installation and reference guide

HP MPIO Full-Featured DSM for EVA Disk Arrays 2.01.00
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About this guide

This guide provides information about HP MPIO Full-Featured Device Specific Module (DSM) for EVA Disk Arrays (called the “HP MPIO EVA DSM” throughout this guide), including:

• Installing, upgrading, and removing HP MPIO EVA DSM
• Support for load balancing in Microsoft Cluster Server (MSCS) environments
• Managing HP MPIO EVA DSM

Intended audience

This document is intended for users who have purchased the HP MPIO EVA DSM and who are experienced with the following:

• Microsoft Windows 2000 and Windows Server 2003 (32-bit or 64-bit systems)
• EVA4000, EVA6000, and EVA8000 disk arrays
• Microsoft Cluster Server (MSCS) environments

Related documentation

In addition to this guide, see HP MPIO Full-Featured DSM for EVA Disk Arrays release notes. Additional documentation, including whitepapers and best-practices documents, is available at http://www.hp.com

Document conventions and symbols

<table>
<thead>
<tr>
<th>Table 1 Document conventions</th>
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<tbody>
<tr>
<td><strong>Convention</strong></td>
</tr>
<tr>
<td>Medium blue text: Related documentation</td>
</tr>
<tr>
<td>Medium blue, underlined text (<a href="http://www.hp.com">http://www.hp.com</a>)</td>
</tr>
<tr>
<td><strong>Bold font</strong></td>
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<td><strong>Monospace, bold font</strong></td>
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</tbody>
</table>
**WARNING:**
Indicates that failure to follow directions could result in bodily harm or death.

**CAUTION:**
Indicates that failure to follow directions could result in damage to equipment or data.

**IMPORTANT:**
Provides clarifying information or specific instructions.

**NOTE:**
Provides additional information.

---

**HP technical support**

Telephone numbers for worldwide technical support are listed on the HP support web site: [http://www.hp.com/support/](http://www.hp.com/support/)

Collect the following information before calling:
- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

For continuous quality improvement, calls may be recorded or monitored.

HP recommends that customers sign up on line using the Subscriber’s choice web site: [http://www.hp.com/go/e-updates](http://www.hp.com/go/e-updates)

- Subscribing to this service provides you with e-mail updates on the latest product enhancements, newer versions of drivers, and firmware documentation updates as well as instant access to other product resources.
- After signing up, you can quickly locate your products by selecting **Business support** and then **Storage** under **Product Category**.

**HP-authorized reseller**

For the name of your nearest HP-authorized reseller:

- In the United States, call 1-800-282-6672.
- Elsewhere, visit the HP web site: [http://www.hp.com](http://www.hp.com). Then click **Contact HP** to find locations and telephone numbers.
Helpful web sites

For other product information, see the following HP web sites:

• http://www.hp.com
• http://www.hp.com/go/storage
• http://www.hp.com/support/
• http://www.docs.hp.com
1 Installing the HP MPIO Full-Featured DSM for EVA Disk Arrays

HP MPIO Full-Featured Device Specific Module (DSM) for EVA Disk Arrays (HP MPIO EVA DSM) provides multipathing support for HP StorageWorks EVA disk arrays on Windows platforms using the Microsoft Multipath Input-Output (MPIO) framework. This chapter describes the following:

- Preparing for installation
- Installing HP MPIO EVA DSM
- Upgrading HP MPIO EVA DSM
- Removing HP MPIO EVA DSM
- Using silent installation
- Setting up boot from SAN

Preparing for installation

Before installing HP MPIO EVA DSM, verify that your system components support the HP MPIO EVA DSM and determine whether you need to upgrade hardware or software before installation.

NOTE:
Some of the tasks or procedure steps may not apply to your configuration.

To prepare your system for the installation of HP MPIO EVA DSM:

1. Complete the pre-installation checklist (Table 2).
2. Install all hardware components, as described in the hardware installation and configuration documentation.
3. Install any required operating system service packs.
4. Back up your computer.
5. Log in with administrator privileges.
6. Ensure that no other installation program is in progress (for example, the Found New Hardware wizard).
7. If your system is running Microsoft Terminal Server, change the Terminal Server from Execution mode to Installation mode.
Table 2 lists the information you need before installing the HP MPIO EVA DSM.

**Table 2 Pre-installation checklist**

<table>
<thead>
<tr>
<th>Task</th>
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<tbody>
<tr>
<td>Check the contents of the HP MPIO EVA DSM kit and the Fibre Channel hardware to make sure nothing is missing. If you are missing any component, contact your account representative, or call the HP Customer Service hotline at (800) 354-9000.</td>
<td></td>
</tr>
<tr>
<td>Obtain and review the most current versions of the following documents:</td>
<td></td>
</tr>
<tr>
<td>• HP MPIO Full-Featured DSM for EVA Disk Arrays release notes</td>
<td></td>
</tr>
<tr>
<td>• Installation and configuration information for your system, available at the following web site: <a href="http://www.hp.com/country/us/eng/prodserv/storage.html">http://www.hp.com/country/us/eng/prodserv/storage.html</a></td>
<td></td>
</tr>
<tr>
<td>• Supported SAN topologies for HP MPIO EVA DSM, as defined and described in the HP StorageWorks SAN design reference guide available at the following web site: <a href="http://h18006.www1.hp.com/products/storageworks/san/documentation.html">http://h18006.www1.hp.com/products/storageworks/san/documentation.html</a></td>
<td></td>
</tr>
<tr>
<td>See the HP MPIO Full-Featured DSM for EVA Disk Arrays release notes to verify that your Host Bus Adapter (HBA) drivers are the required version(s).</td>
<td></td>
</tr>
</tbody>
</table>

⚠️ **CAUTION:**

Installing HP MPIO EVA DSM when the Terminal Server is in execution mode may have adverse effects on other software products. For detailed information, see the Microsoft web site: http://support.microsoft.com/default.aspx?scid=kb;en-us;186612

## Installing HP MPIO EVA DSM

You can install HP MPIO EVA DSM on a stand-alone system or a cluster configuration. The installation procedure depends on the current configuration of your system.

This section describes how to install HP MPIO EVA DSM on the following configurations:

• Installing HP MPIO EVA DSM on stand-alone systems
• Installing HP MPIO EVA DSM on cluster configurations

### Installing HP MPIO EVA DSM on stand-alone systems

You can install this software prior to attaching the hardware. To install the HP MPIO EVA DSM on a stand-alone system, complete the steps below:

1. Complete the pre-installation checklist (Table 2) and the pre-installation procedure.
2. Ensure that only a single path is connected to the storage devices.
3. Configure the storage sets.
4. Insert the HP MPIO EVA DSM CD-ROM on your server or a network drive.
5. Choose one of the following options to access the CD-ROM:
   - From your server: If you have AutoRun enabled on your server, the setup program starts automatically. Otherwise, select Start > Run, then locate the Launch.exe program on the CD-ROM drive.
   - From your network drive: If you are accessing the CD-ROM on a network drive, select Start > Run, then locate the Launch.exe program on the network drive.
6. In the launch window, click **Install HP MPIO Full-Featured DSM for EVA Disk Arrays**.
7. Follow the on-screen instructions to complete the installation.
8. Restart the server.
9. Add the redundant paths to the storage devices.

**NOTE:**
For more information about the option **Enable Load Balancing in Cluster** in the Configuration Settings window presented during installation, see **Support for load balancing in Microsoft Cluster Server environments**.

---

**Installing HP MPIO EVA DSM on cluster configurations**

To install HP MPIO EVA DSM on each member of a cluster configuration, complete the steps below:

**NOTE:**
In a cluster configuration, HP MPIO EVA DSM must be installed on one node at a time for all nodes of the cluster.

1. Complete the pre-installation checklist (Table 2) and the pre-installation procedure.
2. Using Cluster Administrator:
   a. Move all cluster resources owned by the current node to another node in the cluster.
   b. Pause the current cluster node.
   c. Select **Resource Attributes > Disable failback** for all groups containing resources managed by the current node.
3. Install HP MPIO EVA DSM on the current node by following step 2–9 from the procedure **Installing HP MPIO EVA DSM on stand-alone systems**.
4. Using Cluster Administrator, resume the current cluster node.

**NOTE:**
Repeat steps 2–4 for all nodes in the cluster.

5. Using Cluster Administrator:
   a. Restore failback for all groups containing resources as needed.
   b. Redistribute cluster resources as desired.

---

**Upgrading HP MPIO EVA DSM**

You can upgrade HP MPIO EVA DSM from an existing version to the current version on a stand-alone system or cluster configuration.

This section describes how to upgrade HP MPIO EVA DSM on the following configurations:

- Upgrading HP MPIO EVA DSM on stand-alone systems
- Upgrading HP MPIO EVA DSM on cluster configurations
Upgrading HP MPIO EVA DSM on stand-alone systems

To upgrade HP MPIO EVA DSM from a previous version on stand-alone systems, complete the steps below:

1. Complete the pre-installation checklist (Table 2) and the pre-installation procedure.
2. Insert the HP MPIO EVA DSM CD-ROM on your server or a network drive.
3. Choose one of the following options to access the CD-ROM:
   - From your server: If you have AutoRun enabled on your server, the setup program starts automatically. Otherwise, select Start > Run, then locate the Launch.exe program on the CD-ROM drive.
   - From your network drive: If you are accessing the CD-ROM on a network drive, select Start > Run, then locate the Launch.exe program on the network drive.
4. In the launch window, click Install HP MPIO Full-Featured DSM for EVA Disk Arrays.
5. Select the upgrade option.
6. Follow the on-screen instructions to complete the upgrade.
7. Restart the server.

**NOTE:**
For more information about the option Enable Load Balancing in Cluster in the Configuration Settings window presented during the upgrade, see Support for load balancing in Microsoft Cluster Server environments.

Upgrading HP MPIO EVA DSM on cluster configurations

To upgrade HP MPIO EVA DSM from a previous version on each member of a cluster configuration, complete the steps below:

**NOTE:**
In a cluster configuration, HP MPIO EVA DSM must be upgraded on one node at a time for all nodes in the cluster.

1. Complete the pre-installation checklist (Table 2) and the pre-installation procedure.
2. Using Cluster Administrator:
   a. Move all cluster resources owned by the current node to another node in the cluster.
   b. Pause the current cluster node.
   c. Select Resource Attributes > Disable failback for all groups containing resources managed by the current node.
3. Upgrade HP MPIO EVA DSM on the current node by following steps 2–6 from the procedure Upgrading HP MPIO EVA DSM on stand-alone systems.
4. Using Cluster Administrator, resume the current cluster node.

**NOTE:**
Repeat steps 2–4 for all nodes in the cluster.

5. Using Cluster Administrator:
   a. Restore failback for all groups containing resources as needed.
   b. Redistribute cluster resources as desired.
Removing HP MPIO EVA DSM

To remove the HP MPIO EVA DSM, you must reconfigure the SAN and reboot your server.

⚠️ CAUTION:
Removing multipathing software from a multipath hardware configuration can cause data loss or corruption. You must disconnect the server from the multipath storage or eliminate all but one path to that storage from the server prior to removing the HP MPIO EVA DSM.

To remove HP MPIO EVA DSM, complete the steps below:

1. Back up all user data on multipath storage.
2. If possible, disconnect the storage from the server. If it is necessary to maintain single-path connections from the server to the storage (as in the case of servers that boot from a SAN device), use the following guidelines:
   • If it is a one-host/one-storage array, HP recommends removing redundant cable connections.
   • If the storage continues to be accessed by other servers still in multipath mode and by this server in single-path mode and it is on an EVA system, use switch zoning to establish the single connection (path) from the server.

⚠️ NOTE:
Make sure you perform step 1 and step 2 before proceeding further.

3. Select Start > Settings > Control Panel > Add or Remove Programs.
4. Select HP MPIO Full-Featured DSM for EVA Disk Arrays from the Remove Program dropdown list.
5. Click Remove and follow the on-screen instructions.
   The system displays a cautionary statement advising of the potential data loss or corruption that may result from removing this software.
6. Close the Add/Remove Programs window.

⚠️ NOTE:
The LUNs may be inaccessible at this time.

7. Reboot the system.

Using silent installation

Silent installation can be run from the CD-ROM on your computer or from a network drive. It installs the HP MPIO EVA DSM with little intervention. Silent installation is useful if you are installing the software on a large number of servers that require software installation.

This section describes the following:
• Installing HP MPIO EVA DSM
• Upgrading HP MPIO EVA DSM
• Removing HP MPIO EVA DSM

Syntax:
<install drive>:\MPInstall\setup.exe /s /f1C:\setup.iss /f2C:\MPSInstallLog.txt

The <install drive> refers to the drive which contains the installation media.
The setup.iss is the response file from which information is taken for silent installation.
The MPSInstallLog.txt file records information about the silent installation.

The ResponseResult section of the MPSInstallLog.txt log file displays the result code, indicating whether or not the silent installation succeeded. An integer value is assigned to the ResultCode keyname in the ResponseResult section.

Following are the list of common return values along with their descriptions in the ResultCode key:

<table>
<thead>
<tr>
<th>Result Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Success</td>
</tr>
<tr>
<td>−1</td>
<td>General error</td>
</tr>
<tr>
<td>−3</td>
<td>Required data not found in the setup.iss file</td>
</tr>
<tr>
<td>−4</td>
<td>Not enough memory available</td>
</tr>
<tr>
<td>−5</td>
<td>File does not exist</td>
</tr>
<tr>
<td>−6</td>
<td>Cannot write to the response file</td>
</tr>
<tr>
<td>−7</td>
<td>Unable to write to the log file</td>
</tr>
<tr>
<td>−8</td>
<td>Invalid path to the InstallShield Silent response (.iss) file</td>
</tr>
<tr>
<td>−51</td>
<td>Cannot create the specified folder</td>
</tr>
<tr>
<td>−52</td>
<td>Cannot access the specified file or folder</td>
</tr>
</tbody>
</table>

**NOTE:**
The C:/ and /f1C:/ and /f2C:/ refers to a local drive on the system or a network drive which is used to obtain the response file and write the MPSInstallLog.txt (provided there is write permission in the directory).

<Default_Target_Dir> = C:\Program Files\Hewlett-Packard\HP MPIO DSM\EVA DSM

<User_Target_Dir> = a directory on the system on which the new installation is to be done or the directory of an existing installation.

You must enclose the paths to the response file and the log file, which records the information about the silent installation, in quotes (’ or ”).

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**Installing HP MPIO EVA DSM**

To perform a silent installation of HP MPIO EVA DSM, complete the steps below:

1. Make a copy of the new.iss file in the installation kit.
2. Rename this copy of the file as setup.iss
3. Choose one of the following options:
   • To install the Microsoft MPIO Framework component along with the DSM component, use the renamed default setup.iss file.
   • To install only the DSM component (when the Microsoft MPIO Framework already exists on your system), edit the renamed default setup.iss file as follows:
     a. In line 35, replace Component-count=2 with Component-count=1.
     b. Remove line 36.
     c. In line 37, replace Component-1=DSM with Component-0=DSM.
4. If you want to install in a directory other than the default directory, replace szDir= with szDir=<User_Target_Dir> in lines 28 and 33 of the setup.iss file.
5. If you want to enable load balancing in clusters, replace sel-0=0 with sel-0=1 in line 41 of the setup.iss file.
6. If you want to avoid the automatic reboot feature, edit the setup.iss file as follows:
   a. In line 54, replace Result=6 with Result=1.
   b. In line 55, replace BootOption=3 with BootOption=0.

Upgrading HP MPIO EVA DSM

To upgrade from a previous version of HP MPIO EVA DSM to the current version, complete the steps below:
1. Make a copy of the update.iss file in the installation kit.
2. Rename this copy of the file as setup.iss
3. Choose one of the following options:
   a. To upgrade the Microsoft MPIO Framework component along with the DSM component, use the renamed default setup.iss file.
   b. To upgrade only the DSM component (when the Microsoft MPIO Framework already exists on your system), edit the renamed default setup.iss file as follows:
      a. In line 24, replace Component-count=2 with Component-count=1.
      b. Remove line 25.
      c. In line 26, replace Component-1=DSM with Component-0=DSM.
4. If you want to enable load balancing in clusters, replace sel-0=0 with sel-0=1 in line 30 of the setup.iss file.
5. If you want to avoid the automatic reboot feature, edit the setup.iss file as follows:
   a. In line 43, replace Result=6 with Result=1.
   b. In line 44, replace BootOption=3 with BootOption=0.

Removing HP MPIO EVA DSM

To remove HP MPIO EVA DSM, complete the steps below:
1. Make a copy of the uninstall.iss file in the installation kit.
2. Rename this copy of the file as setup.iss
3. If you want to avoid the automatic reboot feature, edit the renamed setup.iss file as follows:
   a. In line 28, replace Result=6 with Result=1.
   b. In line 29, replace BootOption=3 with BootOption=0.

Setting up boot from SAN

HP MPIO EVA DSM can be set up to boot externally from a SAN that uses HP StorageWorks HBAs and RAID arrays. Booting externally offers the following advantages:
- Optional elimination of server-based internal boot devices
- Decreased downtime in the event of a server failure

Booting from a SAN requires specific setup procedures based on the specific software solutions, HBA firmware, and boot BIOS versions. See the following documents for detailed information about booting from a SAN:
2 Support for load balancing in Microsoft Cluster Server environments

This section describes the following:

- Enabling support for load balancing in MSCS environments
- Disabling support for load balancing in MSCS environments
- Recovering inaccessible disk devices

By default, HP MPIO EVA DSM supports the No Load Balancing policy in Microsoft Cluster Server (MSCS) environments. This is because MSCS uses SCSI-2 reservations to synchronize access to the cluster-managed devices. However, HP MPIO EVA DSM provides a feature to support load balancing for all HP disk arrays that support the SCSI-3 persistent reservations management method by mapping the MSCS-issued SCSI-2 reservations to SCSI-3 persistent reservations.

HP MPIO EVA DSM supports load balancing in MSCS environments only under the following conditions:

- All nodes in the cluster must have the same version of the HP MPIO EVA DSM installed.
- Support for load balancing in MSCS environments must be enabled on all cluster nodes in the HP MPIO EVA DSM.
- The disk array containing the cluster resources must support the SCSI-3 persistent reservations.

**NOTE:**
Contact HP technical support for details on disk arrays and the firmware revisions that support persistent reservations.

Enabling support for load balancing in MSCS environments

You can enable load-balancing support in MSCS environments while installing the HP MPIO EVA DSM or anytime after the installation.

**CAUTION:**
You must enable the load-balancing feature on all nodes in the cluster. If the setting is not consistent across all cluster nodes, the cluster node failover functionality can be impaired.

To enable load balancing at the time of installing HP MPIO EVA DSM, select **Enable Load Balancing in Cluster** in the **Configuration Settings** window.

To enable load balancing after you have installed HP MPIO EVA DSM, complete the following steps:

**NOTE:**
You must repeat the following procedure on all nodes in the cluster, one at a time.

1. If MSCS is installed on your system, move all cluster resources owned by the current node to another node in the cluster. If this is not applicable, proceed to step 2.
2. Navigate to the HP MPIO EVA DSM installation directory `<installdir>` on the current node using Windows Explorer.

3. Double-click the registry file (depending upon the operating system you are using):
     `<installdir>`\x86\hpeaadsm_pr_on.reg
   • For Windows Server 2003 (IA64):
     `<installdir>`\IA64\hpeaadsm_pr_on.reg
   • For Windows Server 2003 x64 Edition:
     `<installdir>`\AMD64\hpeaadsm_pr_on.reg

**NOTE:**
The `<installdir>` refers to the folder which you have selected during the HP MPIO EVA DSM installation. The default installation directory is %ProgramFiles%\Hewlett-Packard\HP MPIO DSM\EVA DSM.

4. Follow the on-screen instructions.

5. Reboot the system for the new registry parameter to take effect.

**NOTE:**
Once all the nodes in the cluster have the support for load balancing in MSCS enabled, you can change the load-balancing policy for the cluster device(s) using the HPDSM CLI or HP MPIO DSM manager.

### Disabling support for load balancing in MSCS environments

To disable the load balancing support in MSCS environments in HP MPIO EVA DSM, complete the following steps:

**NOTE:**
You must repeat the following procedure on all nodes in the cluster, one at a time.

1. If MSCS is installed on your system, move all cluster resources owned by the current node to another node in the cluster. If this is not applicable, proceed to step 2.

2. Navigate to the HP MPIO EVA DSM installation directory `<installdir>` on the current node, using Windows Explorer.

3. Double-click the registry file (depending upon the operating system you are using):
     `<installdir>`\x86\hpeaadsm_pr_off.reg
   • For Windows Server 2003 (IA64):
     `<installdir>`\IA64\hpeaadsm_pr_off.reg
   • For Windows Server 2003 x64 Edition:
     `<installdir>`\AMD64\hpeaadsm_pr_off.reg

**NOTE:**
The `<installdir>` refers to the folder which you have selected during the HP MPIO EVA DSM installation. The default installation directory is %ProgramFiles%\Hewlett-Packard\HP MPIO DSM\EVA DSM.
4. Follow the on-screen instructions.
5. Reboot the system for the new registry parameter to take effect.

**IMPORTANT:**

During the process of enabling or disabling of load balance in an MSCS environment (for a cluster with more than two nodes), you may have a set of nodes using SCSI-3 persistent reservations along with another set of nodes using SCSI-2 reservations. In such cases (as part of step 1 in the above sections), HP recommends that you move the cluster resources to the set of nodes that has the majority reservation.

---

**Recovering inaccessible disk devices**

If there is a stray reservation on a disk device, the device becomes inaccessible to the host systems connected to it. This is because the strong reservation type (persistent reservations) supports load balancing in clusters.

You can use the persistent reservations clear utility that comes with the HP MPIO EVA DSM package to remove the stray reservations. For more information on how to use this utility, see HP MPIO EVA DSM persistent reservations clear utility.
Support for load balancing in Microsoft Cluster Server environments
3 Adaptive Load balance

The HP MPIO EVA DSM implements array specific load balancing algorithms that utilize certain features supported by the disk arrays, to deliver better performance for host I/O requests. The Adaptive Load Balance (ALB) setting is supported on a per logical unit basis and works in conjunction with the load balancing policies supported by the DSM, which includes Round Robin, Shortest Queue Requests, Shortest Queue Bytes, and Shortest Queue Service Time.

By default, ALB is disabled for the newly discovered LUN. If the newly discovered LUN is part of any Logical Unit Group, the ALB setting of the existing group prevails.

**NOTE:**
- All devices that are part of the Logical Unit Group, has the same ALB setting.
- The ALB setting is not applicable for devices that have the No Load Balancing policy enabled.
- The ALB setting for a given LUN is persistent across host system reboots.

You can modify (enable/disable) the ALB setting for a given LUN either through the HP MPIO DSM Manager or the HP DSM CLI. See Managing storage arrays with HP MPIO EVA DSM CLI utility for more information.
Managing storage arrays using the HP MPIO EVA DSM with the CLI utility

The command line interface utility (CLI) of HP MPIO EVA DSM enables you to monitor and manage multipathing devices. This chapter describes the following CLI commands:

- `hpdsm devices`
- `hpdsm paths device`
- `hpdsm set device policy`
- `hpdsm set device alb`
- `hpdsm set device path`
- `hpdsm cleanup device`
- `hpdsm notify`
- `hpdsm help`

**hpdsm devices**

**Syntax:** `hpdsm devices`

The `hpdsm devices` command displays information about the HP MPIO devices as shown in the following example. If there are no devices present, the following message is displayed: **No devices found.**

**NOTE:**

See `hpdsm set device policy` for a definition of the policies. The P.B.T.L. column shows the device port, bus, target, and LUN.

**Example:**

```
Device#  Device Name  Serial No.  Active Paths  Policy  Disk#  P.B.T.L ALB
1         HSV210     600508B400101F6A000070001D950000 9  SQST  Disk 10  4.0.1.1 Y
2         HSV210     600508B400101F6A000070001D9B0000 9  SQST  Disk 11  4.0.1.2 N
3         HSV210     600508B400101F6A000070001DA10000 9  RR   Disk 12  4.0.1.3 Y
4         HSV210     600508B400101F6A000070001E160000 9  SQR   Disk 13  3.0.2.4 Y
5         HSV210     600508B400101F6A000070001E220000 9  NLB   Disk 14  2.0.2.5 N
6         HSV210     600508B400101F6A000070001E2E0000 9  NLB   Disk 15  2.0.2.6 N
7         HSV210     600508B400101F6A000070001E2E0000 9  SQST   Disk 16  3.0.2.7 N
8         HSV210     600508B400101F6A000070001E2E0000 9  SQST   Disk 17  3.0.2.8 N
```
hpdm paths device

**Syntax:** hpdm paths device=x

The `hpdm paths device` command displays information about the paths available for device x, as shown in the following example.

**NOTE:**

The P.B.T.L. column shows the device port, bus, target, and LUN.

<table>
<thead>
<tr>
<th>Path#</th>
<th>Controller</th>
<th>State</th>
<th>HBA Slot#</th>
<th>RTP</th>
<th>P.B.T.L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P8398DXAAQQ013</td>
<td>Active</td>
<td>4</td>
<td>00020008</td>
<td>2.0.2.1</td>
</tr>
<tr>
<td>2</td>
<td>P8398DXAAQQ013</td>
<td>Active</td>
<td>4</td>
<td>00020007</td>
<td>2.0.5.1</td>
</tr>
<tr>
<td>3</td>
<td>P8398DXAAQQ010</td>
<td>Active</td>
<td>4</td>
<td>00010001</td>
<td>2.0.6.1</td>
</tr>
<tr>
<td>4</td>
<td>P8398DXAAQQ010</td>
<td>Active</td>
<td>4</td>
<td>00010001</td>
<td>3.0.0.1</td>
</tr>
<tr>
<td>5</td>
<td>P8398DXAAQQ013</td>
<td>Active</td>
<td>4</td>
<td>00020007</td>
<td>3.0.1.1</td>
</tr>
<tr>
<td>6</td>
<td>P8398DXAAQQ013</td>
<td>Active</td>
<td>4</td>
<td>00020008</td>
<td>3.0.2.1</td>
</tr>
<tr>
<td>7</td>
<td>P8398DXAAQQ010</td>
<td>Active</td>
<td>3</td>
<td>00010001</td>
<td>4.0.0.1</td>
</tr>
<tr>
<td>8</td>
<td>P8398DXAAQQ013</td>
<td>Active</td>
<td>3</td>
<td>00020008</td>
<td>4.0.1.1</td>
</tr>
<tr>
<td>9</td>
<td>P8398DXAAQQ013</td>
<td>Active</td>
<td>3</td>
<td>00020007</td>
<td>4.0.2.1</td>
</tr>
</tbody>
</table>

hpdm set device policy

**Syntax:** hpdm set device=x policy=policy

The `hpdm set device policy` command sets the load-balancing policy for device x to one of the following:

- **No_Load_Balance (NLB)** - All I/O requests are routed through a chosen active path.
- **Round_Robin (RR)** - All I/O requests are distributed across all active paths to the device in a round robin manner.
- **Shortest_Queue_Requests (SQR)** - Each I/O request is routed to the active path with the least number of outstanding requests.
- **Shortest_Queue_Bytes (SQB)** - Each I/O request is routed to the active path with the least number of outstanding data bytes.
- **Shortest_Queue_ServiceTime (SQST)** - Each I/O request is routed to the active path where the total outstanding time for pending I/O requests is the least.

The example below demonstrates the information displayed by the `hpdm set device policy` command.

**NOTE:**

You cannot change the load balance policy for the devices using SCSI-2 reservations in an MSCS environment.
Example:

```
hpdsm set device=1 policy=rr
Device Name : HP HSV210
Device Serial No. : 600508B400101F6A000070001D950000
Change Load Balance policy (y/n) ? y

Load Balance policy changed. Verify by issuing "hpdsm" command.
```

**hpdsm set device alb**

**Syntax:** hpdsm set device=x alb=y/n

The **hpdsm set device alb** command changes the Adaptive Load Balance setting for the device x.

**Example:**

```
hpdsm set device=1 alb=y
Device Name : HP HSV210
Device Serial No. : 600508B400101F6A000070001D950000
Change Adaptive Load Balance policy (y/n) ? y
```

**hpdsm set device path**

**Syntax:** hpdsm set device=x path=y

The **hpdsm set device path** command changes the preferred path for device x, as shown in the example below.

**NOTE:**
Use the **hpdsm paths device** command to view the available paths for the device.

```
hpdsm set device=1 path=1
Device Name : HP HSV210
Device Serial No. : 600508B400101F6A000070001D950000
Controller Port No. : P8398DXAAQQ013
Change Load Balance policy (y/n) ? y

Preferred Path changed. Verify by issuing "hpdsm" command.
```
**hpdsms cleanup device**

Syntax: `hpdsms cleanup device=x`

The `hpdsms cleanup device` command allows you to clean up the failed path information for a specified device `x`, as shown in the example below.

Example:

```
hpdsms cleanup device=1
Device Name : HP HSV210
Device Serial No. : 600508B400101F6A000070001D950000
Cleanup the failed path information for this LUN (y/n) ? y
Cleanup Succeeded. Verify by issuing "hpdsms" command.
```

**hpdsms notify**

Syntax: `hpdsms notify event = notification_event_number time=number_of_minutes`

The `hpdsms notify` command defines user notification of events. The time attribute defines the number of minutes that will elapse from the time the event occurs until the user is notified. The maximum value is 700,000 minutes.

Table 3 defines the selections for the notification command string.

### Table 3 Notification strings

<table>
<thead>
<tr>
<th>Notification string</th>
<th>Notification_event_number</th>
<th>Notifies the user when DSM Manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPDSM_NEW_DEVICE</td>
<td>1</td>
<td>Detects a new device.</td>
</tr>
<tr>
<td>HPDSM_ADDITIONAL_PATH</td>
<td>2</td>
<td>Detects a redundant path to an existing device.</td>
</tr>
<tr>
<td>HPDSM_MAX_PATH_REACHED</td>
<td>3</td>
<td>Determines that a device configuration contains the maximum number of supported paths.</td>
</tr>
<tr>
<td>HPDSM_DEVICE_REMOVAL</td>
<td>4</td>
<td>Detects that a device was removed.</td>
</tr>
<tr>
<td>HPDSM_PATH_FAILOVER</td>
<td>5</td>
<td>Detects an existing path to a device has failed and an alternate path is being used.</td>
</tr>
<tr>
<td>HPDSM_MAX_LUNS_REACHED</td>
<td>6</td>
<td>Determines that the configuration contains the maximum number of supported LUNs.</td>
</tr>
<tr>
<td>HPDSM_ALL_NOTIFICATIONS</td>
<td>7</td>
<td>Detects any event related to MPIO framework and DSM Manager occurs.</td>
</tr>
</tbody>
</table>

The above notifications are sent by the HP MPIO EVA DSM and MPIO framework to the CLI. The CLI displays the event in the command window as shown in the following example.
Example:

**HPDSM NOTIFY EVENT=7 TIME=5**

Received HPDSM_PATH_FAILOVER : 600508B400101F6A000070001D950000;(4.0.0.1);from hpeaadsm
Received HPDSM_PATH_FAILOVER : 600508B400101F6A000070001D9B0000;(4.0.0.2);from hpeaadsm
Received HPDSM_PATH_FAILOVER : 600508B400101F6A000070001DA10000;(4.0.0.3);from hpeaadsm
Received HPDSM_PATH_FAILOVER : 600508B400101F6A000070001D9B0000;(4.0.0.4);from hpeaadsm
Received HPDSM_PATH_FAILOVER : 600508B400101F6A000070001D9B0000;(4.0.0.5);from hpeaadsm
Received HPDSM_PATH_FAILOVER : 600508B400101F6A000070001D9B0000;(4.0.0.6);from hpeaadsm
Received HPDSM_PATH_FAILOVER : 600508B400101F6A000070001E160000;(4.0.0.7);from hpeaadsm
Received HPDSM_PATH_FAILOVER : 600508B400101F6A000070001E1C0000;(4.0.0.8);from hpeaadsm
Received HPDSM_DEVICE_REMOVAL : 600508B400101F6A000070001D950000;(2.0.6.1);from hpeaadsm
Received HPDSM_DEVICE_REMOVAL : 600508B400101F6A000070001D9B0000;(2.0.6.2);from hpeaadsm
Received HPDSM_DEVICE_REMOVAL : 600508B400101F6A000070001DA10000;(2.0.6.3);from hpeaadsm
Received HPDSM_DEVICE_REMOVAL : 600508B400101F6A000070001E160000;(2.0.6.4);from hpeaadsm
Received HPDSM_DEVICE_REMOVAL : 600508B400101F6A000070001E1C0000;(2.0.6.5);from hpeaadsm
Received HPDSM_DEVICE_REMOVAL : 600508B400101F6A000070001E220000;(2.0.6.6);from hpeaadsm
Received HPDSM_DEVICE_REMOVAL : 600508B400101F6A000070001E280000;(2.0.6.7);from hpeaadsm
Received HPDSM_DEVICE_REMOVAL : 600508B400101F6A000070001E2E0000;(2.0.6.8);from hpeaadsm
Received HPDSM_NEW_DEVICE : 600508B400101F6A000070001D950000;(3.0.0.1);from hpeaadsm
Received HPDSM_NEW_DEVICE : 600508B400101F6A000070001D9B0000;(3.0.0.2);from hpeaadsm
Received HPDSM_NEW_DEVICE : 600508B400101F6A000070001DA10000;(3.0.0.3);from hpeaadsm
Received HPDSM_NEW_DEVICE : 600508B400101F6A000070001E160000;(3.0.0.4);from hpeaadsm
Received HPDSM_NEW_DEVICE : 600508B400101F6A000070001E1C0000;(3.0.0.5);from hpeaadsm
Received HPDSM_NEW_DEVICE : 600508B400101F6A000070001E220000;(3.0.0.6);from hpeaadsm
Received HPDSM_NEW_DEVICE : 600508B400101F6A000070001E280000;(3.0.0.7);from hpeaadsm
Received HPDSM_NEW_DEVICE : 600508B400101F6A000070001E2E0000;(3.0.0.8);from hpeaadsm
Received HPDSM_ADDITIONAL_PATH : 600508B400101F6A000070001D950000;(3.0.1.1);from hpeaadsm
Received HPDSM_ADDITIONAL_PATH : 600508B400101F6A000070001D9B0000;(3.0.1.2);from hpeaadsm
Received HPDSM_ADDITIONAL_PATH : 600508B400101F6A000070001DA10000;(3.0.1.3);from hpeaadsm
Received HPDSM_ADDITIONAL_PATH : 600508B400101F6A000070001E160000;(3.0.1.4);from hpeaadsm
Received HPDSM_ADDITIONAL_PATH : 600508B400101F6A000070001E1C0000;(3.0.1.5);from hpeaadsm
Received HPDSM_ADDITIONAL_PATH : 600508B400101F6A000070001E220000;(3.0.1.6);from hpeaadsm
Received HPDSM_ADDITIONAL_PATH : 600508B400101F6A000070001E280000;(3.0.1.7);from hpeaadsm
Received HPDSM_ADDITIONAL_PATH : 600508B400101F6A000070001E2E0000;(3.0.1.8);from hpeaadsm
Received Moved to STATE_NORMAL from MPIO Disk(17)
Received Moved to STATE_NORMAL from MPIO Disk(18)
Received Moved to STATE_NORMAL from MPIO Disk(19)

**hpdsm help**

**Syntax:**  
**hpdsm help**

The `hpdsm help` command displays help information for the CLI.
This appendix describes the following components of HP MPIO EVA DSM:

- **Drivers**
- **User mode components**

**Drivers**
Multipathing drivers are a critical element of the operating system. The HP MPIO EVA DSM components include the following multipath drivers:

- Microsoft MPIO Framework Drivers
  - MPIO.SYS is the multipathing bus driver.
  - MPDEV.SYS is the replacement class driver. It communicates with MPIO.SYS.
  - MPSPFLTR.SYS is a port driver filter (HBA upper filter).
- HP DSM driver
  - HPEAADSM.SYS is the HP DSM driver for EVA disk arrays. It interacts with MPIO.SYS to provide device-specific functions.

HP recommends that you do not remove, delete, or disable these drivers while multipath hardware is attached to your system.

**User mode components**
The user mode components includes:

- HP MPIO DSM manager GUI
- HP MPIO EVA DSM command line interface
- HP MPIO EVA DSM performance monitoring provider
- HP MPIO EVA DSM persistent reservations clear utility

**HP MPIO DSM manager GUI**
The HP MPIO DSM manager GUI monitors and manages the HP DSMs. It also enables administrator to receive email notifications on path/device failure events. The HP MPIO DSM Manager is provided as a separate installation package.

**HP MPIO EVA DSM command line interface (CLI)**
The HP MPIO EVA DSM command line interface (HPDSM.EXE) enables you to monitor and manage HP DSMs in an MPIO environment.

**HP MPIO EVA DSM performance monitoring provider**
The HP MPIO EVA DSM performance monitoring provider (HpPerfProv.DLL) helps you monitor the Input/Output (I/O) performance of a device path using the system monitor.

To start the performance monitoring, complete the steps below:

1. Select **Start > Programs > Hewlett-Packard > EVA DSM > Path Performance**.
   Alternatively, you can select **Start > Run** and execute the command `perfmon/wmi`. 
2. Select **HP DSM High Performance Provider** performance object and add the appropriate counters.

**HP MPIO EVA DSM persistent reservations clear utility**

The HP MPIO EVA DSM persistent reservations clear utility enables you to view and clear reservations on the disk(s) that are left behind due to incorrect installation or removal of the HP MPIO EVA DSM or an unsuccessful cluster node failover.

⚠ **CAUTION:**

Using this utility incorrectly may result in loss of data and/or incorrect operation of MSCS. HP shall not be liable for problems resulting from the incorrect use of this utility or for solving them.

The persistent reservations clear utility is located on the HP MPIO EVA DSM installation media, and gets copied to the HP MPIO EVA DSM installation directory during the installation. You can run this utility either on a system that has HP MPIO EVA DSM installed or on a system where HP MPIO EVA DSM is not installed.

To run this utility on a system where the HP MPIO EVA DSM is installed, complete the steps below:

1. Select **Start > Programs > Hewlett-Packard > EVA DSM > HPDSM PR Utility**.

2. Enter the command `hpprutil /?` at the command prompt to display the instructions for using this utility.
B Multipathing driver event log messages

This appendix lists the event log messages for HP MPIO EVA DSM drivers and provides a description of each message. The error log messages are written in the SYSTEM log file.

This appendix provides information about the following event log messages:
- MPIO.SYS event log messages
- HP MPIO EVA DSM event log messages

MPIO.SYS event log messages

Table 4 lists MPIO driver event log messages, an explanation of each message, and a description of the data that accompanies the message.

<table>
<thead>
<tr>
<th>Event ID</th>
<th>Message</th>
<th>Description</th>
<th>Contents of the data dump</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pseudo-LUN created.</td>
<td>MPIO created a new pseudo-LUN (a new disk physical device object).</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>Added device to pseudo-LUN.</td>
<td>A new instance of an existing pseudo-LUN device object is seen through a different path.</td>
<td>The current number of paths to the device</td>
</tr>
<tr>
<td>3</td>
<td>There was an error creating a device claimed by the DSM.</td>
<td>MPIO failed to create a new (or update an existing) pseudo-LUN device object, even though DSM_name claimed support for it.</td>
<td>N/A</td>
</tr>
<tr>
<td>16</td>
<td>A fail-over on pseudo-LUN occurred.</td>
<td>A pseudo-LUN handled a failover. This message does not indicate whether the failover was successful.</td>
<td>The Path ID of the failed device</td>
</tr>
<tr>
<td>17</td>
<td>Pseudo-LUN is currently in a degraded state. One or more paths have failed, though the process is now complete.</td>
<td>At least one path to a pseudo-LUN has failed. This signals the end of failover handling for the pseudo-LUN and that the device is now operating with at least one less path.</td>
<td>N/A</td>
</tr>
<tr>
<td>18</td>
<td>A Single Path Fail-Over is being attempted on pseudo-LUN</td>
<td>A pseudo-LUN has just one path, and DSM has requested a failover.</td>
<td>The Path ID of the failing device</td>
</tr>
<tr>
<td>19</td>
<td>An operation failed on device due to lack of memory.</td>
<td>Resource allocation failed during an attempted failover, and failover is not currently active.</td>
<td>The Path ID of the failing device</td>
</tr>
<tr>
<td>Event ID</td>
<td>Message</td>
<td>Description</td>
<td>Contents of the data dump</td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
<td>-------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>20</td>
<td>A Path Verification request to a device on pseudo-LUN that is controlled by DSM_name has failed. This may indicate a path failure.</td>
<td>A call to a DSM’s PathVerify routine to a pseudo-LUN has failed. This event occurs during final initialization after PathVerify has checked whether the device can be reached through a newly found path.</td>
<td>N/A</td>
</tr>
<tr>
<td>21</td>
<td>The internal state of device_object is inconsistent. This indicates potential failures in this support.</td>
<td>MPIO is unable to run through its maintained list of pseudo-LUNs.</td>
<td>N/A</td>
</tr>
<tr>
<td>22</td>
<td>A fail-over on pseudo-LUN was attempted, however the attempt failed. The devices will be removed.</td>
<td>A failover attempt on a pseudo-LUN has failed. This indicates that the DSM did not return a valid path after the call to InvalidatePath.</td>
<td>N/A</td>
</tr>
<tr>
<td>23</td>
<td>All paths have failed. Pseudo-LUN will be removed.</td>
<td>There are no available paths to the pseudo-LUN. The device has gone into total failure and will be removed.</td>
<td>N/A</td>
</tr>
<tr>
<td>24</td>
<td>A PnP Operation rejected, as device is not in a state where the request can be honored.</td>
<td>A PnP request for QueryRemove was rejected because the device is in the paging, hiber, or crash dump path state.</td>
<td>N/A</td>
</tr>
<tr>
<td>25</td>
<td>Requests that were queued to pseudo-LUN have failed during resubmission.</td>
<td>An issued request from the pseudo-LUN’s queue failed. This always occurs when the device is in the process of being removed.</td>
<td>Path ID used for resubmission</td>
</tr>
<tr>
<td>32</td>
<td>DSM_name failed to return a Path to pseudo-LUN.</td>
<td>One of the following events occurred during failover: MPIO’s call to the DSMs InvalidatePath failed; DSM did not return a new path; DSM did not return a path when MPIO called the LBGetPath routine.</td>
<td>N/A</td>
</tr>
<tr>
<td>33</td>
<td>DSM_name returned a bogus path to device.</td>
<td>MPIO is unable to find an operational device-path pair representation (device info) for the path that the DSM wants to use for the I/O to the device</td>
<td>Bogus Path ID returned by DSM; if the Path ID = NULL, the DSM has failed to return a path.</td>
</tr>
<tr>
<td>35</td>
<td>DSM_name supplied an invalid ID for an operation on notification_type.</td>
<td>MPIO received a DSMNotification call, but is unable to map the DSMID to a device.</td>
<td>DSM ID</td>
</tr>
<tr>
<td>Event ID</td>
<td>Message</td>
<td>Description</td>
<td>Contents of the data dump</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>36</td>
<td>An unknown DSM supplied an invalid ID for an operation on pseudo-LUN.</td>
<td>DSM called DSMSendRequest to have MPIO send a request on its behalf, but MPIO is unable to find the pseudo-LUN requested.</td>
<td>DSM ID</td>
</tr>
<tr>
<td>37</td>
<td>DSM_name is attempting an operation on pseudo-LUN. The Type is noted in the dump data.</td>
<td>DSM_name has called DSMNotification on a pseudo-LUN.</td>
<td>The type of notification called by DSM</td>
</tr>
<tr>
<td>38</td>
<td>A device under pseudo-LUN, being controlled by DSM_name was removed, but the DSM failed the operation.</td>
<td>An MPIO call to DSM’s RemoveDevice operation failed.</td>
<td>DSM ID of the failed attempt</td>
</tr>
</tbody>
</table>
Table 5 lists the HP MPIO EVA DSM event log messages and provides a description of each message.

### Table 5 HP MPIO EVA DSM event log messages

<table>
<thead>
<tr>
<th>Event ID</th>
<th>Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Discovered a new multipath capable disk with serial number X; first path SCSI address Y.</td>
<td>A new multipath disk has been discovered. X represents the serial number of the new disk. Y is the SCSI address of the first path to this disk.</td>
</tr>
<tr>
<td>102</td>
<td>A new path (SCSI address Y) was added to existing multipath capable disk X.</td>
<td>A new path to an existing multipath disk has been discovered. X represents the serial number of the disk. Y is the SCSI address of the new path that was found.</td>
</tr>
<tr>
<td>103</td>
<td>The path (SCSI address Y) to multipath capable disk X has recovered.</td>
<td>A failed path to an existing multipath disk has recovered. X represents the serial number of the disk. Y is the SCSI address of the path that has been recovered.</td>
</tr>
<tr>
<td>107</td>
<td>The preferred path (SCSI address Y) for multipath capable disk X has been restored.</td>
<td>A previously selected path has been restored as the preferred path for I/O operation. X represents the serial number of the disk. Y is the SCSI address of the preferred path that has been restored.</td>
</tr>
<tr>
<td>108</td>
<td>The DSM has completed remove processing for path (SCSI address Y) to multipath capable disk X.</td>
<td>The DSM has completed processing the removal notification for a path to a given multipath disk. X represents the serial number of the disk. Y is the SCSI address of the path for which the removal notification has been processed.</td>
</tr>
<tr>
<td>109</td>
<td>The DSM (version X) has been started successfully.</td>
<td>The DSM has successfully completed the initialization during startup. X is the version of the DSM.</td>
</tr>
<tr>
<td>301</td>
<td>The DSM failed to initialize during startup.</td>
<td>The DSM did not initialize successfully during startup.</td>
</tr>
<tr>
<td>302</td>
<td>An unrecoverable path failure occurred on SCSI address Y. Disk X failed due to no redundant paths available.</td>
<td>All paths to an existing multipath disk have failed. X represents the serial number of the disk. Y is the SCSI address of the last path that failed.</td>
</tr>
<tr>
<td>303</td>
<td>Too many paths for disk with serial number X. Path (SCSI address Y) not added.</td>
<td>A new path in excess of the supported number of paths for an existing multipath disk has been discovered. X represents the serial number of the disk. Y is the SCSI address of the newly found path.</td>
</tr>
<tr>
<td>304</td>
<td>An unrecoverable path failure occurred on SCSI address Y. Disk X is still accessible over redundant path(s).</td>
<td>A redundant path to an existing multipath disk has failed. X represents the serial number of the disk. Y is the SCSI address of the path that failed.</td>
</tr>
<tr>
<td>305</td>
<td>The DSM timed out on the I/O throttle operation for multipath capable disk X.</td>
<td>The DSM was unable to successfully throttle I/O activity within the time-out period, for the specified multipath disk. X is the serial number of the disk.</td>
</tr>
</tbody>
</table>
This glossary defines the terms used in this guide or related to this product. It is not a comprehensive glossary of computer terms.

**ALB**
Adaptive Load Balance (ALB) is a feature provided by the EVA DSM that utilizes certain features supported by the array, to deliver better performance for host I/O requests.

**controller**
A hardware device that facilitates communication between a host and one or more LUNs organized as an array.

**DSM**
Device Specific Module

**fabric**
A network that contains high-speed fiber connections resulting from the interconnection of switches and devices. A fabric is an active and intelligent non-shared interconnect scheme for nodes.

**failover**
The automatic substitution of a functionally equivalent system component for a component that has failed.

**HBA**
Host Bus Adapter. An I/O device that serves as the interface connecting a host system to the SCSI bus or SAN (Storage Area Network)

**host**
The computer system on which the Multipath software is running.

**LUN**
Logical Unit Number. The actual unit number assigned to a device by the RAID system controller.

**mode**
A user-selectable parameter that specifies path behavior during normal and failure conditions. Paths can be set to one of the following modes:
- **Preferred** — Indicates the path you choose for the desired I/O paths. When a path is in preferred mode, load balance is not enabled and the Load Balance Type displays as **none**.
- **Alternate** — Indicates a path that is used for device access and I/O activities when the preferred path fails.

**MPIO**
Multipathing Input/Output.

**path**
A virtual communication route that enables data and commands to pass between a host server and a storage device.

**path state**
An attribute that describes the operational condition of a path. A path can exist in one of the following states:
- **Active** — Path is currently used for the I/O stream or is available for load balancing.
- **Available** — Path is currently available, but not used for device access. The path is only in this state when no load balancing policy has been selected for the LUN.
- **Standby** — Intermediate state of the path before it is initialized (made ready for device access), normally will not be seen.
- **Failed** — Path is currently unusable for the I/O stream.
**port A**  
The relative number of an HBA. A specific port number is determined according to its order of discovery by the Windows operating system. HBA's include SCSI, Fibre Channel, and IDE adapter types.

**SAN**  
Storage Area Network. A configuration of networked devices for storage.

**state**  
An attribute that describes the current operational condition of an object. The possible states include:
- **Good**: The multipathing device can be accessed on at least one path.
- **Degraded**: One or more paths are failed to the storage unit.

**target**  
The definition of target depends on the environment:
- For parallel SCSI configurations, the target is the actual target number assigned to a device.
- For Fibre Channel configurations, a target number is assigned by a mapping function at the miniport-driver level and is derived from AL_PA (Arbitrated Loop Physical Addresses) in an FC-AL topology.
- For SAN switched fabric, a target is assigned to a WWPN. This target can have values between 16 and 125.
- For a fabric topology, target is a mapping function derived from the order of discovery according to port connections at the SAN (Storage Area Network) switch.

**topology**  
An interconnection scheme that allows multiple servers and storage devices to communicate. Arbitrated loop and switched fabric are examples of Fibre Channel topologies.
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