Virtual Tape Library for IBM i Integration Guide

This document provides instructions for integration of the Data Domain VTL and the IBM i for Power Systems and System i servers.

The instructions provided in this document by EMC Data Domain are for customer convenience and are not warranted or supported by EMC Data Domain. EMC Data Domain expects users to customize installation of third-party software for use at a particular site, but EMC Data Domain is not responsible for the usability of third-party software after installation.

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Related Documentation

Data Domain Documents

The Documentation page at https://my.datadomain.com/documentation provides access to three categories of documents that are related to use of Data Domain products:

- End user documents, under Product Documentation.
- Documents about how to integrate Data Domain systems with third party backup applications, under Integration Documentation.
- Matrices that show which components are compatible with each other, under Compatibility Matrices.

▼ View Data Domain documents


2. To view user documents, click Product Documentation and then perform the following steps:
   a. Select the Data Domain model from the Platform list and click View.
   b. On the row for the correct Data Domain operating system (DD OS) version, click View under Documentation.
   c. Click the desired title.

3. To view integration-related documents, perform the following steps:
   a. Click Integration Documentation.
   b. Select the vendor from the Vendor menu.
   c. Select the desired title from the list and click View.

4. To view compatibility matrices, perform the following steps.
   a. Click Compatibility Matrices.
   b. Select the desired title from Product menu and click View.
Purpose

This document describes the integration of Data Domain VTL (virtual tape library) and the IBM i for Power Systems and System i servers. All the necessary steps that are required to configure the Data Domain VTL for IBM i are described and an overview of IBM i save and restore operations are also included. After reading this document you will be able to configure the Data Domain VTL for IBM i use.

This integration guide illustrates the configuration of VTL and devices using the Data Domain Enterprise Manager, accessible using a web browser and the "green screen" command line interface of the IBM i, using a 5250 emulation program.

This integration guide also covers basic configuration of Backup Recovery and Media Services. For more information on advanced configuration of BRMS, see the IBM Manual: *Backup, Recovery, and Media Services for IBM i, SC41-5345-06*, for the appropriate release of BRMS.

Introduction

Using DD OS 5.0 or greater and the Data Domain Virtual Tape Library feature (VTL), backup applications can connect to and manage Data Domain system storage as if it were a tape library. All of the functionality generally supported by a physical tape library is available with a Data Domain system configured as a VTL. The movement of data from a system configured as a VTL to a physical tape is managed by backup software, not by the Data Domain system.

Virtual tape drives are accessible to backup software in the same way physical tape drives are. Once drives are created in the VTL, they appear to the backup software as SCSI tape drives. A virtual tape library appears to the backup software as a SCSI robotic device accessed through standard driver interfaces.

When Disaster Recovery capabilities are required, tape pools and individual tapes can be replicated to a remote Data Domain system using Data Domain replication.

Data Domain VTL has been initially tested and is supported with IBM i V5R4M5, V6R1M0, V6R1M1, V7R1M0, and VIOS 2.1/2.2 as well as the associated releases of the IBM tape management software Backup Recovery and Media Services, or BRMS. Supported third-party backup software vendors include Help Systems RobotSave and LXI Backup and Recovery Software. Data Domain VTL also supports native IBM i tape handling and save and restore commands.

To view the latest version of the Data Domain compatibility matrix document, log into the support portal at: https://my.datadomain.com/documentation. Click Compatibility Matrices and select the desired title from the Product menu.
Requirements

Hardware

The Data Domain VTL for the IBM i operating environment can be either connected through a supported fibre channel switch or directly connected to the Data Domain. For supported HBAs, switches, and guidelines for direct connection, refer to the latest version of the Backup Application Compatibility List. See “Related Documentation” on page 4.

The 5704 and 5761 IOAs support a maximum of 16 devices per port, with one port on a card.

The 5273, 5774, 5749, 5735, and 5774 support a maximum of 64 devices per port, and 128 per two port card, with a limit of 32 devices per tape library device.

Software

It is recommended to set the Auto Configure System Value QAUTOCFG (Auto configure Devices) to 1 during the configuration of new tape devices. To change the system value from the command line enter the command:

```
CHGSYSVAL SYSVAL(QAUTOCFG) VALUE('1').
```

This value can be changed back after the configuration of the tape library and devices.

Because BRMS is a licensed program product, the operating system release level will determine the BRMS release level, which is consistent with the OS level.

The maximum number of elements (storage slots, plus drives, plus import export elements or CAPS) in one logical library is limited to 5000. The limit is increased to 15,000 storage elements with PTFs MF55406 and /MF50093 (IBM i 6.1.1) or MF55409 (IBM i 7.1), but when loading from a CD-booted system, the maximum number of elements remains 5,000.

V5R4M5

V5R4M5 requires PCI-x based HBAs with a separate IOP for Fiber Channel Tape connectivity. The IOP based 5704 and 5761 are the only HBAs that are supported on V5R4M5 of IBM i.

The latest Cumulative, HIPER and Database PTF packages should be applied, in addition to the BRS group PTF package. For more information on supported PTF levels see the Backup Compatibility Guide, Data Domain Operating System.

To display the current PTF levels on the operating system from the command line enter the command `WRKPTFGRP`. Press F11 to display the text description of the PTF groups and use option 5 to display the PTF level.

V6R1M0

V6R1M0 has been qualified to use the 5704 and 5761 IOAs on Power5 hardware, while Power6 hardware allows the use of either 5704/5761 or the "SmartIOA" cards, 5749 / 5774/5735 and 5273.
The latest Cumulative, HIPER and Database PTF packages should be applied, in addition to the BRS group PTF package. For more information on supported PTF levels see the Backup Compatibility Guide, Data Domain Operating System.

To Display the current PTF levels on the operating system from the command line enter the command WRKPTFGRP. Press F11 to display the text description of the PTF Groups and use option 5 to display the PTF level.

### V6R1M1

V6R1M1 has been qualified to use the 5704 and 5761 IOAs on Power5 hardware, while Power6 hardware allows the use of either 5704/5761 or the "SmartIOA" cards, 5749 / 5774 / 5735. Power7 hardware requires the use of the “SmartIOA” cards and V6R1M1 of the operating system.

The latest Cumulative, HIPER and Database PTF packages should be applied, in addition to the BRS group PTF package. For more information on supported PTF levels see the Backup Compatibility Guide, Data Domain Operating System.

To Display the current PTF levels on the operating system from the command line enter the command WRKPTFGRP. Press F11 to display the text description of the PTF Groups and use option 5 to display the PTF level.

Also, ensure the following individual PTFs are applied on V6R1M1 while using Smart IOAs:

- MF49234
- MF49458
- MF49463
- MF50751
- MF47237
- MF49246
- MF50691
- MF50587
- MF50671
- SI32538
- SI34026
- SI35218
- SI36084

To display individual PTFs with a MF prefix, type the command:

```
DSPPTF LICPGM(5760999) SELECT(MFXXXXX)
```

To display individual PTFs with a SI prefix type the command:

```
DSPPTF LICPGM(5760999) SELECT(S1XXXXX)
```

Review the Informational APAR for PTF requirements on the IBM website for the latest PTF requirements for SmartIOAs.
II14355 - PTF PREREQUISITES AND SPECIFIC SUPPORT DATES FOR THE SMART IOA (IOPless) FIBRE CHANNEL, SAS, and SCSI LVD ADAPTERS SUPPORT:

http://www-01.ibm.com/support/docview.wss?uid=nas27f65244c38e39c46862573cb0041f343

V7R1M0

V7R1M0 has been qualified to use the 5704 and 5761 IOAs on Power5 hardware, while Power6 hardware allows the use of either 5704/5761 or the "SmartIOA" cards, 5749 / 5774/5735 and 5273. Power7 hardware allows the use of 5749 /5774/5735 and 527.

The latest Cumulative, HIPER and Database PTF packages should be applied, in addition to the BRS group PTF package. For more information on supported PTF levels see the Backup Compatibility Guide, Data Domain Operating System.

To display the current PTF levels on the operating system from the command line enter the command WRKPTFGRP. Press F11 to display the text description of the PTF Groups and use option 5 to display the PTF level.

IBM i Connectivity

Introduction

The IBM Power systems utilize a hardware virtualization layer commonly referred to as the Licensed Internal Code, or LIC, to provide access from the operating system to physical hardware. All peripheral equipment must emulate IBM equipment, including IBM tape libraries and devices, when presented to the operating system.

Additionally, there are no user-installable hardware drivers used by IBM i. All drivers are embedded in the LIC, or in LIC PTFs, or Program Temporary Fixes. In most cases, hardware configuration settings cannot be manually configured, as only IBM or IBM emulated equipment will be attached, requiring only fixed configuration settings.

Fibre Channel devices can be connected directly to host through FC-AL topology or through a switched fabric (FC-SW) topology. The Fibre Channel host bus adapters or IOAs (Input / Output Adapters) can negotiate at 2 Gbps, 4 Gbps, and 8 Gbps speeds in a FC-SW environment without any configuration on the operating system other than plugging in the cable at the host.

DD OS versions 5.1 and 5.2 let users directly connect the IBM i host “Smart IOAs” to the Data Domain system, eliminating the need for a switch.

IOPs and IOAs are typically installed by an IBM business partner.
Direct Connect

The next table shows the hardware support matrix for connecting an IBM i host FC port directly to an FC port on the Data Domain system. This configuration is supported on DDOS v5.1 and v5.2. Please note that direct connect is not supported on Power5 hardware Virtual I/O Server and 5761/5704 IOA’s. For the latest information see the Data Domain compatibility guide.

Table 1:

<table>
<thead>
<tr>
<th></th>
<th>V6R1M 1</th>
<th>V7R1M0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power5</td>
<td>Not Supported</td>
<td>Not Supported</td>
</tr>
<tr>
<td>Power6</td>
<td>5273, 5735, 5749, 5774</td>
<td>5273, 5735, 5749, 5774</td>
</tr>
<tr>
<td>Power7</td>
<td>5273, 5735, 5749, 5774</td>
<td>5273, 5735, 5749, 5774</td>
</tr>
</tbody>
</table>

IOP Based HBAs

Note: A more detailed and thorough listing of host HBAs can be found in the Compatibility Matrices section of the Data Domain portal. See “Related Documentation” on page 4.

IBM 2844 IOP

2844 is a PCI I/O processor that drives PCI IOA adapters in the system unit and in HSL attached PCI or PCI-X I/O expansion units. A 2844 IOP is required to use either the 5704 or 5761 IOA. The use of the 2843 PCI IOP is not supported. There is no connectivity between this adapter and the Data Domain system.

2844 IOP with 5704 IOA

The 5704 PCI-X Fiber Channel Tape Controller provides Fiber Channel attachment capability for external tape devices. The 5704 supports point-to-point topologies and has an LC-type cable connector. The 5704 supports 64-bit, 133 MHz PCI-X bus speeds. The 5704 will auto-negotiate for the highest data rate between adapter and an attaching device at 1 Gbps or 2 Gbps of which the device or switch is capable.

2844 IOP with 5761 IOA

The 5761 PCI-X Fiber Channel Tape Controller provides Fiber Channel attachment capability for external tape devices. The 5761 supports point-to-point topologies and has an LC-type cable connector. The 5761 supports 64-bit, 133 MHz PCI-X bus speeds. The #5761 will auto-negotiate for the highest data rate between adapter and an attaching device at 1 Gbps, 2 Gbps or 4 Gbps of which the device or switch is capable.

Smart IOA HBAs

5749 IOA

The 4 Gigabit Dual-Port Fiber Channel PCI-X 2.0 DDR Adapter is a 64-bit address/data, short form factor PCI-X adapter with an LC type external fiber connector that provides single or dual initiator capability over an optical fiber link or loop. The adapter will auto-negotiate for the highest data rate between adapter and an attaching device at 1 Gbps, 2 Gbps, or 4 Gbps of which the device or switch is capable. LEDs on each port provide information on the status and link speed of the port. The adapter can be used to attach devices by means of Fiber Channel Switches.
5774 IOA
The 4 Gigabit PCI Express Dual Port Fibre Channel Adapter is a 64-bit, short form factor x4, PCIe adapter with an LC-type external fiber connector. The adapter automatically negotiates the highest data rate between the adapter and an attaching device at 1 Gbps, 2 Gbps, or 4 Gbps of which the device or switch is capable. LEDs on each port provide information on the status and link speed of the port. The adapter can be used to attach devices by means of Fiber Channel Switches.

5735/5273 IOA
The 8 Gigabit PCI Express Dual Port Fiber Channel Adapter is a high-performance adapter based on the Emulex LPe12002 PCIe Host Bus Adapter (HBA) with an LC type connector. The adapter automatically negotiates the highest data rate between the adapter and an attaching device at 1 Gbps, 2 Gbps, 4 Gbps or 8 Gbps of which the device or switch is capable. LEDs on each port provide information on the status and link speed of the port. The adapter can be used to attach devices by means of Fibre Channel Switches.

Zoning
Data Domain VTL supports switched connectivity. Switched connectivity also allows access to a greater number of HBAs and increase flexibility and scalability, as well as the ability to share a single library among multiple heterogeneous systems.

A zone is comprised of a set of devices that access one another, in an initiator to target model. It is recommended that only one target and one initiator be in each VTL zone. Additional HBAs may be assigned to a VTL HBA by adding another zone. Soft zoning is recommended, in which the zone will consist of the WWPN or alias of one of the HBA ports on the Data Domain VTL, and the WWPN or alias of one of the IBM i HBA ports. Zones are then added to a zoneset and activated.

4 or 8 Gbps switches are recommended for connectivity to the System i. See “Related Documentation” on page 4 for information on accessing Data Domain compatibility documents.

Sharing Tape and Disk on the Same Initiator HBA Port
EMC Data Domain does not support sharing tape and disk traffic on the same initiator HBA port. The supported configuration is to isolate the tape traffic to a dedicated initiator HBA FC port when communicating to a Data Domain system via a SAN. Sharing tape and disk traffic on the same initiator HBA FC port can be problematic and several backup software and storage vendors do not recommend this practice.

These are some of the problems that may occur if you attempt to share tape and disk traffic across the same initiator HBA port:

- Tape drives may disappear from the backup application, or they may go offline or down.
- Drives or the robotic arm may disappear from the operating system of the host, causing the backup application to lose the devices. This could cause a cascade effect of errors:
  - I/O errors
• Tapes stuck in the drives if writing or reading is occurring at the time of the interruption
• Error messages from the backup application about media move or position errors
• Tapes being marked full prematurely
• Errors may occur on the switch port to which the host backup server or Data Domain VTL are connected.
• The Data Domain system may cause a host initiator to hang, which would force a reboot of the host server to clear the condition.
• Performance can be poor, particularly when using the VTL for writes and reads.
• Troubleshooting problems is difficult because of the port sharing.
• Supported driver and multipath software conflicts or setting conflicts occur.
• SAN, storage, and application support provider policy conflicts exist.

Quick Start

Quick Start Diagram
Quick Start List

1. Discovery
   a. Discover WWPN of VTL HBA
   b. Discover WWPN of IBM i HBA
2. Zone VTL HBA to IBM i HBA
3. Web GUI tasks
   a. Create Alias for IBM i HBA
   b. Create Virtual MLB Device on VTL
   c. Create Tape Pool on VTL
   d. Create Tapes in Tape Pool
   e. Move Virtual Tapes into Virtual MLB Device
4. IBM i Task
   a. Enable autoconfig on IBM i
5. Web GUI Task
   a. Create Access Group on VTL with HBA WWN and MLB Device
6. Prepare IBM i for Normal Operations
   a. Verify the Virtual Library and tape devices are visible to host
   b. Allocate drives to the MLB device
   c. Add and initialize tapes

Virtual Libraries

Data Domain VTL supports one type of Library Configuration for IBM i use. This is an IBM TS3500 configured with IBM LTO3 virtual tape drives. Virtual Library Management is done from the Virtual Tape Libraries Tab. From the Create Library you can set the number of virtual drives and the number of slots.
Quick Start Guide

1. Ensure that the i/OS license has been installed on the Data Domain system.

2. Discovery: Discover WWPN of VTL HBA
   a. Under Data Management | VTL on the Data Domain Enterprise Manager, the world wide port name of the VTL HBA ports is visible from the Physical Resources /HBA Ports tab.

   b. Discover WWPN of IBM i HBA

   To discover the WWPN of the HBA, first identify the Logical Name of the Tape Controller using the command WRKHDWRSC *STG from the IBM i command line. Note the DCXX resource name of the Tape controller.

   c. To identify the WWPN for this controller, use the Licensed Internal Code interface "System Service Tools" by entering the command STRSST from the command line.
d. Sign on to SST using service tools credentials, and select option 1 to start a service tool.

e. Select option 7 for hardware service manager.
f. Select option 3 to locate resource by resource name.

![Image of screen showing utility options]

Select one of the following:
1. Packaging hardware resources (systems, frames, cards,...)
2. Logical hardware resources (buses, IOPs, controllers,...)
3. Locate resource by resource name
4. Failed and non-reporting hardware resources
5. System power control network (SPCN)
6. Work with service action log
7. Display label location work sheet
8. Device Concurrent Maintenance
9. Work with resources containing cache battery packs

Selection

F3=Exit F8=Print configuration F9=Display card gap information
F10=Display resources requiring attention F12=Cancel

---

g. Locate the resource by entering the tape controller resource name identified earlier (DCXX) and enter that information.

![Image of screen showing resource to be located]

Type resource name to be located, press Enter.

Resource name ......... do00

---

h. Select option 5 to display detailed information about the tape controller.

![Image of screen showing logical hardware resources]

Logical Hardware Resources

Type options, press Enter.
2=Change detail 4=Remove 5=Display detail 6=I/O debug
7=Verify 8=Associated packaging resources

Opt Description Type-Model Status Resource Name

Storage TGH 2000-001 Operational 0000

F3=Exit F4=Refresh F5=Print F9=Failed resources
i. The world wide port name (WWPN) will be provided for both ports on a dual port card, or one port on a single port card. This is the WWN that will be used to zone to the Data Domain HBA. All IBM i HBAs use a WWPN beginning with the prefix 10000000C9.

![Auxiliary Storage Hardware Resource Detail](image1)

3. Once the cabling of the VTL and the IBM i HBA has been completed, create appropriate tape zones on the fibre channel switch with one initiator and one target: the WWPN of the VTL HBA and the WWPN of the IBM i HBA. The IBM i does not allow multiple paths to tape devices, so the zoning for each library or tape device should consist of only one initiator and one target.

4. Web GUI tasks
   a. Create Alias for IBM i HBA.
      i. Under Data Management | VTL on the Data Domain Enterprise Manager, navigate to the Physical Resources/Initiators tab to view the WWPN of the IBM i HBA. Click More Tasks to define the alias for the initiator.
ii. On the Set Alias screen, create a name for the WWN, then click Next to confirm.

b. Create a Virtual Tape Media Library on VTL.

i. Under Data Management | VTL on the Data Domain Enterprise Manager, navigate to the Virtual Tape Libraries tab. Right click More Tasks to bring up the Library and Tape drop down, then select Create.
ii. Enter a Library name, number of drives, Drive Model: IBM-LTO-3, number of slots, and Changer Model Name: TS3500. Then click next to continue. The only supported values for Changer and Drive Models are TS3500 and IBM-LTO-3.

**Note:** The maximum number of drives that an IBM system host supports is 32 and slots is 4096. While it is possible to create Data Domain Virtual Libraries with larger configurations, the above are limits imposed by the IBM system.

c. Create Tape pool on Data Domain VTL.

i. Under Data Management | VTL on the Data Domain Enterprise Manager, navigate to the Pools tab, click on the "More Tasks" button to bring up the Pool and Tapes drop down, select Create.
ii. Type in a name for your tape pool.

d. Create Tapes in Tape pool.

i. Under Data Management | VTL | Pools on the Data Domain Enterprise Manager, select your tape pool. Then click More Tasks, and click Create under Tapes.
ii. On the Create Tapes menu, select the Tape Pool, Number of Tapes, Starting Barcode (format is 6 characters followed by L3 for LTO-3), and Capacity. Click Next to continue.

**Note:** Only L3 drive types are supported. See the *Backup Compatibility Guide, Data Domain Operating System*.

---

**e.** Move Virtual tapes into Virtual Tape Media Library device.

**i.** Under Data Management | VTL on the Data Domain Enterprise Manager, navigate to the Virtual Tapes Libraries tab. Expand your Virtual Tape Library, and then click on Tapes.
ii. Set the Location as Vault, and specify the pool where you created the tapes in the last step, then click search.

![Screen shot of virtual tape library interface]

iii. Select any Tapes you want to move into the Library.

![Screen shot of virtual tape library interface]

iv. Click Import from Vault, and then click Next.
5. IBM i Tasks
   a. Enable auto configuration of devices in IBM i.
      i. Enter the command `CHGSYSVAL SYSVAL(QAUTOCFG) VALUE('1')` from the command line to enable the IBM i to auto create logical devices, such as tape drives and libraries.

6. Web GUI Tasks
   a. Create an Access Group on VTL.
      i. Under Data Management | VTL on the Data Domain Enterprise Manager, navigate to the Access Groups Tab. Click More Tasks to open the Group drop down menu
ii. Type in the Group name, and select the alias (initiator) for the IBM i HBA, then click Next.

iii. On the Create Group menu, click the "+" sign to add a device.
iv. Select the Library, and the devices to assign to this alias. Select the VTL HBA port that is zoned to the IBM i as the primary. Click OK. Assign the changer and the recommended number of drives to an HBA; see the next table for best practice recommendations. Do not assign the devices to more than one port as primary, or to a secondary port. This is not supported.

Table 2: Best Practice Recommendations for Number of Drives per Port

<table>
<thead>
<tr>
<th>System</th>
<th>HBA Card Type</th>
<th>IBM i Versions</th>
<th>Recommended Number Of Drives Per Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power7 Hardware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5774/5774</td>
<td>4Gb PCIe “SmartIOA”</td>
<td>v6.1.0, v6.1.1, v7.1.0</td>
<td>6</td>
</tr>
<tr>
<td>5749/576B</td>
<td>4Gb PCI “SmartIOA”</td>
<td>v6.1.0, v6.1.1, v7.1.0</td>
<td>6</td>
</tr>
<tr>
<td>5735/577D</td>
<td>8Gb PCIe “SmartIOA”</td>
<td>v6.1.0, v6.1.1, v7.1.0</td>
<td>8</td>
</tr>
<tr>
<td>5273/577D</td>
<td>8Gb PCIe “SmartIOA”</td>
<td>v6.1.0, v6.1.1, v7.1.0</td>
<td>8</td>
</tr>
<tr>
<td>Power6 Hardware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5761/280D</td>
<td>4Gb PCIx HBA</td>
<td>v5.4.5, v6.1.1, v7.1.0</td>
<td>6</td>
</tr>
<tr>
<td>5704/5704</td>
<td>2Gb PCI x HBA</td>
<td>v5.4.5, v6.1.1, v7.1.0</td>
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<tr>
<td>Power5 Hardware</td>
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<tr>
<td>5761/280D</td>
<td>4Gb PCIx HBA</td>
<td>v5.4.5, v6.1.0, v6.1.1, v7.1.0</td>
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<td>v5.4.5, v6.1.0, v6.1.1, v7.1.0</td>
<td>6</td>
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</tbody>
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The 5704 and 5761 IOAs support a maximum of 16 devices per card. The 5774, 5749, 5735 and 5273 Smart-IOA cards (2 ports) support a maximum of 64 devices per port, and 128 per card, with a limit of 32 devices per tape library device.
v. Click next to go to the summary.

vi. Click Finish to Create Group.

7. Prepare IBM i for normal operations.
   a. Verify the virtual library and tape devices are visible to the host.
i. Use the command `WRKHDWRSC *STG` to verify that the library is visible and operational under the tape controller attached to the VTL.

![Work with Storage Resources](image1.png)

ii. Select option 9 and then option 5 to find the name of the associated logical resource (it may or may not have the same name as the hardware resource). Option 7 may be used to identify the serial number of the library or tape devices - this may be valuable to identify the logical device to virtual device mapping. Make note of the logical resource library name.

![Work with Storage Controller Resources](image2.png)
iii. The logical resource name may not match. If so, the system will assign the next available physical and logical resource names. The reserved names are often different for the physical (LIC) and logical (OS), based upon previously configured devices.

![Work with Configuration Descriptions](image)

iv. Using the logical library name, enter the command

```
WRKMLBSTS MLB<Library name>.
```

![Main Menu](image)

b. Allocate drives to the MLB device

There are three ways to configure the allocation of tape devices to the library.

- Allocated: The tape device is allocated to a particular system or LPAR. No other system can access a tape device that is allocated.

- Allocated Unprotected: The tape device is available to requests made to the library on any system in which the status is unprotected. This allows multiple systems to utilize the same tape devices, which are assigned by the changer. When in use, the tape device is assigned and cannot be used by another system.

- Deallocated: The tape device is present, but not available for use by the local system. This option may be used if all tape devices are presented to a number of systems, but each system has specific assigned tape devices.
When a tape device is shared between LPARs or systems, it should be assigned as allocated unprotected. The library will manage the assignment of the drives as needed. The library should be varied on, and all of the drives should be varied on, to be made available as required by the changer.

In this case, option 4 is used on the tape drives allocated to the control of this library on this LPAR.

c. Add and Initialize Tapes
   i. Select option 9 next to the MLB device to enter the work with tape cartridges view.
ii. The work with tape cartridges menu screen is also accessible by using the command `WRKTAPCTG` and specifying the library. Confirm that the Cartridge ID matches the barcodes specified on your virtual tapes. Place a 1 next to a tape to logically add it to the MLB device, and hit F4 to prompt.

![Work with Tape Cartridges](image1)

iii. From the Add Tape Cartridge screen, change "check volume identifier" to *no. You may also change the category to `*SHARE400` if using tape pools shared among different systems.

![Add Tape Cartridge](image2)
iv. Enter 10 next to the added tape to initialize the tape. Press enter.

v. Enter as volume identifier, typically matching the barcode, and press Enter on the Initialize tape screen to initialize the tape.

vi. The tape is now ready for Save/Restore operations.
Quick Start for Virtual I/O Server (VIOS)

Follow these steps to configure VIOS Virtual Fibre Channel devices:

1. Verify that the switch port is NPIV-enabled. Use these commands:
   
   **Brocade CLI:** `portcfgshow`
   
   **Cisco CLI:** `show npv status`

2. Verify that the Fiber Channel adapter is NPIV-capable (FC 5735; CCIN 577D).

3. Create the virtual Fibre Channel server adapter in the Virtual I/O Server partition.
   
   a. On the HMC, select the managed server to be configured by choosing Systems Management > Servers > VIOS1.
   
   b. Select the Virtual I/O Server partition on which to configure the virtual Fibre Channel server adapter.
   
   c. Select Dynamic Logical Partitioning > Virtual Adapters from the Tasks right-click menu as shown in the next figure.
d. To create a virtual Fibre Channel server adapter, select Actions > Create > Fibre Channel Adapter as shown in the next figure.

e. Enter the virtual slot number for the Virtual Fibre Channel server adapter.

f. Select the Client Partition to which the adapter can be assigned, enter the Client adapter ID as shown in the next figure, and click OK.

<table>
<thead>
<tr>
<th>VTL</th>
<th>LPAR</th>
<th>Host Name</th>
<th>vdev</th>
<th>Client Path 1 Adapter ID</th>
<th>VIOS2 Virtual Adapter ID</th>
<th>Card</th>
<th>Port</th>
<th>fcs#</th>
</tr>
</thead>
<tbody>
<tr>
<td>VTL1</td>
<td>VIOS_iClient</td>
<td>VIOS1</td>
<td>Vfhost1</td>
<td>12</td>
<td>11</td>
<td>E2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

g. Click OK in the Virtual Adapters dialog box to save the changes.
h. Update the partition profile of the Virtual I/O Server partition by using the Configuration > Save Current Configuration option as shown in the next figure to save the changes to a new profile.

4. Follow these steps to create a virtual Fibre Channel client adapter in the virtual I/O client partition.

a. Select the virtual I/O client partition on which to configure the virtual Fibre Channel client adapter.

If the partition is not activated, change the partition profile by selecting Configuration > Manage Profiles as shown in the next figure.

Note: You can add a virtual Fibre Channel adapter to a running client partition by using Dynamic Logical Partitioning (DLPAR). However, if you then manually changing the partition profile to reflect the DLPAR change and attempt to make the profile persistent across partition restarts, a different pair of virtual WWPNs will be generated. To prevent this undesired situation, which will require another SAN zoning and storage configuration change for the changed virtual WWPN to prevent an access loss condition, save any virtual Fibre Channel client adapter DLPAR changes into a new partition profile by selecting Configuration > Save Current Configuration and change the default partition profile to the new profile.
b. Click the profile name to edit it and select the Virtual Adapters tab in the Logical Partition Profile Properties dialog box.

c. To create a virtual Fibre Channel client adapter, select Actions > Create > Fibre Channel Adapter as shown in the next figure.

d. Enter virtual slot number for the Virtual Fibre Channel client adapter.
e. Select the Virtual I/O Server partition to which the adapter can be assigned and enter the Server adapter ID as shown in the next figure.

![Virtual Fibre Channel Adapter: VIOS_iClient](https://example.com/image1)

<table>
<thead>
<tr>
<th>VTL</th>
<th>LPAR</th>
<th>Host Name</th>
<th>vdev</th>
<th>Client Adapter ID</th>
<th>VIOS Adapter ID</th>
<th>Card</th>
<th>Port</th>
<th>fcs#</th>
</tr>
</thead>
<tbody>
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<td>VTL1</td>
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<td>Vfhost1</td>
<td>11</td>
<td>12</td>
<td>E2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

f. Click OK and Close in the Managed Profiles dialog box to save the changes.

5. From the Servers screen, select the server that you are configuring and choose Configuration > Virtual Storage Management.

![Hardware Management Console](https://example.com/image2)

6. Click the Query VIOS button to collect the hardware information on the Virtual I/O Server.
7. Select the physical adapter that you are using for NPIV.

8. Select your newly configured virtual adapter and click OK.

You will now see your new virtual adapter assigned to the physical port.
9. After you have created the virtual Fibre Channel server adapters in the Virtual I/O server partition and in the virtual I/O client partition, zone the SAN switch:

a. Get the information about the WWPN of the virtual Fibre Channel client adapter created in the virtual I/O client partition.

b. Select the appropriate virtual I/O client partition, and click Properties in the Task right-click menu.

Expand the Virtual Adapters tab, select the Client Fibre Channel client adapter and then select Actions > Properties to list the properties of the virtual Fibre Channel client adapter, as shown in the next figure.

c. The next figure shows the properties of the virtual Fibre Channel client adapter. This page shows the virtual WWPN that you need for zoning. Verify this WWPN in the LPARs also.

d. Log on to your SAN switch and create a new zone for the virtual WWPN and the corresponding physical storage ports, or customize an existing zone.
10. Create the Data Domain VTL and access group.

<table>
<thead>
<tr>
<th>Number of Drives</th>
<th>Slot</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2 Drives per LPAR)</td>
<td></td>
</tr>
</tbody>
</table>

| VTL1 for: VIOS_iClientId | 10 | 1500 |

On IBM i the new virtual Fibre Channel devices report in automatically, using the system value default QAUTOCFG=1.

### Integrated Virtualization Manager (IVM) Steps

1. Log on to the IVM server, select the VIOS server, and click properties, as shown in the next figure.

2. Click the Physical Adapters tab and verify that an NPIV-capable adapter is assigned to the VIOS server.
3. Verify that the fcsxx devices have been created for the HBA.

4. Select Properties from the More Tasks menu for the client LPAR.

5. Click the Storage tab and expand the Virtual Fibre Channel tab to view the configured NPIV WWPNs.
6. Click Add to create additional WWPNs.

7. Select Automatically generate and click OK.

The next figure shows the resulting new NPIV WWPN.
IBM i Configuration and Operation

Once the Virtual Library is presented to the HBA, the device will be visible from the WRKHDWRSC *STG screen. IBM i recognizes the Library as type 3584-032, and the individual tape drives are type 3580-003.

Tape media libraries are defined as a device of type *TAPMLB in IBM i, while drives are defined as *TAP devices. Names for physical and logical resources are assigned automatically by the operating system, using a naming convention of TAPMLBXX for libraries, and TAPxx for tape drives.

Enter 7 next to the MLB device to display the Resource Detail of the MLB device. The detail will show the Serial Number of the MLB device. This Serial Number matches the serial number of the device on the VTL GUI.

The WRKMLBSTS command enables allocation of tape drives for use by IBM i. Option 4 allocates the drive for exclusive use by one LPAR.

Option 9 on the MLB device in the WRKMLBSTS screen displays the WRKTAPCTG screen and the tape volumes that are in the tape library, allowing execution of tape operations.

Option 1 on the Work with Tape Cartridges screen will logically add the tape to the MLB.
Option 10 allows initialization of a tape that has been logically added to the MLB using the INZTAP command.

Once the Tape has been initialized it is available to IBM i for all Save Restore operations.
Backup Recovery and Media Services, or BRMS, is the IBM backup and media management software application for the IBM systems running the IBM i operating environment. It is used to manage save/restore operations, as well as media and tape libraries. Some additional steps are required to configure BRMS when used in conjunction with physical or virtual tape libraries. Because the VTL presents as an emulated IBM physical tape library and device, there are no steps necessary that are not also necessary for a physical tape library. Therefore, what follows is standard device and tape initialization procedures for physical or virtual tape.

BRMS requires the licensed program product "5722SS1, option 18, Media and Storage Extensions" be installed. The base option for BRMS is "5722BR1, option *BASE, Backup Recovery and Media Services", and must be the only tape management product installed on the IBM i LPAR or system. It must also be installed after Media and Storage Extensions for proper configuration. An optional program, BRMS network feature, may be installed to enable sharing of media information between systems sharing the same library, but is not required. This is used to coordinate media use, and to ensure that a system does not overwrite a tape that was used from another system.

Once the TAPMLB device is visible from WRKHDWRSC *STG and the associated logical TAPMLB device is created and tested, the BRMS configuration of the device is required.

The INZBRM *DEVICE command will add the Virtual TAPMLB device to the BRMS database. This will create configuration objects in the BRMS database with the same name as the logical tape library and devices. The names must match the name of the logical device in the operating system. If devices are recreated or renamed in the operating system, BRMS devices must be reinitialized.

1. After initialization, the WRKMLBBRM will bring you to the BRMS Tape Library management screen. Select 8 on the MLB Device to bring you to the Work with MLB Media menu (WRKMLMBRM).

2. Press Enter on the WRKMLMBRM screen to view all the volumes on the selected MLB Device.
3. Enter 1 next to a volume to logically add the Tape to BRMS.

4. On the Add media Library Media to BRM screen, enter *YES for Initialize Media, and ULTRIUM3 for Media Class. This media class corresponds to a media class in the BRMS configuration created during initialization of the devices.
5. Once the volume is added to BRMS and initialized, review BRMS system policies to ensure successful BRMS operations. Enter `GO BRMS` to go to the BRMS menu. Option 11 will bring you to the BRMS policy administration menu. Type `GO BRMSYSPCY` to go to the BRMS System Policy Menu.

6. Select Option 1 to display or change System Policy.

7. Make note of the Media Policy. Ensure that the new MLB device is in the Devices Field, and the Media Class is Ultrium3. If the new library will be a secondary device rather than the primary backup device, it may be specified in individual backup policies or control groups (backup definitions).
8. From the Command Line type `Go BRMPCY` to go to the BRMS Policy Administration Screen, select option 7 to work with media policies. Select Option 5 to display the Media Policy that was present in the System Policy.

9. Ensure the Media Class specifies the System Policy.
10. From the Command Line type **SAVLIBBRM** and prompt with the F4 key.

![Save Library using BRM (SAVLIBBRM)](image)

11. This command will execute a backup of the library QGPL using available tapes in the managed library TAPMLB01, and track the save in the BRMS catalog. More typically, users will create a control group in BRMS that specifies similar parameters, and is executed from the scheduler on a regular basis.

**IBM i Native Commands—Data Domain VTL Without BRMS**

It is highly recommended that BRMS be used as the media management interface for use with VTL on Data Domain systems. However, it is possible to effectively use the VTL support without BRMS.

**Notes:**

- For further information, review the IBM i Information Center topic, *Tape library use without a media management application*.

- IBM includes the functionality of a Tape Category to facilitate tape management on the system. If you are using BRMS as a media management interface, IBM recommends that you DO NOT set up and use user defined Tape Categories.

- If you share the Data Domain Tape Library definition between systems (or partitions), the tape library will not use the Tape Category definitions to protect tapes from use by another partition.

Tape Categories are similar in function to Data Domain Tape Pools, but the IBM i system does not communicate the tape category information to the Data Domain system, and cannot modify the Tape Pool assignment of a tape image.

There are a number of system-defined tape categories on the IBM i system, and these will be designated by an asterisk (*) at the beginning of their names. User defined tape categories can have arbitrary names, following the object naming restrictions on IBM i.

User defined tape categories must be created before being used using the **CRTTAPCGY** command.

Tape cartridge images can be assigned (or re-assigned) to a tape category using the **CHGTAPCTG** command. Some examples of tape categories are: DAILY, WEEKLY,
MONTHLY, SCRATCH, PERM, etc. Tape categories are used to make it easier to divide and manage tape cartridges (or images).

To assign a set of tapes to be used as input to a save/restore job, the SETTAPCGY command is used to choose the tape category for input, and optionally, change the category of tapes after they are processed.

Typically, the flow of operations would be as follows:

1. Preparation:
   a. Create tapes on the Data Domain system.
   b. Create tape categories
   c. Add the tapes to the library.
   d. Initialize the tapes on the IBM i system
   e. Assign tapes to the categories as needed.

2. Backup:
   a. Use SETTAPCGY to mount a tape category, like the SCRATCH category, and assign an output category for the job. For example, for a Daily backup, use the output category DAILY.
   b. Process the backup using the normal SAVxxx commands, specifying VOL(*MOUNTED). As tapes are used and unmounted, they will be changed to the output category.
   c. After the backup completes, execute the SETTAPCGY OPTION(*DEMOUNTED) to release the tape category from the job.

**Tape Library and Cartridge Management Commands**

Tape Category descriptions are used to manage tapes inserted and processed in a tape library. A category is a logical grouping of tape cartridges. A category allows referencing a group of cartridges by the category name instead of individual cartridge identifiers.

Tape Category descriptions are managed with the following commands:

- CRTTAPCGY - Create Tape Category
- DLTTAPCGY - Delete Tape Category
- DSPTAPCGY - Display Tape Category
- ADXTAPCTG - Add Tape Cartridge
- CHGTAPCTG - Change Tape Cartridge
- WRKTAPCTG - Work With Tape Cartridges
- DSPTAPCTG - Display Tape Cartridge
- RMVTAPCTG - Remove Tape Cartridge
To make use of a group of tapes during a save or restore operation, the Tape Category can be assigned for use within a job. All save/restore operations that specify VOL(*MOUNTED) will use tapes from the specified category.

 Optionally, tapes processed within the job can have a new tape category assigned after processing. There are several options on the SETTAPCGY command for controlling the behavior of tape cartridges within the library.

**SETTAPCGY - Set Tape Category**

### Supported Operating System SAVE/RESTORE Commands

#### SAVE Commands

**SAVSYS**

The Save System (SAVSYS) command saves a copy of the Licensed Internal Code and the QSYS library in a format compatible with the installation of the operating system. It does not save objects from any other library. In addition, it saves security and configuration objects that can also be saved using the Save Security Data (SAVSECDTA) and Save Configuration (SAVCFG) commands.

**SAVSYS DEV(TAP01)**

**SAVLIB**

The Save Library (SAVLIB) command saves a copy of one or more libraries; this includes the library description, the object descriptions, and the contents of the objects in the library.

**SAVLIB LIB(QGPL) DEV(TAP01)**

**SAVOBJ**

The Save Object (SAVOBJ) command saves a copy of a single object or a group of objects located in the same library.

**SAVOBJ OBJ(TEST) LIB(QGPL) DEV(TAP01)**

**SAVSECDTA**

The Save Security Data (SAVSECDTA) command saves all security information without requiring a system in a restricted state. The SAVSECDTA command saves the same security information that is saved when a Save System (SAVSYS) command is run

**SAVSECDTA DEV(TAP01)**

**SAVDLO**

The Save Document Library Object (SAVDLO) command saves a copy of the specified documents, folders, or distribution objects (mail).

**SAVDLO DLO(*ALL) DEV(TAP01)**

**SAV**

The Save Object (SAV) command saves a copy of one or more objects to use in integrated file system.
**SAV DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/MYDIR')**

**RESTORE Commands**

**RSTLIB**

The Restore Library (RSTLIB) command restores to the system one library or a group of libraries that was saved by the Save Library (SAVLIB) command. The Restore Library (RSTLIB) command restores the whole library, which includes the library description, object descriptions, and contents of the library's objects.

**RSTLIB LIB(QGPL) DEV(TAP01)**

**RSTOBJ**

The Restore Object (RSTOBJ) command restores a copy of a single object or a group of objects located in the same library.

**RSTOBJ OBJ(TEST) LIB(QGPL) DEV(TAP01)**

**RSTDLO**

The Restore Document Library Object (RSTDLO) command restores a copy of the specified documents, folders, or distribution objects (mail).

**RSTDLO DLO(*ALL) DEV(TAP01)**

**RSTUSRPRF**

The Restore User Profile (RSTUSRPRF) command restores the basic parts of a user profile or a set of user profiles that were saved by the Save System (SAVSYS) command or Save Security Data (SAVSECDTA) command.

**RSTUSRPRF DEV(TAP01)**

**RSTAUT**

The Restore Authority (RSTAUT) command restores the private authorities to user profiles. This command restores the object authorities that each user profile had when the profiles were saved by the Save System (SAVSYS) or the Save Security Data (SAVSECDTA) command.

**RSTAUT**

**RST**

The Restore (RST) command restores a copy of one or more objects that can be used in the integrated file system.

**RST DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/MYDIR')**

**Go Save**

The Go Save menu uses the operating system commands listed above, but provides a menu driven interface which allows groups of related objects to be saved, including the entire system. The most common options are 21 (Entire System), 22 (System Data Only), and 23 (all User Data).
Option 21 (Save Entire System): The Option 21 Save saves the entire system. The Option 21 save requires the System to be in a Restricted State, which means no other tasks can be run while the save is taking place. A successful Option 21 save will allow the restore of the entire system to the same or a different system. This option will put the system into a Restricted State, preventing other tasks from being run.

Option 22 (System Data Only): Backs up the System Data only, it does not backup any user data. This option will also put the system into a restricted state.

Option 23 (User Data Only): Option 23 saves all user data. This information includes files, records, and other data that your users supply into your server. This option will also put the system into a restricted state.

Go Restore

The Go Restore menu lists all the types of information you can restore on your system. The most common options are 21 (Entire System), 22 (System Data Only), and 23 (all User Data).

Option 21 (Save Entire System): The Option 21 Restores the entire system with the exception of Spool Files. The Option 21 Restore requires the System to be in a Restricted State, which means no other tasks can be run while the save is taking place. A successful Option 21 save tape is required.

Option 22 (System Data Only): Restores the System Data only, it does not restore any user data. The Option 22 restore puts the system into a Restricted State. A successful Option 22 save tape is required.

Option 23 (User Data Only): Option 23 Restores all user data. This information includes files, records, and other data that your users supply into your server. Option 23 puts your server into a restricted state. A successful Option 23 save tape is required.

Go Backup

The Go Backup menu provides a menu driven interface to schedule a nightly backup. For smaller environments, this is often the backup application of choice, as it is simple and straightforward. It uses the operating system save commands and job scheduler and the save can be restored using the standard operating system restore commands.

Option 10 (Set up a backup) allows the user to define options for the Daily, Weekly, and Monthly backups, as well as the library and folder backup list. The Backup schedule can also be defined.

Option 20 (Initialize a tape) and Option 21(Initialize a tape set) bring up the INZTAP command, with the Option 21 allowing the further option of initializing a group of tapes in a library.

Option 1 (Run a Backup) brings up the "Run a Backup" menu which allows the user to run any of the defined daily, weekly, or monthly backups, optionally backing up the IBM libraries or the entire system.

Disaster Recovery

For disaster recovery using the VTL, load the LIC CD into the IBM i optical drive. The optical drive should be tagged in the HMC as the alternate IPL device. When you IPL the IBM i LPAR to load the Licensed Internal Code, or LIC, tag the tape drive as the alternate
installation device by selecting the bus, and then select the tape drive by serial number. At that point, the system may be reloaded from the tape device.

IPL from fibre channel tape is not supported.

Once the LIC is loaded, the operating system can be installed from the same device, and the system reloaded. It is not recommended to load the LIC from install media and restore the operating system from tape. The difference in PTF levels between the install media and saved operating system may render the system unusable during the recovery procedure.
**Best Practices**

Following IBM i best practices will ensure the most successful implementation of the VTL tape environment and minimize troubleshooting issues after configuration. This section describes some of the best practices we have developed in implementing virtual tape devices in the IBM i environment. Many of the specific operations or procedures are described elsewhere in this document.

**Configuration**

Proper housekeeping of the environment is critical to the operation of tape devices on the IBM i system. Ensure that failed and non-reporting tape devices are cleared from the configuration in system service tools. This will ensure that "phantom" devices do not conflict with newly configured operational devices. If a failed device cannot be removed from the configuration, use concurrent maintenance to power off the card and clear the failed device from the configuration. Reserved physical resource names can also be cleared from the work with resource by resource name in SST.

One exception to this would be tape devices on HBAs that are dynamically allocated between LPARs. These non-reporting devices serve as placeholders for devices that may reappear at a later time.

Do not include more than one initiator and target in a zone for tape devices, and do not attempt to use multipath on IBM i tape devices. Neither represents a supported option. Avoid changing the zoning of an existing tape library or device after configuration. This will generate a new library and device and require remapping of logical resources to the new physical resource. If autoconfigure is still active, new logical devices will be created. Since all tape management scripts use the logical name of the library or device to access the virtual device, any dependant operations will fail.

If using legacy HBAs with a separate IOP, try to ensure that the IOP is dedicated to the tape IOA. While a shared IOP is supported for tape, a shared IOP will represent a bottleneck, especially if shared with a disk controller. A shared IOP will also prevent the IPL of the IOP to autoconfigure new tape libraries or devices. Use autoconfiguration wherever possible. This will ensure that all parameters of the tape device are configured in a supported mode.

When assigning the tape libraries and devices to IBM i LPARs, build a design that takes into consideration all of the requirements for the environment. In a system with high throughput requirements, balance the load across both host and VTL HBAs. In an environment with multiple hosts, balance the overall workload during save operations across available VTL connections.
When using the new generation of "SmartIOA", load the required PTFs and review the informational APAR on requirements for these new HBAs. Tape libraries assigned to a fibre channel port should be optimized for throughput. Additional drives assigned to an FC port will not necessarily reduce save times - testing on SmartIOAs has determined that four concurrent backup streams on a single host port will likely maximize the efficiency of backup times. Additionally, SmartIOAs are slower to check in devices than the IOP driven cards, and a large number of devices may result in certain devices coming up non-operational on IPL and subsequently leading to failed logical resources. In this case, setting the logical resource to not vary on at IPL and instead using a startup routine to vary on the library may be advisable. This is described in the IBM APAR II13772:

Troubleshooting

Troubleshooting Fault Tree

IBM i Troubleshooting Procedures

1. Problem Determination for failed initialization or backup.
   a. **WRKCFGSTS *DEV TAP* to display the operational status of tape libraries and devices**
   b. **Display the Job Log for the failing job: From the Command Line enter DSPJOBLOG to return a log of all events that have taken place during the current session. If the job failed during a submitted job, identify the failing job and use DSPJOB, option 4 to review the job log.**
   c. **Display the System Operator Message Queue: From the Command Line enter DSPMSG QSYSOPR to display system messages sent to QSYSOPR.**
d. Work with Problems: From the Command Line enter **WRKPRB** to display failures of physical hardware components.

e. Review the Product Activity Log for failure of system hardware components. See appendices.

f. Determine whether the error is BRMS related (skip to step 2), or an Operating System Error (skip to step 3).

2. BRMS errors

   a. Error Message indicates BRMS software configuration error.
      i. Contact IBM Support.

   b. Error Indicates Tape Library or device error.
      i. Verify BRMS Devices: enter **WRKMLBBRM**.
         ii. Verify devices match operating system names.
             - If devices do not match: Initialize BRMS: INZBRM *DEVICE
         iii. Verify Tapes and capacity available on VTL.
             - If tapes or capacity are not available: add Capacity or tapes.
         iv. Verify device functionality in operating system.

3. Operating System Errors

   a. Verify device functionality in operating system.
      i. WRKMLBSTS verify varied on
         - Verify drive varied off and library varied on
         - Vary off and on to verify operability
         - Test save to library or device from operating system

   b. If failed, WRKHDWRSC *STG and verify hardware is operational.
      i. If hardware shows operational
         - Check physical to logical device mapping
         - Remap logical device to correct physical device

   c. IPL IOP (See appendix)

   d. Check Zoning
      i. Correct Zoning

   e. Check Group Access on VTL
      i. Correct Group Access

   f. Verify VTL configuration & health checks
Appendix A: IBM i Terminology

**ASP**: Auxiliary storage pool, which refers to the organization of disk storage into single level storage containers. There are three types of ASPs, System, User and iASP. The first ASP is always the system ASP, ASPs 2-32 are user ASPs, and iASPs are “independent” ASPs, which can be moved to another system in an iSeries cluster.

**AUTOCONFIG**: A configurable IBM i operating system value QAUTOCFG. When set to on, a Device Description is created when a new physical device is presented to the host.

**BRMS**: Backup Recovery and Media Services, a licensed program product from IBM providing tape and tape library management and backup automation, which requires the purchase of a license for each processor from IBM.

**Device Description**: An object within the operating system that contains information describing a particular device or logical unit (LU) that is attached to the system. The system-recognized identifier for the object type is *DEVD. Device descriptions are used to address and control the operational status of peripheral devices from the operating system.

**HBA**: A host bus adapter (HBA) is a circuit board and/or integrated circuit adapter that provides input/output (I/O) processing and physical connectivity between a server and a storage device.

**DLO**: Document Library Objects represents a file system also referenced as QDLS in the IFS. The `SAVDLO` command is used to back up the DLO.

**DST**: Dedicated Service Tools, a dedicated interface to the Licensed Internal Code functions, allowing manipulation and control of hardware components.

**Hardware Resource**: Physical devices attached to the IBM i create a licensed internal code object representing the peripheral device. The hardware resource is logically linked to a device description, allowing the operating system to access the device.

**iASP**: An Auxiliary Storage Pool which can be mounted on an alternate system as part of a clustered architecture.

**IFS**: The IBM i file system, including all data and programs in IBM i. In common use, however, this term refers to the open system, ASCII file structure, which is backed up by the SAV command.

**IOA**: Input Output Adapter. An IBM i feature card that communicates with a peripheral device. An IOA requires an IOP or virtual IOP to interface with the main processor.

**IOP**: A IBM i Input Output Processor. An IOP may be a separate card or a chip on an "IOPless" or "SmartIOA". One IOP can handle one or more IOAs (I/O Adapters). While the IOA talks with the device, the IOP handles the traffic between the IOA and the system bus, offloading the i/o operations from the main processor. An IOP embedded on an IOA is referred to as a virtual IOP.

**IPL**: Initial Program Load. The boot process for the IBM i or individual IOP cards installed on the system. This can be accomplished from SST.

**iSeries**: An historical name for the System i. The IBM i has had many names since its introduction in 1988: Application System/400, AS400, iSeries eserver, iSeries, IBM i and Power with i.

**Library**: An AS400 namespace used to organize database files into groups, similar to a directory on open systems. Libraries are contained within the QSYS.LIB file structure in the IFS. Libraries are backed up by the SAVLIB command, the objects within them are backed up by the `SAVOBJ` command.
**LIC:** Licensed Internal Code is the AS400 software that communicates directly with the hardware. LIC typically performs the following functions: storage management, pointer and address management, program management, expectation and event management, data management, I/O management, and security management. A new release of LIC may be required to support new features. A new release of the LIC within the same operating system level is either a "respin", which includes new LIC PTFs and is designated by a letter code, or a "mod" release, which introduces new hardware functionality or processor support and is designated by a modification level, such as V6R1M1.

**Load Source:** The Load Source is the boot volume for IBM i and contains two copies of the LIC, A and B. The A side has only permanently applied PTFs, while the B side contains permanent and temporary PTFs. The A side is used to IPL the system if a temporarily applied PTF causes IPL failure.

**LPAR:** Logical Partitions are separate logical systems running on a single hardware platform. LPARs may utilize separate physical resources, or in some configurations, share physical resources.

**Option 21:** A full system save of the IBM i LIC, operating system and user data.

**PTF:** Are AS400 Program Temporary Fixes. These are remedies to problems that may have been encountered by one or more machines; enhancements to the operating system, Licensed Program Products, or the LIC. Fixes which have wide applicability are issued as Cumulative (CUM), High Impact and Pervasive (HIPER) and Database packages, while other functional or program groups have their own group PTFs. Individual PTFs may also be required to remediate specific hardware or software problems. It is essential that PTFs are applied as part of a regular maintenance routine.

**Restricted State:** An operational state for the IBM i in which all subsystems are ended and no user sessions are available. Only the console can be used to access the system in a restricted state. Commonly used for full system saves.

**SAVF:** An IBM i save file. Similar to a tar or zip file on open systems. A way to save objects or transfer files on the System i.

**SmartIOA:** The newest generation of peripheral cards, which contain an embedded IOP chip, rather than requiring a separate IOP card.

**SST:** IBM i System Service Tools are used to configure, manage, and service the server. Can be used to power cycle the tape controllers. Can be accessed by the STRSST command along with a USERID and PWD.

**TAPMLB:** Tape Media Library, a logical device representing a media changer and controlling tape devices associated with it.

**User ASP:** One of 31 auxiliary storage pools which may be configured in addition to the System ASP. A user ASP contains “user” data, which may include programs, data, or other file systems, but does not contain operating system or LIC elements.

**Vary On/Off:** The process of making a logical resource available or unavailable on the iSeries. In order to execute logical operations, the physical resource must be present and operational on the system. The status of the physical resource is verified by the command WRKHDWRSC *STG.

**VIOS:** Virtual Input Output Server, also known as PowerVM. PowerVM is a virtualization layer supporting the IBM i on blades and the Power6 platform at V6.1 and above.
Appendix B: IPL IOP

If the Tape Library does not function, identify the storage controller resource name and associated IOP by executing the command `WRKHDWRSC *STG`. In this example, the IOP driving the storage controller DC09 is the IOP CMB07.

1. If the library appears, select option 7 on the library to verify the serial number of the device. Select option 9 to verify associated tape devices are varied on. Note the name of the storage controller and the IOP.

2. Start system service tools by entering `STRSST` from the command line.
3. Sign on to SST, and select option 1 to start a service tool.

4. Select option 7 for hardware service manager.
5. Select option 3 to Locate Resource by resource name.

6. Type the storage controller resource name (**CMB07**) and hit enter.
7. Select option 6 I/O Debug.

8. Select option 4 to IPL IO Processor.
9. Press Enter to Confirm.
Appendix C: Failed and Non-Reporting Resources

1. Select Option 1: Start a service tool.

   ![System Service Tools (SST)](image1)

   Select one of the following:
   1. Start a service tool
   2. Work with active service tools
   3. Work with disk units
   4. Work with diskette data recovery
   5. Work with system partitions
   6. Work with system capacity
   7. Work with system security
   8. Work with service tools user IDs and Devices

   ![Selection](image2)

2. Select Option 7: Hardware service manager.

   ![Start a Service Tool](image3)

   Warning: Incorrect use of this service tool can cause damage to data in this system. Contact your service representative for assistance.

   Select one of the following:
   1. Product activity log
   2. Trace Licensed Internal Code
   3. Work with communications trace
   4. Display/Alter/Dump
   5. Licensed Internal Code log
   6. Main storage dump manager
   7. Hardware service manager

   ![Selection](image4)
3. Select Option 4: Failed and non-reporting hardware resources.

4. Enter 4 next to all Failed and Non-Reporting Logical Hardware Resources you wish to remove. Verify all none of the resources required for dynamically allocated resources in an LPAR environment. Resources will vary by system.
5. Enter to confirm removal.

![Confirm Remove of Logical Hardware Resources]

To confirm your choices for 4=Remove, press Enter.
To return to change your choices, press F12.

<table>
<thead>
<tr>
<th>Description</th>
<th>Type-Model</th>
<th>Status</th>
<th>Resource Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Storage IDA</td>
<td>6802-001</td>
<td>Unknown</td>
<td>DC02</td>
</tr>
<tr>
<td>Virtual Comm IDA</td>
<td>6803-001</td>
<td>Unknown</td>
<td>LIN01</td>
</tr>
<tr>
<td>Virtual Comm IDA</td>
<td>6803-001</td>
<td>Unknown</td>
<td>LIN02</td>
</tr>
<tr>
<td>Virtual Comm IDA</td>
<td>200C-001</td>
<td>Unknown</td>
<td>LIN03</td>
</tr>
<tr>
<td>Disk Unit</td>
<td>4326-070</td>
<td>Unknown</td>
<td>DD01</td>
</tr>
<tr>
<td>Disk Unit</td>
<td>4326-070</td>
<td>Unknown</td>
<td>DD02</td>
</tr>
<tr>
<td>Disk Unit</td>
<td>4326-070</td>
<td>Unknown</td>
<td>DD03</td>
</tr>
<tr>
<td>Tape Unit</td>
<td>3580-003</td>
<td>Unknown</td>
<td>TAP01</td>
</tr>
<tr>
<td>Tape Unit</td>
<td>3580-003</td>
<td>Unknown</td>
<td>TAP02</td>
</tr>
<tr>
<td>Tape Unit</td>
<td>3570-C12</td>
<td>Unknown</td>
<td>TAP07</td>
</tr>
<tr>
<td>Virtual Comm Port</td>
<td>6803-001</td>
<td>Unknown</td>
<td>CHN01</td>
</tr>
<tr>
<td>Virtual Comm Port</td>
<td>6803-001</td>
<td>Unknown</td>
<td>CHN02</td>
</tr>
</tbody>
</table>

6. Verify removal is successful.

![Failed and Non-Reporting Logical Hardware Resources]

Type options, press Enter.
2=Change detail 4=Remove 5=Display detail 6=I/O debug
7=Verify 8=Associated packaging resource(s)

<table>
<thead>
<tr>
<th>Opt Description</th>
<th>Type-Model</th>
<th>Status</th>
<th>Resource Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Appendix D: Product Activity Log

1. Select Option 1, Start a Service Tool.

2. Select Option 1, Product Activity Log.
3. Select Option 1, Analyze Log.

4. Select option 1 for All Logs, and enter a time frame for the logs.
5. Select default options.

6. Select option 5 to display the error report.