release it until the end of control group B.

- Enhanced support for Work with Libraries to Omit from backups:

  You can now specify *ALL in the Type field to omit either a library or group of libraries. The *ALL choice indicates to omit specified libraries when any special value (such as *IBM) or a generic value is used in a backup control group or the SAVLIBBRM command that includes the specified libraries.

A.2.2 Media management enhancements

Some of the media management enhancements include:

- Enhanced BRMS/400 networking:
  - Selective synchronization of media content information at the library level.

    You can specify in the Change Network Group display whether you want the local system to receive media information or media content information (library).
  - Ability to rename the local system.
  - Add network ID to change media function.
  - Add the selection "Shared inventory delay":

    The system policy has a new field added that allows the customer to set the time to wait for journal entries to be sent over the network to update media files. The longer the time is, the fewer synchronization jobs are submitted. Similarly, the shorter the delay is, the more synchronization jobs are submitted. Use caution in shortening the delay, since depending on the amount of data that you are synchronizing, the performance of the network may be affected.
  - Network time synchronization:

    You can synchronize network times for subgroups within the network group (for example, AS/400 systems in Seattle and New York are synchronized to different times even though they are in the same network group).

- Automatic duplication of media:

  A new field has been added to the media policy field that indicates whether media is duplicated that is created under this policy. The DUPMEDBRM command is enhanced to specify *SEARCH that finds volumes that are marked for duplication.

- Auto enroll media:

  You can now specify in the system policy whether to automatically enroll media used in BRMS/400 processing. For each device that you specify, you can determine whether to allow auto enroll of media.

  Note: Only non-library devices can auto enroll.

- Logical end of volume:

  BRMS/400 now supports a concept called *logical end of volume* for devices that support it. The benefit that you can derive from this concept is that it allows you to maximize the use of your registered media, therefore, reducing media registration costs and media inventory requirements.

  The logical end of volume can be described as the last active file on the volume. Any time the special value *END is specified for the file sequence number for output to tape (for example, specifying *END in the SEQNBR parameter in the SAVLIBBRM command or specifying *YES in the Append to media field on a backup control group), for a BRMS/400 volume, BRMS/400 determines the logical end of the volume and redirects the output to start at that position. If all files on the volume are expired, the beginning of the volume is the starting position for the output operation.

- Work with Media display:

  Two new options have been added to the Work with Media display. They are:
  – Option 18: Mark for duplication
  – Option 19: Remove mark for duplication

- Pre-assignment of slot numbers:

  You can now pre-assign the slot number assignment when you do a verified move of media.

A.2.3 Command enhancements

Some of the command enhancements include:

- New parameters for save commands:

  The following commands have had new parameters added. These parameters allow you to specify *NONE on the media policy and specify the parameters for the media policy in the command. You can also change the parameters of a specified media policy "on the fly" for the particular save operation that you are performing.
  – SAVDLOBRM
  – SAVLIBBRM
  – SAVOBJBRM
  – SAVOBJLBRM
  – SAVFLRLBRM
  – SAVMEDIBRM
  – SAVSYSBRM

- Enhanced INZBRM command:

  The INZBRM command has been enhanced with the *RESET and *DEVICE options. The *RESET option allows you to remove BRMS/400 information and re-initialize all BRMS/400 files. The re-initialization portion of *RESET is equivalent to processing the INZBRM command using the parameter OPTION(*DATA). This option is useful when moving BRMS/400 from one system to another. Use caution when using this option since all BRMS/400 files are re-initialized and data (such as media information) is lost. The *DEVICE option clears device and media library information and adds information for devices currently defined to the system.

- Enhanced RSTOBJBRM command:

  The RSTOBJBRM command has been enhanced to restore *ALL object names.

- Enhanced WRKMEDBRM command:

  The WRKMEDBRM command has been enhanced to add generic support in the volume parameter. A parameter has been added to select media by file group.

- Enhanced DSPLOGBRM command:

  The DSPLOGBRM command has been changed. The SLTDATE parameter has been changed to the PERIOD parameter. This allows you to specify a date and time. Additionally, two new fields have been added: User ID and Message ID.

- Enhance system selection on the WRKMEDIBRM command:

- Slot numbers have been added to the ADDMEDBRM and the CHGMEDBRM commands.

- Major changes to the SAVSAVFBRM command:

  – Added an ENDOPT parameter.
  – Allow multiple devices to be specified.
  – Multiple library selection.
  – Add a new media policy parameter to allow you to select values for output.
  – Allows consolidation of save files on the selected media.

- Changes to the WRKOBJBRM and WRKFLRBRM commands:

  The default date range for the SLTDATE parameter has been changed from *CURRENT, *CURRENT to *BEGIN, *END.

- Changes to the MOVMEDBRM command:

  Parameters have been added to the command to allow selection criteria to media that you are selecting to move.

- Changes to the SETRTVBRM command:

  You can now specify how long objects that have been retrieved are kept on the system. After the object retention period has passed, the storage associated with the object is freed.

- Changes to the STRBKUBRM command:

  You can now specify the sequence number and library from which you want to restart backup processing.

- New WRKLNKBRM command:

  A new command has been added to work with saved integrated file system information. You can add, remove, restore, and review information down to the object level.

- New CHKEXPBRM command:

  A new command has been added to check the available media prior to a save.

A.2.4 Reports

Some of the new report enhancements include:

- New report, Link Information report that is in the QP1ADI printer file.
- New report, Object Link List = QP1AFS.

A.2.5 General

Enhanced recoverability feature requires the conversion of all programs to ILE.

A.3 Summary of changes from V3R1 to V3R2

You should be aware of the following enhancements and changes when you upgrade from V3R1 to V3R2.

A.3.1 Backup enhancements

Some of the backup enhancements include:

- File systems support:

  You can now use BRMS/400 to save and restore integrated file system objects. A new type of list, *LNK, has been added to allow you to enter integrated file system directories and objects that you want to save. Integrated file system backup support allows you to specify directories that are not only in your AS/400 network, but also on attached PCs or other types of systems.

- Forecasting media required in backup operations:

  A new command, Check Expired Media (CHKEXPBRM), has been added to calculate the amount of media available for a save or tape operation. The media that it calculates is compared to a number of expired volumes required in the media policy or in the command. If the number calculated equals or is greater than the value in the media policy or the command, the operation continues.

- Console monitoring:

  Option 4 (Start console monitor) has been added to the Backup menu. This option allows you to start or suspend the console monitor. When the console monitor is started, the console is in a monitored state. By entering the proper password, you can suspend console monitoring and enter system commands. After you are finished entering the commands, you can return to console monitoring. A display has also been added that requires you to enter a password to end console monitoring.

- Improvement in subsystems to end:

  The subsystems to end function has been changed to the *subsystems to process*. This allows you to start or end subsystems. You can end a

subsystem at the beginning of control group A and not restart it until the end of control group B.

- Improvement in job queues to hold:

  The job queues to hold function has been changed to the *job queues to process*. This allows you to hold or release job queues. You can hold a job queue at the beginning of control group A and not release it until the end of control group B.

- Enhanced support for Work with Libraries to Omit from backups:

  You can now specify *ALL in the Type field to omit either a library or group of libraries. The *ALL choice indicates to omit specified libraries when any special value (such as *IBM) or a generic value is used in a backup control group or the SAVLIBBRM command that includes the specified libraries.

A.3.2 Media management enhancements

Some of the media management enhancements include:

- Enhanced BRMS/400 networking:

  – Selective synchronization of media content information at the library level.

    You can specify in the Change Network Group display whether you want the local system to receive media information or media content information (library).

  – Ability to rename the local system.

  – Add network ID to change media function.

  – Add the selection "Shared inventory delay":

    The system policy has a new field added that allows the customer to set the time to wait for journal entries to be sent over the network to update media files. The longer the time is, the fewer synchronization jobs are submitted. Similarly, the shorter the delay is, the more synchronization jobs are submitted. Use caution when shortening the delay, since depending on the amount of data that you are synchronizing, the performance of the network may be affected.

  – Network time synchronization:

    You can synchronize network times for subgroups within the network group (for example, AS/400 systems in Seattle and New York are synchronized to different times even though they are in the same network group).

- Common media management chapter

  A new chapter has been added for common media management. Some material from the media management chapter as well as additional networking information has been used in this chapter. The chapter is designed to provide more detail for customers that want to network BRMS/400 systems and share media information among systems in a network.

- Automatic duplication of media:

  A new field has been added to the media policy field that indicates whether media is duplicated that is created under this policy. The DUPMEDBRM command is enhanced to specify *SEARCH that finds volumes that are marked for duplication. The DUPMEDBRM command is enhanced to allow specification of the special value, *SET, in the FROMVOL parameter. This

special value can be used when copying a media set interactively and is required when copying a media set in batch.

- Auto enroll media:

  You can now specify in the system policy whether to automatically enroll media used in BRMS/400 processing. For each device that you specify, you can determine whether to allow auto enroll of media.

- Logical end of volume:

  BRMS/400 now supports a concept called *logical end of volume*. The benefit that you can derive from this concept is that it allows you to maximize the use of your registered media, therefore, reducing media registration costs and media inventory requirements.

  The logical end of volume can be described as the last active file on the volume. Any time the special value *END is specified for the file sequence number for output to tape (for example, specifying *END in the SEQNBR parameter in the SAVLIBBRM command or specifying *YES in the Append to media field on a backup control group), for a BRMS/400 volume, BRMS/400 determines the logical end of the volume and redirects the output to start at that position. If all files on the volume are expired, the beginning of the volume is the starting position for the output operation.

- Work with Media display:

  Two new options have been added to the Work with Media display. They are:

    – Option 18: Mark for duplication
    – Option 19: Remove mark for duplication

- Pre-assignment of slot numbers:

  You can now pre-assign the slot number assignment when you do a verified move of media.

- Enhanced support for third-party media libraries:

  In previous releases, you could specify up to seven commands for third-party (*USRDFN) media libraries that you add to BRMS/400. Four commands have been added to the list of commands that you can specify for a third-party media library:

    – Allocate Device command
    – Deallocate Device command
    – Start of Media Movement command
    – End of Media Movement command

A.3.3 Command enhancements

Some of the command enhancements include:

- New parameters for save commands:

  The following commands have had new parameters added. These parameters allow you to specify *NONE on the media policy and specify the parameters for the media policy in the command. You can also change the parameters of a specified media policy "on the fly" for the particular save operation that you are performing.

    – SAVDLOBRM
    – SAVLIBBRM

- – SAVOBJBRM
- – SAVOBJLBRM
- – SAVFLRLBRM
- – SAVMEDIBRM
- – SAVSYSBRM

- Enhanced INZBRM command:

  The INZBRM command has been enhanced with *RESET and *DEVICE options. The *RESET option allows you to remove BRMS/400 information and re-initialize all BRMS/400 files. The re-initialization portion of *RESET is equivalent to processing the INZBRM command using the parameter OPTION(*DATA). This option is useful when moving BRMS/400 from one system to another. Use caution when using this option since all BRMS/400 files are re-initialized and data (such as media information) is lost. The *DEVICE option clears device and media library information and adds information for devices currently defined to the system.

- Enhanced RSTOBJBRM command:

  The RSTOBJBRM command has been enhanced to restore *ALL object names.

- Enhanced WRKMEDBRM command:

  The WRKMEDBRM command has been enhanced to add generic support in the volume parameter. A parameter has been added to select media by file group.

- Enhanced DSPLOGBRM command:

  The DSPLOGBRM command has been changed. The SLTDATE parameter has been changed to the PERIOD parameter. This allows you to specify a date and time. Additionally, two new fields have been added: User ID and Message ID.

- Enhanced system selection on the WRKMEDIBRM command.

- Slot numbers have been added to the ADDMEDBRM and CHGMEDBRM commands.

- Major changes to the SAVSAVFBRM command:

  - – Added an ENDOPT parameter.
  - – Allow multiple devices to be specified.
  - – Multiple library selection.
  - – Add a new media policy parameter to allow you to select values for output.
  - – Allows consolidation of save files on the selected media.

- Changes to the WRKOBJBRM and WRKFLRBRM commands:

  The default date range for the SLTDATE parameter has been changed from *CURRENT, *CURRENT to *BEGIN, *END.

- Changes to the MOVMEDBRM command:

  Parameters have been added to the command to allow selection criteria to media that you are selecting to move.

- Changes to the SETRTVBRM command:

  You can now specify how long objects that have been retrieved are kept on the system. After the object retention period has passed, the storage associated with the object is freed.

- Changes to the STRBKUBRM command:

  You can now specify the sequence number and library from which you want to restart backup processing.

- New WRKLNKBRM command :

  A new command has been added to work with saved integrated file system information. You can add, remove, restore, and review information down to the object level.

- New CHKEXPBRM command:

  A new command has been added to check the available media prior to a save.

- New parameter for the STRRCYBRM command:

  – A new special value (*LNKLIST) has been added to the OPTION parameter in the STRRCYBRM command to allow you to specify an integrated file system list for recovery. The new special value works in conjunction with a new parameter, LIST, where you can specify the name of the list that you want to restore or all integrated file system lists.

  – The default special value for the OMITLIB parameter has been changed from *NONE to *DELETE. This change allows the user to choose whether to restore deleted libraries rather than assuming that they want to restore deleted libraries.

- New parameter for the CHGSCDBRM command:

  A new special value (*IJS) has been added to the TYPE parameter in the CHGSCDBRM command to allow you to use OS/400 job scheduler. By using this new special value, you do not have to specify the commands (for example, the Add Job command) used in OS/400 job scheduler in the CHGSCDBRM command.

A.3.4 Reports

Some of the report enhancements include:

- A new Reports menu has been added to the BRMS/400 main menu. The Reports menu contains commonly used reports.

- New report, Link Information report that is in Q1APDI printer file.

- New report, Object Link List = QP1AFS.

A.3.5 General

Other general enhancements include:

- Enhanced recoverability feature requires the conversion of all programs to ILE.

- A user profile called QBRMS is now created during installation for you on your system. This user profile is used for internal BRMS/400 purposes and should not be deleted. This change provides the BRMS/400 database more security in that changes can only be made to the database through BRMS/400 functions or APIs unless the user has a higher assigned authority such as QSECOFR.

Appendix B. Save and restore tips for better performance

There are several factors that affect your save and restore performance such as:

- CPU model
- Amount of main storage
- Tape drive
- Data transfer rate of the tape drive
- Use of hardware compression or software compression
- I/O processor
- System bus speeds

The performance suggestions mentioned here are aimed at the high performance tape drives such as the 3590. However, other tape drives can also benefit by ensuring that the correct parameters and options are used during your save and restore operation.

B.1 Data compression

Some of the older AS/400 tape I/O processors provide data compression in the data path hardware. This is referred to as *hardware data compression (HDC)*. Hardware data compression increases the data rate and the tape capacity of the attached tape drive. For data interchange and compatibility with I/O processors that do not provide HDC, the HDC algorithm is implemented in the AS/400 system and is known as *system data compression (SDC)*. SDC provides a performance increase for the entry level tape devices. For high-end tape devices, SDC is a severe limitation to performance. HDC and SDC are controlled by the DTACPR parameter of the SAVxxx commands on the AS/400 system.

The choice of using HDC (the DTACPR option on the save commands) and compaction (the COMPACT option on save commands) is important when deciding between faster rates or fewer tapes used. For each of the following tape devices, these are the options that you should have:

- 6380 tape device:

  a. DTACPR(*YES) COMPACT(*NO)
  b. DTACPR(*YES) COMPACT(*NO)

- 6385 tape device (using QIC5010 format cartridge):

  a. DTACPR(*NO) COMPACT(*DEV)
  b. DTACPR(*NO) COMPACT(*DEV)

- 6385 tape device (using other format cartridges):

  a. DTACPR(*YES) COMPACT(*DEV)
  b. DTACPR(*YES) COMPACT(*DEV)

- 6390 tape device:

  a. DTACPR(*NO) COMPACT(*DEV)
  b. DTACPR(*NO) COMPACT(*DEV)

- 2644 IOP (using 3422, 3430, 3480, 3490 tape devices):

  a. DTACPR(*YES) COMPACT(*NO)
  b. DTACPR(*YES) COMPACT(*DEV)

- 6501 IOP (using 3490, 3570 or 3590 tape devices):
  a. DTACPR(*DEV) COMPACT(*DEV)
  b. DTACPR(*DEV) COMPACT(*DEV)

Note: Option **a** provides the best performance. Option **b** uses fewer tapes.

B.2 Load balancing

To achieve maximum tape performance, the placement of the tape and the disk IOP is important. The tape IOP should be placed on the system bus that has fewer number of disk arms attached to it. This decreases the likelihood that the bus will be a performance constraint to system save and restore performance. Across all other system buses, the number of disk IOPs should be spread evenly, and the disk arms should be spread evenly across all IOPs. This advice is more helpful when the higher performing tape devices are being used such as the 3590.

The data written to the tape must come from the disk drives. Therefore, the sum of disk operations and tape operations must be equal to or less than the system bus bandwidth. Two high performance tape devices on the same bus can create a performance bottleneck, where the tape drives compete with the system bus bandwidth.

With the RISC systems, the I/O bus rate has increased from 8 MB/sec to 16 MB/sec or 24 MB/sec depending on the machine type. The higher bus bandwidth now allows you to attach the tape drive and the disk drives on the same bus.

B.3 Using the USEOPTBLK parameter

For V3R7 and beyond, setting the USEOPTBLK parameter to *YES on the save commands can significantly improve performance of the 3570 and 3590 tape devices.

On CISC systems, the block size is 24 KB. With V3R6, this block size was increased to 28 KB. Beginning with V3R7, the block size is 256 KB. This allows better save and restore rates for high performance tape drives such as the 3590 and the 3570.

B.4 Additional hints and tips

For additional hints and tips, and to gain an understanding of how tape volumes are supported on the AS/400, see *Tape and Diskette Device Programming*, SC41-4716.

Appendix C. Example LAN configuration for 3494

The following example configurations provide details on how you can configure a 3494 Automated Tape Library Data Server under a LAN environment.

C.1 Line description

```
                    Display Line Description                    Page    1
Line description . . . . . . . . . . :   LIND       TRN3494
Option . . . . . . . . . . . . . . . :   OPTION     *ALL
Category of line . . . . . . . . . . :              *TRLAN
Resource name  . . . . . . . . . . . :   RSRCNAME   LIN021
Online at IPL  . . . . . . . . . . . :   ONLINE     *YES
Vary on wait . . . . . . . . . . . . :   VRYWAIT    *NOWAIT
Maximum controllers  . . . . . . . . :   MAXCTL     40
Line speed . . . . . . . . . . . . . :   LINESPEED  16M
Maximum frame size . . . . . . . . . :   MAXFRAME   1994
TRLAN manager logging level  . . . . :   TRNLOGLVL  *OFF
  Current logging level  . . . . . . :                 *OFF
TRLAN manager mode . . . . . . . . . :   TRNMGRMODE *OBSERVING
Log configuration changes  . . . . . :   LOGCFGCHG  *LOG
Token-ring inform of beacon  . . . . :   TRNINFBCN  *YES
Local adapter address  . . . . . . . :   ADPTADR    4010A0036011
Exchange identifier  . . . . . . . . :   EXCHID     056A0036
Early token release  . . . . . . . . :   ELYTKNRLS  *YES
Error threshold level  . . . . . . . :   THRESHOLD  *OFF
Text . . . . . . . . . . . . . . . . :   TEXT       Token Ring Line Description
for 3494
--------------Active Switched Controllers--------------
  (No active switched controllers attached)
SSAP list  . . . . . . . . . . . . . :   SSAP
----Source Service Access Points-----   ----Source Service Access Points-----
   SSAP     Maximum Frame    Type       SSAP      Maximum Frame    Type
   04         *MAXFRAME      *SNA         AA        *MAXFRAME      *NONSNA
   12         *MAXFRAME      *NONSNA      C8        *MAXFRAME      *HPR
Link speed . . . . . . . . . . . . . :   LINKSPEED  16M
Cost/connect time  . . . . . . . . . :   COSTCNN    0
Cost/byte  . . . . . . . . . . . . . :   COSTBYTE   0
Security for line  . . . . . . . . . :   SECURITY   *NONSECURE
Propagation delay  . . . . . . . . . :   PRPDLY     *LAN
User-defined 1 . . . . . . . . . . . :   USRDFN1    128
User-defined 2 . . . . . . . . . . . :   USRDFN2    128
User-defined 3 . . . . . . . . . . . :   USRDFN3    128
Autocreate controller  . . . . . . . :   AUTOCRTCTL *YES
Autodelete controller  . . . . . . . :   AUTODLTCTL 1440
Recovery limits  . . . . . . . . . . :   CMNRCYLMT
  Count limit  . . . . . . . . . . . :              2
  Time interval  . . . . . . . . . . :              5
Functional address . . . . . . . . . . . . . . :   FCNADR
--------------------Functional Addresses----------------------
  (No functional addresses found)
```

C.2 Controller description

```
                   Display Controller Description              Page    1
Controller description . . . . . . :   CTLD       CTL3494
Option . . . . . . . . . . . . . . :   OPTION     *ALL
Category of controller . . . . . . :              *APPC
Link type  . . . . . . . . . . . . :   LINKTYPE   *LAN
Online at IPL  . . . . . . . . . . :   ONLINE     *YES
Character code . . . . . . . . . . :   CODE       *EBCDIC
Maximum frame size . . . . . . . . :   MAXFRAME   16393
Remote network identifier  . . . . :   RMTNETID   *NETATR
Remote control point . . . . . . . :   RMTCPNAME  LIBMGR
Initial connection . . . . . . . . :   INLCNN     *DIAL
Dial initiation  . . . . . . . . . :   DIALINIT   *LINKTYPE
Switched disconnect  . . . . . . . :   SWTDSC     *YES
Data link role . . . . . . . . . . :   ROLE       *NEG
LAN remote adapter address . . . . :   ADPTADR    400000003494
LAN DSAP . . . . . . . . . . . . . :   DSAP       04
LAN SSAP . . . . . . . . . . . . . :   SSAP       04
```

```
Autocreate device  . . . . . . . . . :    AUTOCRTDEV  *ALL
Text . . . . . . . . . . . . . . . :      TEXT        3494 LAN Controller Descript
ion
Switched line list . . . . . . . . . :    SWTLINLST
-------------------Switched Lines--------------------
TRN3494
Attached devices . . . . . . . . . . :    DEV
------------------Attached Devices-------------------
DEV3494
APPN-capable . . . . . . . . . . . :      APPN        *YES
APPN CP session support  . . . . . :      CPSSN       *YES
APPN/HPR capable . . . . . . . . . :      HPR         *YES
APPN node type . . . . . . . . . . :      NODETYPE    *ENDNODE
APPN transmission group number . . :      TMSGRPNBR   1
APPN minimum switched status . . . :      MINSWTSTS   *VRYONPND
Autodelete device  . . . . . . . . :      AUTODLTDEV  1440
User-defined 1 . . . . . . . . . . :      USRDFN1     *LIND
User-defined 2 . . . . . . . . . . :      USRDFN2     *LIND
User-defined 3 . . . . . . . . . . :      USRDFN3     *LIND
Model controller description . . . :      MDLCTL      *NO
Control owner  . . . . . . . . . . :      CTLOWN      *USER
Disconnect timer . . . . . . . . . :      DSCTMR
  Minimum connect timer  . . . . . :                  170
  Disconnection delay timer  . . . :                  30
LAN frame retry  . . . . . . . . . :      LANFRMRTY   *CALC
LAN connection retry . . . . . . . :      LANCNNRTY   *CALC
LAN response timer . . . . . . . . :      LANRSPTMR   *CALC
LAN connection timer . . . . . . . :      LANCNNTMR   *CALC
LAN acknowledgement timer  . . . . :      LANACKTMR   *CALC
LAN inactivity timer . . . . . . . :      LANINACTMR  *CALC
LAN acknowledgement frequency  . . :      LANACKFRQ   *CALC
LAN max outstanding frames . . . . :      LANMAXOUT   *CALC
LAN access priority  . . . . . . . :      LANACCPTY   *CALC
LAN window step  . . . . . . . . . :      LANWDWSTP   *NONE
              Display Controller Description                   Page    2
Controller description . . . . . . :      CTLD        CTL3494
Option . . . . . . . . . . . . . . :      OPTION      *ALL
Category of controller . . . . . . :                  *APPC
Recovery limits  . . . . . . . . . :      CMNRCYLMT
  Count limit  . . . . . . . . . . :                  2
  Time interval  . . . . . . . . . :                  5
```

C.3 Device description

```
Device description . . . . . . . . :      DEVD        DEV3494
Option . . . . . . . . . . . . . . :      OPTION      *ALL
Category of device . . . . . . . . :                  *APPC
Automatically created  . . . . . . :                  NO
Remote location  . . . . . . . . . :      RMTLOCNAME  LIBMGR
Online at IPL  . . . . . . . . . . :      ONLINE      *YES
Local location . . . . . . . . . . :      LCLLOCNAME  *NETATR
Remote network identifier  . . . . :      RMTNETID    *NETATR
Attached controller  . . . . . . . :      CTL         CTL3494
Message queue  . . . . . . . . . . :      MSGQ        QSYSOPR
  Library  . . . . . . . . . . . . :                    *LIBL
Local location address . . . . . . :      LOCADR      00
APPN-capable . . . . . . . . . . . :      APPN        *YES
Single session . . . . . . . . . . :      SNGSSN
  Single session capable . . . . . :                  *NO
Text . . . . . . . . . . . . . . . :      TEXT        3494 APPC Device Description
Mode . . . . . . . . . . . . . . . :      MODE
------------------------Mode-------------------------
*NETATR
```

Appendix D. Performing restricted saves to a 3494 on CISC

You may use the example program shown in Figure 162 on page 306 through Figure 164 on page 308 to perform restricted saves on a 3494 tape library using BRMS/400 with CISC AS/400 systems *only*. You do not need to use this circumvention for RISC AS/400 systems.

The BRMSAVSYS program manages the subsystem and message queues to perform the save. It calls the SETBRMVOL program to create a tape category and add volumes to it.

```
/**************************************************************/
/* PROGRAM:     BRMSAVSYS                                   */
/**************************************************************/

   PGM         PARM(&DEV)
   DCL         VAR(&DEV) TYPE(*CHAR) LEN(10)

/**************************************************************/
/* Define the media policy to be used.                     */
/**************************************************************/

   DCL         VAR(&MEDPCY) TYPE(*CHAR) LEN(10) VALUE(SAVSYS)

/**************************************************************/
/* Make sure that QSYSOPR does not interrupt the save.      */
/**************************************************************/

   CHGMSGQ     MSGQ(QSYSOPR) DLVRY(*HOLD)
   MONMSG      MSGID(CPF0000)

/**************************************************************/
/* Call program SETBRMVOL to create a category and add      */
/* volumes to it in the order BRM will expect them          */
/**************************************************************/

   CALL        PGM(SETBRMVOL) PARM(&DEV ADD)
   MONMSG      MSGID(CPF0000)

/**************************************************************/
/* Rename QMLDSBS so that BRMS/400 will not be able to      */
/* start it after the SAVSYSBRM command completes           */
/**************************************************************/

   ENDMLD OPTION(*IMMED)
   DLYJOB DLY(60)
   RNMOBJ      OBJ(QMLD/QMLDSBS) OBJTYPE(*SBSD) NEWOBJ(QMLDSBSTMP)
   MONMSG      MSGID(CPF0000)

/**************************************************************/
/* Perform the system save                                  */
/**************************************************************/

   SAVSYSBRM   DEV(&DEV) MEDPCY(&MEDPCY) ENDOPT(*LEAVE) +
   CLEAR(*ALL) STRCTLSBS(*NO)
   MONMSG      MSGID(CPF0000)


/**************************************************************/
/* Save the following libraries while still restricted.     */
/**************************************************************/

   SAVLIBBRM   LIB(QGPL) DEV(&DEV) MEDPCY(&MEDPCY) +
               SAVTYPE(*FULL) ENDOPT(*LEAVE) SEQNBR(*END)
   MONMSG      MSGID(CPF0000)

   SAVLIBBRM   LIB(QUSRSYS) DEV(&DEV) MEDPCY(&MEDPCY) +
               SAVTYPE(*FULL) ENDOPT(*LEAVE) SEQNBR(*END)
   MONMSG      MSGID(CPF0000)

   SAVLIBBRM   LIB(QUSRMLD QMLD) DEV(&DEV) MEDPCY(&MEDPCY) +
               SAVTYPE(*FULL) SEQNBR(*END)
   MONMSG      MSGID(CPF0000)

/**************************************************************/
/* Rename the subsystem                                     */
/**************************************************************/

   RNMOBJ      OBJ(QMLD/QMLDSBSTMP) OBJTYPE(*SBSD) NEWOBJ(QMLDSBS)
   MONMSG      MSGID(CPF0000)

/**************************************************************/
/* Call SETBRMVOL to change the volume category to          */
/* *NOSHARE and delete the catagory we created.             */
/**************************************************************/

   INZMLD
   DLYJOB DLY(360)
   CALL        PGM(SETBRMVOL) PARM(&DEV RMV)
   MONMSG      MSGID(CPF0000)

ENDPGM
/**************************************************************/
```

Figure 162. Program for restricted save processing with the 3494

```
/************************************************************/
/* Program SETBRMVOL                                        */
/************************************************************/

   PGM     PARM(&DEV &OPTION)
   DCLF    FILE(QTEMP/BRMVOL)              /* File of expired volumes */
   DCL     VAR(&DEV) TYPE(*CHAR) LEN(10)   /* Tape device name. */
   DCL     VAR(&OPTION) TYPE(*CHAR) LEN(3) /* ADD or RMV */
   DCL     VAR(&COUNT) TYPE(*DEC) LEN(2 0) VALUE(1)
   DCL     VAR(&SYSNAME) TYPE(*CHAR) LEN(10)
   DCL     VAR(&LOCNAME) TYPE(*CHAR) LEN(10)
   DCL     VAR(&QRYSLT) TYPE(*CHAR) LEN(75)
   DCL     VAR(&CTG) TYPE(*CHAR) LEN(10)   /* Category name. */

/************************************************************/
/* Define the number of volumes to add to this category    */
/************************************************************/

   DCL        VAR(&VOLCNT) TYPE(*DEC) LEN(2 0) VALUE(7)

/************************************************************/
/* Define the name of the 3494                             */
/************************************************************/

   DCL        VAR(&MLDNAME) TYPE(*CHAR) LEN(10) VALUE('MLD01     ')

/************************************************************/
/* Define the media class                                  */
/************************************************************/

   DCL        VAR(&MEDCLS) TYPE(*CHAR) LEN(10) VALUE('SAVSYS    ')

/************************************************************/
/* Use the SYSTEM name as the temporary category           */
/* BRMS/400 uses the LOCAL LOCATION name on the volume record */
/************************************************************/

   RTVNETA    SYSNAME(&SYSNAME)  LCLLOCNAME(&LOCNAME)

/************************************************************/
/* Option ADD processing.                                  */
/************************************************************/

   IF         COND(&OPTION *EQ 'ADD') THEN(DO)

 /* Create the category.                                 */

     CHGVAR     VAR(&CTG) VALUE(&SYSNAME)
     CRTCTGMLD  MLD(&MLDNAME) CTG(&CTG)
     MONMSG     MSGID(CPF0000)

 /* Determine the volumes BRMS/400 will use              */

     CHGVAR     VAR(&QRYSLT) VALUE('TMCEND *EQ Y *AND TMCCLS *EQ ' +
                || &MEDCLS || ' *AND TMCVLT *EQ ' || &MLDNAME   +
                ' *AND TMSYID *EQ ' || &LOCNAME)
     OPNQRYF    FILE((QUSRBRM/QA1A1MM)) QRYSLT(&QRYSLT) +
                KEYFLD(*FILE) OPNID(QA1AMMTMP)
     CPYFRMQRYF FROMOPNID(QA1AMMTMP) TOFILE(QTEMP/BRMVOL) +
                MBROPT(*REPLACE) CRTFILE(*YES)
   ENDDO

/************************************************************/
/* Option RMV processing.                                  */
/************************************************************/

   IF         COND(&OPTION *EQ 'RMV') THEN(DO)
     CHGVAR     VAR(&CTG) VALUE('*NOSHARE')
   ENDDO

LOOP:
     RCVF
 /* Change the category the volume is assigned to.       */

     CHGMEDMLD  MLD(&MLDNAME) VOL(&TMCVSR) CTG(&CTG)
     CHGVAR     VAR(&COUNT) VALUE(&COUNT + 1)
     IF         COND(&COUNT *NE &VOLCNT) THEN(GOTO CMDLBL(LOOP))
```

Figure 163. CL program to create a tape category and add volumes (Part 1 of 2)

```
/************************************************************/
/* Option ADD processing                                  */
/************************************************************/

     IF        COND(&OPTION *EQ 'ADD') THEN(DO)

  /* Vary on the tape drive to be used.                 */

     VRYCFG    CFGOBJ(&DEV) CFGTYPE(*DEV) STATUS(*ON) RANGE(*OBJ)
     MONMSG    MSGID(CPF0000)

  /* Mount the category.                                */

     MNTCTGMLD  DEV(&DEV) CTG(&CTG)
     ENDDO

/************************************************************/
/* Option RMV processing                                  */
/************************************************************/

     ELSE      CMD(DO)

  /* Make sure the tape drive is varied on.             */

     VRYCFG    CFGOBJ(&DEV) CFGTYPE(*DEV) STATUS(*ON) RANGE(*OBJ)
     MONMSG    MSGID(CPF0000)

  /* Demount the category.                              */

     DMTCTGMLD  DEV(&DEV)
     MONMSG    MSGID(CPF0000)

  /* Delete the category.                               */

     DLTCTGMLD  MLD(&MLDNAME) CTG(&CTG)
     MONMSG    MSGID(CPF0000)

  /* Vary off the tape drive                            */

     VRYCFG    CFGOBJ(&DEV) CFGTYPE(*DEV) STATUS(*OFF) RANGE(*OBJ)
     MONMSG    MSGID(CPF0000)
     ENDDO

ENDPGM
/************************************************************/
```

Figure 164. CL program to create a tape category and add volumes (Part 2 of 2)

Appendix E. Media missing from the 3494

You may use the example program shown in Figure 165 and Figure 166 on page 310 to identify which tapes are found in BRMS/400 but that are not shown in Library Manager. The program first performs the DSPTAPCTG command to an output file and then it calls the MLDQRY query to compare this file with the media management file (QA1AMM) in the QUSRBRM library. This is only one example of a query that might be run to identify volume mismatches between BRMS/400 and the tape library.

```
/**************************************************************/
/* PROGRAM:       MLDPGM                                      */
/**************************************************************/
        PGM
        DCL       VAR(&MSGDTA) TYPE(*CHAR) LEN(256)
        DCL       VAR(&MSGF) TYPE(*CHAR) LEN(10)
        DCL       VAR(&MSGFLIB) TYPE(*CHAR) LEN(10)
        DCL       VAR(&MSGID) TYPE(*CHAR) LEN(7)
        MONMSG    MSGID(CPF0000 MCH0000) EXEC(GOTO CMDLBL(ERROR))

/**************************************************************/
/* File Override                                             */
/**************************************************************/

        OVRPRTF   FILE(QPPGMDMP) HOLD(*YES)

/**************************************************************/
/* Display MLD information and run the query                 */
/**************************************************************/

        DLTF      FILE(QTEMP/TEMP1)
        MONMSG    MSGID(CPF0000)

        DSPTAPCTG MLD(MLD01) CGY(*SHARE400) OUTPUT(*OUTFILE) +
                    OUTFILE(QTEMP/TEMP1)
        RUNQRY    QRY(QGPL/MLDQRY)
        RETURN

/**************************************************************/
/* Default error handler                                     */
/**************************************************************/

 ERROR:  RCVMSG    MSGTYPE(*EXCP) MSGDTA(&MSGDTA) MSGID(&MSGID) +
                    MSGF(&MSGF) MSGFLIB(&MSGFLIB)
         SNDPGMMSG MSSID(&MSGID) MSGF(&MSGFLIB/&MSGF) +
                    MSGDTA(&MSGDTA) MSGTYPE(*ESCAPE)
         MONMSG    MSGID(CPF0000 MCH0000)

         CHGJOB    LOG(4 0 *SECLVL) LOGCLPGM(*YES)
         DSPJOBLOG OUTPUT(*PRINT)
         ENDPGM
/**************************************************************/
```

Figure 165. Example program to identify volume mismatches

Note: We used MLD01 (highlighted in bold in Figure 165) in our example for the media library device. You need to substitute this parameter with the media library device name that you have on your system.

```
5716QU1  V3R7M0  960517              IBM Query/400           SYSTEM01  7/06/00 20:12:27           Page    1

   Query . . . . . . . . . . . . . . . . . . MLDQRY
     Library . . . . . . . . . . . . . . . QGPL
   Query text  . . . . . . . . . . . . . .
   Query CCSID . . . . . . . . . . . . . . 65535
   Query language id . . . . . . . . . . . ENU
   Query country id  . . . . . . . . . . . US
   Collating sequence  . . . . . . . . . . Hexadecimal

   Processing options
     Use rounding  . . . . . . . . . . . . Yes (default)
     Ignore decimal data errors  . . . . . No (default)
     Ignore substitution warnings  . . . . Yes
     Use collating for all compares  . . . Yes

Selected files
   ID      File          Library       Member        Record Format
   T01     QA1AMM        QUSRBRM       *FIRST        QA1AMMR
   T02     TEMP1         QTEMP         *FIRST        QTAVOUTF


Join tests
   Type of join  . . . . . . . . . . . . . Unmatched records with primary file
   Field              Test           Field
   T02.RDMID          EQ             T01.TMCVSR


Select record tests
   AND/OR  Field            Test      Value (Field, Numbers, or 'Characters')
           T01.TMCVLT       EQ        'MLD01'
    AND    T01.TMCEND       EQ        'Y'


Ordering of selected fields
   Field            Sort      Ascending/  Break  Field
   Name             Priority  Descending  Level  Text
   T01.TMSYID       10        A                  SYSTEM ID
   T01.TMCVSR       20        A                  VOLUME SERIAL NUMBER
   T01.TMCCLS                                    MEDIA CLASS
   T01.TMCEND                                    EXPIRED INDICATOR

Report column formatting and summary functions
   Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
   Field            Summary   Column                                 Dec  Null      Dec  Numeric
   Name             Functions Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
   T01.TMSYID                 0        System                   8
                                      ID
   T01.TMCVSR       5         2        Volume                   6
                                      Serial
   T01.TMCCLS                 2        Media                   10
                                      Class
   T01.TMCEND                 2        Expired                  1
                                      Indicator
Selected output attributes
   Output type . . . . . . . . . . . . . . Printer
   Form of output  . . . . . . . . . . . . Detail
   Line wrapping . . . . . . . . . . . . . No
```

Figure 166. Example query to identify volume mismatches

Appendix F. The QUSRBRM library

There can often be a requirement for information that is not readily available from within the BRMS/400 reports or displays. This requirement may be the sort of thing that a simple query or SQL can solve. With that in mind, we have included a list of the BRMS/400 files in the QUSRBRM library with a brief description of the more important ones. To see the field names, run the command:

```
DSPFFD QUSRBRM/filename OUTPUT(*print)
```

The following files are currently valid for both V3R2M0 and V3R6M0:

```
Object      Type      Attribute    Description
--------------------------------------------------------------------
QJ1ACM      *JRN                   BRMS Journal
QA1AAF      *FILE     PF-DTA       Archive Folder Lists
QA1AAG      *FILE     PF-DTA       Archive Control Groups Entries
QA1AAM      *FILE     PF-DTA       Archive Control Group Attributes
QA1AAO      *FILE     PF-DTA       Archive Object List Entries
QA1AAQ      *FILE     PF-DTA       Archive Spool File List Entries
QA1AARC     *FILE     PF-DTA
QA1AARF     *FILE     PF-DTA
QA1AAX      *FILE     PF-DTA       Archive Policy Attributes
QA1ABMM     *FILE     PF-DTA       Media - Media Class and Volume
QA1ABX      *FILE     PF-DTA       Backup Policy Attributes
QA1ACA      *FILE     PF-DTA       Calendar Names
QA1ACG      *FILE     PF-DTA       Backup Control Group Entries
QA1ACM      *FILE     PF-DTA       Backup Control Group Attributes
QA1ACN      *FILE     PF-DTA       Container Status
QA1ACT      *FILE     PF-DTA       Container Classes
QA1ADI      *FILE     PF-DTA
QA1ADV      *FILE     PF-DTA       Device Name Entries
QA1ADXR     *FILE     PF-DTA       Media Information by Volume
QA1AFD      *FILE     PF-DTA       Folder Save History
QA1AFL      *FILE     PF-DTA       Folder List Names
QA1AFS      *FILE     PF-DTA
QA1AHS      *FILE     PF-DTA       Save History Details
QA1AIA      *FILE     PF-DTA       Subsystems to check before IPL
QA1AJH      *FILE     PF-DTA       Job Queues to hold
QA1ALB      *FILE     PF-DTA
QA1ALG      *FILE     PF-DTA       BRM Log Information
QA1ALI      *FILE     PF-DTA
QA1ALM      *FILE     PF-DTA       Backup and Archive lists
QA1ALQ      *FILE     PF-DTA       Backup Spool File List Entries
QA1ALR      *FILE     PF-DTA       Save History - Save Statistics by Library
QA1AMB      *FILE     PF-DTA       Save History - Save Statistics by Object
QA1AMD      *FILE     PF-DTA       Media Library Device Entries
QA1AME      *FILE     PF-DTA       Media Policy Attributes
QA1AMM      *FILE     PF-DTA       Media Inventory
QA1AMP      *FILE     PF-DTA       Move Policies
QA1AMT      *FILE     PF-DTA       Media Class Attributes
QA1AMV      *FILE     PF-DTA
QA1ANET     *FILE     PF-DTA       Network Save History
QA1AOB      *FILE     PF-DTA       Backup Object List Entries
QA1AOD      *FILE     PF-DTA       Object Detail
QA1AOL      *FILE     PF-DTA       Libraries to omit from backups
QA1AOQ      *FILE     PF-DTA       Save History - Spool Files
QA1AOT      *FILE     PF-DTA       Object types
QA1ARA      *FILE     PF-DTA       Recovery Activities
QA1ARC      *FILE     PF-DTA       Recovery Contacts
QA1ARCY     *FILE     PF-DTA       Recovery Records (STRRCYBRM)
QA1ARMT     *FILE     PF-DTA       Network Group
QA1ARP      *FILE     PF-DTA       Retrieve Policy
QA1ARX      *FILE     PF-DTA       Recovery Policy
QA1ASE      *FILE     PF-DTA       Subsystems to end
QA1ASG      *FILE     PF-DTA       Signoff Exceptions
QA1ASL      *FILE     PF-DTA       Storage Locations
QA1ASP      *FILE     PF-DTA       System Policy
QA1ASRC     *FILE     PF-SRC       Printer File Source
QA1AVER     *FILE     PF-DTA       Version Control
QA1AWAG     *FILE     PF-DTA
QA1AWCG     *FILE     PF-DTA
QA1AWSF     *FILE     PF-DTA
QA1A1CA     *FILE     PF-DTA       Calendar Entries
```

```
QA1A1MP      *FILE      PF-DTA         Move Policy Entries
QA1A1RA      *FILE      PF-DTA         Recovery Activity Information
QA1A1RMT     *FILE      PF-DTA         Network Group Entries
QA1A2NET     *FILE      PF-DTA         Network - Save History
QA1A2RCY     *FILE      PF-DTA
QA1A8ARF     *FILE      PF-DTA
QA1A9ARF     *FILE      PF-DTA
```

Appendix G. QUSRBRM/QA1AMM file specifications: V3R1

```
Field        Length     Position    Field Text
TMCDAT          6           1        Date Stamp
TMCTIM          6           7        Time Stamp
TNCVSR          6          13        Volume Serial Number
TMSYID          8          19        System ID
TMCCLS         10          27        Media Class
TMCEXP          7          37        Expiration Date
TMCCRT          7          44        Creation Date
TMCCTM          6          51        Creation Time Stamp
TMCEND          1          57        Expired Indicator
TMCBTH          6          58        First Use Date
TMCVLT         10          64        Vault Name
TMCOAD          7          74        Out of Area Date
TMCONT         10          81        Container ID
TMMPOL         10          91        Move Policy
TMCFRM          1         101        Move Confirmation
TMCJOB         10         102        Job Name
TMUSER         10         112        Last User ID
TNJNBR          6         122        Job Number
TMCPRV         10         128        Previous Location Name
TMCNXT         10         138        Next Location name
TMCSMD          7         148        Scheduled Move Date
TMCLAB          1         155        Label Print Pending
TMUSES          4         156        Total Uses of the media
TMTMRD          4         160        Temp Read Error Total
TMTMWR          4         164        Temp Write Error Total
TMBYRD          8         168        Bytes Read Total
TMBYWR          8         176        Bytes Written  Total
TMBYCR          6         184        Current Bytes Written
TMBYMX          6         190        Maximum Bytes Written
TMRTRY          4         196        Read Retry Error Total
TMWTRY          4         200        Write Retry Error total
TMCCLN          4         204        Last Clean Date
TMCUSE          4         208        Uses Since Last Cleaning
TMVSEC          4         212        Secure Volume
TMVSEQ          4         216        Volume Sequence
TMTVOL          4         220        Total Volumes in set
TMBVOL          6         224        Beginning Volume
TMSLOT          6         230        Slot Number
TMDUPL          1         236        Duplication Type
TMLDEV         10         237        Last Device
TMCPSL          6         247        Previous Slot
TMTEXT         50         253        Volume Description
TMFILG         10         303        File Group
TMGTYP         10         313        Media Group Type
TMGRID         13         323        Media Group Identification
TMRGSY          8         336        Registered System
TMRGCK         20         344
TMCNET          8         364
TMCCAB         20         372
TMCPSF         10         392
TMCBKY         10         402
TMCSMC          1         412
TMCDVT          4         413
TMCJRC          1         417
```

313

Appendix H. QUSRBRM/QA1AMM file specifications: V3R2/V3R6/V3R7

```
Field        Length    Position    Field Text
TMCDAT          6          1        Date Stamp
TMCTIM          6          7        Time Stamp
TNCVSR          6         13        Volume Serial Number
TMSYID          8         19        System ID
TMCCLS         10         27        Media Class
TMCEXP          7         37        Expiration Date
TMCCRT          7         44        Creation Date
TMCCTM          6         51        Creation Time Stamp
TMCEND          1         57        Expired Indicator
TMCBTH          6         58        First Use Date
TMCVLT         10         64        Vault Name
TMCOAD          7         74        Out of Area Date
TMCONT         10         81        Container ID
TMMPOL         10         91        Move Policy
TMCFRM          1        101        Move Confirmation
TMCJOB         10        102        Job Name
TMUSER         10        112        Last User ID
TNJNBR          6        122        Job Number
TMCPRV         10        128        Previous Location Name
TMCNXT         10        138        Next Location name
TMCSMD          7        148        Scheduled Move Date
TMCLAB          1        155        Label Print Pending
TMUSES          4        156        Total Uses of the media
TMTMRD          4        160        Temp Read Error Total
TMTMWR          4        164        Temp Write Error Total
TMBYRD          8        168        Bytes Read Total
TMBYWR          8        176        Bytes Written  Total
TMBYCR          6        184        Current Bytes Written
TMBYMX          6        190        Maximum Bytes Written
TMRTRY          4        196        Read Retry Error Total
TMWTRY          4        200        Write Retry Error total
TMCCLN          4        204        Last Clean Date
TMCUSE          4        208        Uses Since Last Cleaning
TMVSEC          4        212        Secure Volume
TMVSEQ          4        216        Volume Sequence
TMTVOL          4        220        Total Volumes in set
TMBVOL          6        224        Beginning Volume
TMSLOT          6        230        Slot Number
TMDUPL          1        236        Duplication Type
TMLDEV         10        237        Last Device
TMCPSL          6        247        Previous Slot
TMTEXT         50        253        Volume Description
TMFILG         10        303        File Group
TMGTYP         10        313        Media Group Type
TMGRID         13        323        Media Group Identification
TMRGSY          8        336        Registered System
TMRGCK         20        344
TMCNET          8        364
TMCCAB         20        372
TMCPSF         10        392
TMCBKY         10        402
TMCSMC          1        412
TMCDVT          4        413
TMCJRC          1        417
TMVNXT         10        418
TMVSMD          7        428
TMASLT          6        435
```

Appendix I. Special notices

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317

Appendix J. Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

J.1 IBM Redbooks

For information on ordering these ITSO publications see `www.redbooks.ibm.com`

- *iSeries Handbook*, GA19-5486
- *Setting Up and Implementing ADSTAR Distributed Storage Manager/400*, GG24-4460
- *Complementing AS/400 Storage Management Using Hierarchical Storage Management*, SG24-4450
- *Using ADSM to Back Up Lotus Notes*, SG24-4534
- *Upgrading to Advanced Series PowerPC AS*, SG24-4600

J.2 IBM Redbooks collections

Redbooks are also available on the following CD-ROMs. Click the CD-ROMs button at `ibm.com`/`redbooks` for information about all the CD-ROMs offered, updates and formats.

CD-ROM Title	Collection Kit Number
IBM System/390 Redbooks Collection	SK2T-2177
IBM Networking Redbooks Collection	SK2T-6022
IBM Transaction Processing and Data Management Redbooks Collection	SK2T-8038
IBM Lotus Redbooks Collection	SK2T-8039
Tivoli Redbooks Collection	SK2T-8044
IBM AS/400 Redbooks Collection	SK2T-2849
IBM Netfinity Hardware and Software Redbooks Collection	SK2T-8046
IBM RS/6000 Redbooks Collection	SK2T-8043
IBM Application Development Redbooks Collection	SK2T-8037
IBM Enterprise Storage and Systems Management Solutions	SK3T-3694

J.3 Other resources

These publications are also relevent as further information sources.

- *IBM 3494 Users Guide: Media Library Device Driver for Application System/400*, GC35-0153
- *IBM 9427 210 and 211 Operator's Guide*, SA26-7108
- *Work Management*, SC21-8078
- *Software Installation Guide*, SC41-3120 (V3R2)
- *Central Site Distribution*, SC41-3308
- *Automated Tape Library Planning and Management*, SC41-5309

The following publications are available from the iSeries Information Center in soft copy only:

- *System Operation*, SC41-4203
- *AS/400 APPN Support*, SC41-5407
- *Integrated File System Introduction*, SC41-5711

The following publications are available only on CD-ROM. For more information, please visit the iSeries Information Center at:
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- *AS/400 Road Map for Changing to PowerPC Technology*, SA41-4150
- *OS/400 NetWare Integration Support*, SC41-3124
- *Automated Tape Library Planning Guide*, SC41-3309 (V3R7)
- *SNA Distribution Services*, SC41-3410
- *OS/400 Integration of Lotus Notes*, SC41-3431
- *Software Installation Guide*, SC41-4120 (V3R7)
- *Integrating AS/400 with Novell NetWare*, SC41-4124
- *Backup and Recovery - Basic*, SC41-4304 (V3R7)
- *Backup and Recovery - Advanced*, SC41-4305 (V3R7)
- *Distributed Data Management*, SC41-4307
- *Data Management*, SC41-4710
- *Tape and Diskette Device Programming*, SC41-4716

The following publications are available in the IBM Online Library CD-ROM SK2T-2171:

- *LAN Server/400 Administration*
- *Backup Recovery and Media Services for OS/400*

J.4 Referenced Web sites

These Web sites are also relevant as further information sources:

- AS/400 Internet home page: `http://www.as400.ibm.com`
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Index

Symbols

Numerics

A

job scheduling   91
join logical files   226
    performance   226
joining BRMS/400 networks   118
journal changes   233
    apply   235
    retrieve   233
journal entries, double save   222

K
key factors
    archive   240
    retrieval   240

L
LAN configuration, 3494   171
LAN server   211
LAN Server/400
    administrator   128
    authority   128
    disaster recovery   147
    grant authority   130
    group profile   131
    performance   135
    save and restore options   148
    saving AS/400 configuration information   127
    saving the LAN server configuration   127
    saving user data   127
    special authority   131
    storage space   125
    structure   125
    user data   127
    users with password *NONE   131
libraries, synchronization   76
library considerations, BRMS/400   65
Library Manager for the 3494   160
library mode, save   211
library renaming   244
LIC   195
license information   13, 212
Licensed Internal Code   195
    recovery   197
LINKLIST   137, 140, 208
list entry   128
local location   113
location, secure   101
locations
    *HOME   18
    *VAULT   18
    device   181
    home   19
    media policy   30
    multiple devices, 3494   178
    storage   18
locks, exclusive   72
logical end of volume   294, 298
logical file   237
logical files   225
    archive   225

retrieve   225
logical, multiple physical files   237
Lotus Notes integration   123, 211

M
management, hierarchical storage   217
managing cartridges   183
managing IFS saves   140
managing multiple devices, 3494   177
MAXDEVTIME   169, 175, 185
maximum device wait time   169, 175, 185
media   2
    archive policy   273
    auto enroll   64
    check availability   57
    classes   24
    devices   21
    enrolling   43
    initializing   43
    management   63
    media management files   108
    movement   194
    naming convention   8
    register   14
    scratch pool   8
    security   45
    slotting   20
    types   10
media and storage extensions (MSE)   12, 230
media class   18, 24
    for archive   270
media devices   21
media history information   47, 54
media information   58, 70, 105
    receive   105
    remove   112
media libraries, third-party   23
media library device driver (MLDD)   12, 157, 216
media maintenance   193
media management   63
media management files   108
media movement   60, 193, 194
Media Movement Report   63
media policy   18, 28
    archive   271
    defaults   29
media security   45
media slotting   20
media synchronization   120
media types   10
member level archive   245
member level changes   236
memory requirements, IFS   127
menus and commands, BRMS/400   15
message queue, SWA   73, 80
methods to retrieve   231
missing cartridges   188
mixed characteristic data files   263
MLDD (media library device driver)   12, 157, 216
    deleting libraries   216

R

System Service Tools (SST)   174
system value
   QALWUSRDMN   13
   QSYSLIBL   12

T

tape duplication, archive   227
tape file I/O   260
tape resource   213
Tape Volume Report   60
temporary data files   261
text, control group   72
third-party media libraries   23
time stamp, record   259
time when retrieving objects   242
transaction based members, data file   262
transaction based records, data file   262

U

unattended saves   49
unprotected status   175
update history   222
updating device information, BRMS/400   181
upgrade
   delete MLDD   216
   planning   209
   preparation   209
   restart BRMS/400   211
   resynchronize   215
   save user information   211
   stop BRMS/400   211
Upgrade Assistant tool   211
usage limit   14
user exits   67
user index   13
user information   211
user profile
   QBRMS   100
   QPGMR   101
   QUSER   101
   recovery   199
user queue   13
user space   13
users with password *NONE   131
using a stand-alone tape resource   190

V

V2R3   5, 210
V3R0.5   5, 210
V3R1 IFS data   146
vary off
   FSIOP   134
   Integrated PC Server   134
vary on
   FSIOP   134
   Integrated PC Server   134
vary on devices   179
verify moves   27

Verify Moves using BRM   61
verifying media movement   27
Verifying moves parameter   27
verifying the BRMS/400 network   120
vertical data splitting   248
VFYMOVBRM   27, 61
VOL(*MOUNTED)   185
volume identifiers   8
Volume Statistics Report   60
Volume Threshold Report   60

W

wait time, default   169
Work with Configuration List   101
Work with Configuration Status   166
Work with Control Groups   37, 66, 275
Work with Devices using BRM   21
Work with Job Schedule Entries   277
Work with Library Media using BRM   159
Work with Link Information BRM   140
Work with Lists using BRM   128
work with media BRM   43
Work with Media Classes   24, 270
Work with Media Information   53, 70
Work with Media Libraries   23
Work with Media Library Media   183
Work with Media Library Status   159, 176
Work with Media Policies   214
Work with Move Policies   214, 270
Work with NWS Sessions   133
Work with Object using BRM   205
Work with Registration Information   12
Work with Saved Objects   219
Work with Spooled Files for BRM   85
Work with Storage Locations   19
Work with Tape Cartridges   183
WRKCFGSTS   166
WRKCLSBRM   24
WRKCTLGBRM   37, 66, 275
WRKDEVBRM   21
WRKJOBSCDE   277
WRKLBRM   128
WRKLNKBRM   145
WRKLOCBRM   19
WRKMEDBRM   43
WRKMEDIBRM   53, 70
WRKMLBBRM   23
WRKMLBSTS   159, 175, 176
WRKMLMBRM   159
WRKNWSSSN   133
WRKOBJBRM   205, 219
WRKPCYBRM *MED   214
WRKPCYBRM *MOV   214
WRKPCYBRM *RTV   277
WRKREGINF   12
WRKSPLFBRM   85

Index   **333**

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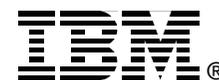|	
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