Veritas™ Dynamic Multi-Pathing Administrator's Guide

VMware ESX

6.0.1

August 2012
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Chapter 1  Understanding DMP ................................. 11
  About Veritas Dynamic Multi-Pathing ......................... 11
  How DMP works ....................................................... 12
    How DMP monitors I/O on paths ............................... 15
    Load balancing ...................................................... 16
  Multiple paths to disk arrays ..................................... 17
  Device discovery ..................................................... 17
    About DMP extended device attributes .................... 17
  Disk device naming in DMP ....................................... 18
    About operating system-based naming ..................... 19
    About enclosure-based naming ................................ 19

Chapter 2  About administering DMP .......................... 25
  Methods to administer DMP ......................................... 25
  About roles and privileges for administering DMP .......... 25
  About enabling and disabling I/O for controllers and storage
  processors ............................................................. 26
  About displaying DMP database information ................ 27
  About the DMP attributes of the paths to an enclosure ... 27
  About DMP attributes ............................................. 28
    About DMP I/O policies .......................................... 29
    About DMP recovery options .................................. 31
    About the minimum redundancy level of DMP paths ..... 32
    About the use_all_paths attribute .......................... 33

Chapter 3  Administering DMP using the command line ....... 35
  About the authentication model for the vxdmpadm command in the
  VMware environment .............................................. 36
  Retrieving information about a DMP node .................... 37
  Displaying consolidated information about the DMP nodes ... 38
  Displaying the paths to a disk ................................. 39
Displaying paths controlled by a DMP node, controller, enclosure, or array port ................................................................. 40
Displaying information about controllers ......................................................... 42
Displaying information about enclosures ......................................................... 43
Displaying information about array ports .......................................................... 44
Displaying extended device attributes ............................................................... 44
Gathering and displaying I/O statistics ............................................................... 45
Examples of using the vxdmpadm iostat command ........................................... 46
Displaying cumulative I/O statistics ................................................................. 47
Setting the attributes of the paths to an enclosure ........................................... 50
Displaying the redundancy level of a device or enclosure ................................ 50
Specifying the minimum number of active paths ............................................. 51
Displaying the I/O policy ............................................................................... 52
Specifying the DMP I/O policy with the command line ..................................... 52
Scheduling I/O on the paths of an Asymmetric Active/Active array or an ALUA array ................................................................ 53
Example of applying load balancing in a SAN .................................................. 54
Disabling I/O for paths, controllers, array ports, or DMP nodes .................... 56
Enabling I/O for paths, controllers, array ports, or DMP nodes ...................... 57
Configuring the response to I/O failures ......................................................... 58
Configuring the I/O throttling mechanism ....................................................... 60
Displaying recovery option values .................................................................... 61
Configuring DMP path restoration policies ..................................................... 61
Stopping the DMP path restoration thread ....................................................... 63
Displaying the status of the DMP path restoration thread ............................... 63
Viewing array policy modules ......................................................................... 64

Chapter 4 Administering DMP using vSphere Client .......................................... 65
Getting started with the Veritas Dynamic Multi-Pathing solution in vSphere Client ........................................................................ 65
Working with the Veritas Dynamic Multi-Pathing for VMware home view ................................................................................. 67
About the Veritas Dynamic Multi-Pathing for VMware home view .................. 67
Downloading the DMP offline bundle for ESX/ESXi ......................................... 68
Downloading the administration CLI package for a remote host ...................... 70
Viewing the DMP and license compliance for hosts ........................................ 72
Viewing the license details ............................................................................... 72
Applying new license to a single host or multiple hosts ................................... 72
Working with the host view in the VxDMP tab ............................................... 73
About the host view in the VxDMP tab ............................................................. 73
### Chapter 5  Administering device discovery ....................................... 95
- About device discovery management .............................................. 95
- About the authentication model for the vxddladm command in the VMware environment ............................................................. 96
- How DMP claims devices ............................................................... 97
- Disk categories ............................................................................ 97
- Discovering and configuring newly added disk devices ................. 97
  - Adding support for a new array ................................................. 97
  - Removing support for an array ................................................ 98
  - DMP libraries for array support .............................................. 100
- Adding support for a new disk array ............................................ 104
- Listing all supported disk arrays ................................................... 104
- Displaying details about a supported array library .................... 104
- Displaying the disk-naming scheme ........................................... 105

### Chapter 6  Performance monitoring and tuning ............................. 107
- About tuning Veritas Dynamic Multi-Pathing (DMP) with templates ................................................................. 107
- DMP tuning templates ............................................................... 108
- Example DMP tuning template .................................................. 110
- Tuning a DMP host with a configuration attribute template ........ 115
- Managing the DMP configuration files .................................... 117
- Resetting the DMP tunable parameters and attributes to the default values ................................................................. 117
- DMP tunable parameters and attributes that are supported for templates ................................................................. 117
- DMP tunable parameters .......................................................... 118

### Appendix A  DMP troubleshooting ................................................ 125
- Troubleshooting tips ............................................................... 125
- Collecting logs for Symantec Support ..................................... 126
Understanding DMP

This chapter includes the following topics:

- **About Veritas Dynamic Multi-Pathing**
- **How DMP works**
- **Multiple paths to disk arrays**
- **Device discovery**
- **Disk device naming in DMP**

**About Veritas Dynamic Multi-Pathing**

Symantec's Veritas Dynamic Multi-Pathing for VMware (VxDMP) is a multi-pathing solution integrated with VMware’s vSphere infrastructure. This brings the established and proven enterprise-class functionality to VMware virtual environments.

Veritas Dynamic Multi-Pathing (DMP) provides multi-pathing functionality for the operating system native devices configured on the system. DMP creates DMP metadevices (also known as DMP nodes) to represent all the device paths to the same physical LUN.

DMP provides the best in class availability, reliability, and performance by using advanced path failover and load balancing for a wide range of storage arrays. DMP also helps you to gain better visibility of your storage, and to manage it better.

DMP solution consists of the following components:

- **DMP bundles installed on the ESX/ESXi servers.**
  
  The ESX/ESXi bundle contains the binaries for DMP that need to be installed on each individual ESX/ESXi server.
You can obtain the ESX/ESXi bundle from the Veritas installation media, or download it using vSphere Client.

Administrative components:

- DMP Console installed on a Windows-based host (physical or virtual). The DMP Console plugs into VMware vSphere Client as vCenter Plugin, and enables you to manage DMP in the vSphere environment. Once the DMP Console is installed, Veritas Dynamic Multi-Pathing is available in vSphere Client, under the vCenter Home view, and as a VxMP tab. The VxDMP tab offers the host view for a selected ESX/ESXi host, or the datacenter view for a selected datacenter. Use the Veritas installation media to install the DMP Console on a Windows-based host, having the supported Windows version.

- Administration CLI installed on a Windows-based or Linux-based remote host.
  
  The conventional `vxdladm` and `vxddlaadm` commands enable you to administer DMP on any ESX/ESXi from a remote host, using a shell that allows scripting.

  You can obtain the CLI package from the Veritas installation media, or download the CLI package using vSphere Client.

How DMP works

Veritas Dynamic Multi-Pathing (DMP) provides greater availability, reliability, and performance by using path failover and load balancing. This feature is available for multiported disk arrays from various vendors.

Disk arrays can be connected to host systems through multiple paths. To detect the various paths to a disk, DMP uses a mechanism that is specific to each supported array. DMP can also differentiate between different enclosures of a supported array that are connected to the same host system.

The multi-pathing policy that is used by DMP depends on the characteristics of the disk array.

DMP supports the following standard array types:

**Active/Active (A/A)**

Allows several paths to be used concurrently for I/O. Such arrays allow DMP to provide greater I/O throughput by balancing the I/O load uniformly across the multiple paths to the LUNs. In the event that one path fails, DMP automatically routes I/O over the other available paths.
| Asymmetric Active/Active (A/A-A) | A/A-A or Asymmetric Active/Active arrays can be accessed through secondary storage paths with little performance degradation. The behavior is similar to ALUA, except that it does not support those SCSI commands which an ALUA array supports. |
| Asymmetric Logical Unit Access (ALUA) | DMP supports all variants of ALUA. |
| Active/Passive (A/P) | Allows access to its LUNs (logical units; real disks or virtual disks created using hardware) via the primary (active) path on a single controller (also known as an access port or a storage processor) during normal operation.  
In implicit failover mode (or autotrespass mode), an A/P array automatically fails over by scheduling I/O to the secondary (passive) path on a separate controller if the primary path fails. This passive port is not used for I/O until the active port fails. In A/P arrays, path failover can occur for a single LUN if I/O fails on the primary path.  
This policy supports concurrent I/O and load balancing by having multiple primary paths into a controller. This functionality is provided by a controller with multiple ports, or by the insertion of a SAN switch between an array and a controller. Failover to the secondary (passive) path occurs only if all the active primary paths fail. |
| Active/Passive in explicit failover mode or non-autotrespass mode (A/P-F) | The appropriate command must be issued to the array to make the LUNs fail over to the secondary path.  
This policy supports concurrent I/O and load balancing by having multiple primary paths into a controller. This functionality is provided by a controller with multiple ports, or by the insertion of a SAN switch between an array and a controller. Failover to the secondary (passive) path occurs only if all the active primary paths fail. |
For Active/Passive arrays with LUN group failover (A/P-G arrays), a group of LUNs that are connected through a controller is treated as a single failover entity. Unlike A/P arrays, failover occurs at the controller level, and not for individual LUNs. The primary controller and the secondary controller are each connected to a separate group of LUNs. If a single LUN in the primary controller’s LUN group fails, all LUNs in that group fail over to the secondary controller. This policy supports concurrent I/O and load balancing by having multiple primary paths into a controller. This functionality is provided by a controller with multiple ports, or by the insertion of a SAN switch between an array and a controller. Failover to the secondary (passive) path occurs only if all the active primary paths fail.

An array policy module (APM) may define array types to DMP in addition to the standard types for the arrays that it supports.

Veritas Dynamic Multi-Pathing uses DMP metanodes (DMP nodes) to access disk devices connected to the system. For each disk in a supported array, DMP maps one node to the set of paths that are connected to the disk. Additionally, DMP associates the appropriate multi-pathing policy for the disk array with the node. Figure 1-1 shows how DMP sets up a node for a disk in a supported disk array.

Figure 1-1  How DMP represents multiple physical paths to a disk as one node

DMP implements a disk device naming scheme that allows you to recognize to which array a disk belongs.
Figure 1-2 shows an example where two paths, `vmhba1:C0:T0:L0` and `vmhba2:C0:T0:L0`, exist to a single disk in the enclosure, but VxVM uses the single DMP node, `enc0_0`, to access it.

How DMP monitors I/O on paths

DMP maintains a pool of kernel threads that are used to perform such tasks as error processing, path restoration, statistics collection, and SCSI request callbacks. The `vxdmpadm gettune` command can be used to provide information about the threads.

One kernel thread responds to I/O failures on a path by initiating a probe of the host bus adapter (HBA) that corresponds to the path. Another thread then takes the appropriate action according to the response from the HBA. The action taken can be to retry the I/O request on the path, or to fail the path and reschedule the I/O on an alternate path.

The restore kernel task is woken periodically (typically every 5 minutes) to check the health of the paths, and to resume I/O on paths that have been restored. As some paths may suffer from intermittent failure, I/O is only resumed on a path if the path has remained healthy for a given period of time (by default, 5 minutes). DMP can be configured with different policies for checking the paths.

See “Configuring DMP path restoration policies” on page 61.
The statistics-gathering task records the start and end time of each I/O request, and the number of I/O failures and retries on each path. DMP can be configured to use this information to prevent the SCSI driver being flooded by I/O requests. This feature is known as I/O throttling.

See “Path failover mechanism” on page 16.

See “I/O throttling” on page 16.

Path failover mechanism

DMP enhances system availability when used with disk arrays having multiple paths. In the event of the loss of a path to a disk array, DMP automatically selects the next available path for I/O requests without intervention from the administrator.

DMP is also informed when a connection is repaired or restored, and when you add or remove devices after the system has been fully booted (provided that the operating system recognizes the devices correctly).

If required, the response of DMP to I/O failure on a path can be tuned for the paths to individual arrays. DMP can be configured to time out an I/O request either after a given period of time has elapsed without the request succeeding, or after a given number of retries on a path have failed.

See “Configuring the response to I/O failures” on page 58.

I/O throttling

If I/O throttling is enabled, and the number of outstanding I/O requests builds up on a path that has become less responsive, DMP can be configured to prevent new I/O requests being sent on the path either when the number of outstanding I/O requests has reached a given value, or a given time has elapsed since the last successful I/O request on the path. While throttling is applied to a path, the new I/O requests on that path are scheduled on other available paths. The throttling is removed from the path if the HBA reports no error on the path, or if an outstanding I/O request on the path succeeds.

See “Configuring the I/O throttling mechanism” on page 60.

Load balancing

By default, Veritas Dynamic Multi-Pathing (DMP) uses the Minimum Queue I/O policy for load balancing across paths for Active/Active (A/A), Active/Passive (A/P), Active/Passive with explicit failover (A/P-F) and Active/Passive with group failover (A/P-G) disk arrays. Load balancing maximizes I/O throughput by using
the total bandwidth of all available paths. I/O is sent down the path which has the minimum outstanding I/Os.

For A/P disk arrays, I/O is sent down the primary paths. If all of the primary paths fail, I/O is switched over to the available secondary paths. As the continuous transfer of ownership of LUNs from one controller to another results in severe I/O slowdown, load balancing across primary and secondary paths is not performed for A/P disk arrays unless they support concurrent I/O.

For A/P, A/P-F and A/P-G arrays, load balancing is performed across all the currently active paths as is done for A/A arrays.

You can change the I/O policy for the paths to an enclosure or disk array.

See “Specifying the DMP I/O policy with the command line” on page 52.

See “Setting the attributes of a storage entity” on page 79.

## Multiple paths to disk arrays

Some disk arrays provide multiple ports to access their disk devices. These ports, coupled with the host bus adaptor (HBA) controller and any data bus or I/O processor local to the array, make up multiple hardware paths to access the disk devices. Such disk arrays are called multipathed disk arrays. This type of disk array can be connected to host systems in many different configurations, (such as multiple ports connected to different controllers on a single host, chaining of the ports through a single controller on a host, or ports connected to different hosts simultaneously).

See “How DMP works” on page 12.

## Device discovery

Device discovery is the term used to describe the process of discovering the disks that are attached to a host. This feature is important for DMP because it needs to support a growing number of disk arrays from a number of vendors. In conjunction with the ability to discover the devices attached to a host, the Device Discovery service enables you to add support for new disk arrays. The Device Discovery uses a facility called the Device Discovery Layer (DDL).

## About DMP extended device attributes

Device Discovery Layer (DDL) extended attributes are attributes or flags corresponding to a DMP LUN or Disk and which are discovered by DDL. These attributes identify a LUN to a specific hardware category.
The list of categories includes:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware RAID types</td>
<td>Displays what kind of Storage RAID Group the LUN belongs to</td>
</tr>
<tr>
<td>Thin Provisioning Discovery and Reclamation</td>
<td>Displays the LUN’s thin reclamation abilities</td>
</tr>
<tr>
<td>Device Media Type</td>
<td>Displays the type of media – whether SSD (solid state disk)</td>
</tr>
<tr>
<td>Storage-based Snapshot/Clone</td>
<td>Displays whether the LUN is a SNAPSHOT or a CLONE of a PRIMARY LUN</td>
</tr>
<tr>
<td>Storage-based replication</td>
<td>Displays if the LUN is part of a replicated group across a remote site</td>
</tr>
<tr>
<td>Transport</td>
<td>Displays what kind of HBA is used to connect to this LUN (FC, SATA, iSCSI)</td>
</tr>
</tbody>
</table>

Each LUN can have one or more of these extended attributes. DDL discovers the extended attributes during device discovery from the array support library (ASL).

For a list of ASLs that supports Extended Attributes, and descriptions of these attributes, refer to the hardware compatibility list (HCL) at the following URL:

http://www.symantec.com/docs/TECH170013

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**Disk device naming in DMP**

Device names for disks are assigned according to the naming scheme which you specify to DMP. The format of the device name may vary for different categories of disks.

See “Disk categories” on page 97.

Device names can use one of the following naming schemes:

- operating system-based naming.
  
  See “About operating system-based naming” on page 19.

- enclosure-based naming.
  
  See “About enclosure-based naming” on page 19.

Devices with device names longer than 31 characters always use enclosure-based names.

On ESX, the devices seen on the host are visible in the /vmfs/devices/disks/ directory or in the Configuration tab in the vSphere GUI. DMP devices appear in
these locations with the enclosure-based name. Currently, only enclosure-based naming is supported for ESX.

**About operating system-based naming**

VMware device names use the format naa.<> or eui.<>, depending on the SCSI VPD ID available for the devices. DMP uses the same name to name its meta-devices when the operating-system naming scheme is selected.

By default, OS-based names are not persistent, and are regenerated if the system configuration changes the device name as recognized by the operating system. If you do not want the OS-based names to change after reboot, set the persistence attribute for the naming scheme.

**About enclosure-based naming**

Enclosure-based naming provides an alternative to operating system-based device naming. In a Storage Area Network (SAN) that uses Fibre Channel switches, information about disk location provided by the operating system may not correctly indicate the physical location of the disks. Enclosure-based naming allows DMP to access enclosures as separate physical entities. By configuring redundant copies of your data on separate enclosures, you can safeguard against failure of one or more enclosures.

*Figure 1-3* shows a typical SAN environment where host controllers are connected to multiple enclosures through a Fibre Channel switch.
In such a configuration, enclosure-based naming can be used to refer to each disk within an enclosure. For example, the device names for the disks in enclosure enc0 are named enc0_0, enc0_1, and so on. The main benefit of this scheme is that it allows you to quickly determine where a disk is physically located in a large SAN configuration.

In most disk arrays, you can use hardware-based storage management to represent several physical disks as one LUN to the operating system. In such cases, VMware ESX also sees a single logical disk device rather than its component disks. For this reason, when reference is made to a disk within an enclosure, this disk may be either a physical disk or a LUN.

Another important benefit of enclosure-based naming is that it enables administrators to avoid accidentally placing redundant copies of data in the same enclosure. This is a good thing to avoid as each enclosure can be considered to be a separate fault domain. For example, if a mirrored volume were configured only on the disks in enclosure enc1, the failure of the cable between the switch and the enclosure would make the entire volume unavailable.

Figure 1-4 shows a High Availability (HA) configuration where redundant-loop access to storage is implemented by connecting independent controllers on the host to separate switches with independent paths to the enclosures.
Such a configuration protects against the failure of one of the host controllers (vmhba1 and vmhba2), or of the cable between the host and one of the switches. In this example, each disk is known by the same name for all of the paths over which it can be accessed. For example, the disk device enc0_0 represents a single disk for which two different paths are known to the operating system, such as vmhba1:C0:T0:L0 and vmhba2:C0:T0:L0.

See “Disk device naming in DMP” on page 18.

To take account of fault domains when configuring data redundancy, you can control how mirrored volumes are laid out across enclosures.

**Summary of enclosure-based naming**

By default, DMP uses enclosure-based naming.

Enclosure-based naming operates as follows:

- All fabric or non-fabric disks in supported disk arrays are named using the `enclosure_name_#` format. For example, disks in the supported disk array, enggdept are named enggdept_0, enggdept_1, enggdept_2 and so on.

You can use the `vxdmpadm` command to administer enclosure names.

See the `vxdmpadm(1M)` manual page.
By default, enclosure-based names are persistent, so they do not change after reboot.

See “Disk categories” on page 97.

**Enclosure based naming with the Array Volume Identifier (AVID) attribute**

By default, DMP assigns enclosure-based names to DMP meta-devices using an array-specific attribute called the Array Volume ID (AVID). The AVID provides a unique identifier for the LUN that is provided by the array. The ASL corresponding to the array provides the AVID property. Within an array enclosure, DMP uses the Array Volume Identifier (AVID) as an index in the DMP metanode name. The DMP metanode name is in the format `enclosureID_AVID`.

With the introduction of AVID to the EBN naming scheme, identifying storage devices becomes much easier. The array volume identifier (AVID) enables you to have consistent device naming across multiple nodes connected to the same storage. The disk access name never changes, because it is based on the name defined by the array itself.

If DMP does not have access to a device’s AVID, it retrieves another unique LUN identifier called the LUN serial number. DMP sorts the devices based on the LUN Serial Number (LSN), and then assigns the index number. All hosts see the same set of devices, so all hosts will have the same sorted list, leading to consistent device indices across the cluster. In this case, the DMP metanode name is in the format `enclosureID_index`.

The DMP utilities such as `vxdmpadm getdmpnode` display the DMP metanode name, which includes the AVID property. Use the AVID to correlate the DMP metanode name to the LUN displayed in the array management interface (GUI or CLI).

The following sample output shows the DMP metanode names:

```
# vxdmpadm host=atria-esx user=root passwd=root123 getdmpnode

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE</th>
<th>ENCLR-TYPE</th>
<th>PATHS ENBL DSBL</th>
<th>ENCLR-NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>hitachi_uspvm0_061a</td>
<td>ENABLED</td>
<td>Hitachi_USP-VM</td>
<td>1 0</td>
<td>hitachi_usp-vm0</td>
</tr>
<tr>
<td>hitachi_uspvm0_061b</td>
<td>ENABLED</td>
<td>Hitachi_USP-VM</td>
<td>1 0</td>
<td>hitachi_usp-vm0</td>
</tr>
<tr>
<td>hitachi_uspvm0_061c</td>
<td>ENABLED</td>
<td>Hitachi_USP-VM</td>
<td>1 0</td>
<td>hitachi_usp-vm0</td>
</tr>
<tr>
<td>hitachi_uspvm0_061d</td>
<td>ENABLED</td>
<td>Hitachi_USP-VM</td>
<td>1 0</td>
<td>hitachi_usp-vm0</td>
</tr>
<tr>
<td>hitachi_uspvm0_0619</td>
<td>ENABLED</td>
<td>Hitachi_USP-VM</td>
<td>1 0</td>
<td>hitachi_usp-vm0</td>
</tr>
</tbody>
</table>
```

```
# vxddladm get namingscheme

<table>
<thead>
<tr>
<th>NAMING_SCHEME</th>
<th>PERSISTENCE</th>
<th>LOWERCASE</th>
<th>USE_AVID</th>
</tr>
</thead>
</table>
```
| Enclosure Based | Yes | Yes | Yes | Yes |
Disk device naming in DMP
About administering DMP

This chapter includes the following topics:

- Methods to administer DMP
- About roles and privileges for administering DMP
- About enabling and disabling I/O for controllers and storage processors
- About displaying DMP database information
- About the DMP attributes of the paths to an enclosure
- About DMP attributes

Methods to administer DMP

You can administer DMP with one of the following methods:

- Using the command line.
- Using the graphical user interface.

About roles and privileges for administering DMP

To use Veritas Dynamic Multi-Pathing (VxDMP) for VMware, you must have the appropriate privileges.

When you are using a vSphere client, or using a remote Command Line Interface (CLI) with vCenter Server credentials, you must have a read-only privilege or an operation privilege assigned to your role, as follows:

- DMP Access privilege. To view the multi-pathing information at any level in the VxDMP configuration, you must have the 'CIM interaction' privilege. This privilege provides read-only access.
Note: If this privilege is not present for some hosts, the VxMP home view and the datacenter view do not display those hosts.

Note: You can provide your ESX login name and password to view the multi-pathing information at the host level during the session. You must enable the 'Allow session cookies' setting for the browser, for the credentials to be retained for the entire session. If the session expires, you must provide the credentials again.

- DMP Admin privilege. To perform DMP administrative operations, you must have the 'Storage partition configuration' privilege. This privilege provides permissions to perform administrative operations at the ESX host level. To perform operations at the home and datacenter levels, you must have this privilege on all the selected hosts.

To set the privileges for your role, you can use the Roles menu option from vSphere Client.

See the VMware vSphere Client documentation.

When you are using the remote Command Line Interface (CLI), you can also use direct ESX credentials to log in to a host.

About enabling and disabling I/O for controllers and storage processors

DMP lets you to turn off I/O through an HBA controller or the array port of a storage processor so that you can perform administrative operations. This feature can be used for maintenance of HBA controllers on the host, or array ports that are attached to disk arrays supported by DMP. I/O operations to the HBA controller or the array port can be turned back on after the maintenance task is completed. You can accomplish these operations using the vxdmpadm command.

For Active/Active type disk arrays, when you disable the I/O through an HBA controller or array port, the I/O continues on the remaining paths. For Active/Passive type disk arrays, if disabling I/O through an HBA controller or array port resulted in all primary paths being disabled, DMP will failover to secondary paths and I/O will continue on them.

DMP does not support the operations to enable I/O or disable I/O for the controllers that use Third-Party Drivers (TPD) for multi-pathing.
After the administrative operation is over, use the `vxdmpadm` command to re-enable the paths through the HBA controllers.

See “Disabling I/O for paths, controllers, array ports, or DMP nodes” on page 56. See “Enabling I/O for paths, controllers, array ports, or DMP nodes” on page 57.

You can also perform certain reconfiguration operations dynamically online.

### About displaying DMP database information

You can use the `vxdmpadm` command to list DMP database information and perform other administrative tasks. This command allows you to list all controllers that are connected to disks, and other related information that is stored in the DMP database. You can use this information to locate system hardware, and to help you decide which controllers need to be enabled or disabled.

The `vxdmpadm` command also provides useful information such as disk array serial numbers, which DMP devices (disks) are connected to the disk array, and which paths are connected to a particular controller, enclosure or array port.

### About the DMP attributes of the paths to an enclosure

The DMP attributes of the paths to an enclosure or disk array specify how DMP handles I/O on the paths. The path attributes indicate whether the path is available for I/O.

The attributes set for the paths are persistent. The attributes are stored in the `/etc/vx/dmppolicy.info` file.

You can set the following attributes:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>active</code></td>
<td>Indicates an active path for an array. Set this attribute to change the standby (failover) path to an active path.</td>
</tr>
<tr>
<td><code>nopreferred</code></td>
<td>Restores the normal priority of a path.</td>
</tr>
</tbody>
</table>
**preference (priority=N)**

Specifies a path as preferred, and optionally assigns a priority number to it. If specified, the priority number must be an integer that is greater than or equal to one. Higher priority numbers indicate that a path is able to carry a greater I/O load.

**Note:** Setting a priority for path does not change the I/O policy. The I/O policy must be set independently.

See “Specifying the DMP I/O policy with the command line” on page 52.

**standby**

Marks a standby (failover) path that it is not used for normal I/O scheduling. This path is used if there are no active paths available for I/O.

You can set the path attributes with the command line or the vSphere GUI.

See “Setting the attributes of the paths to an enclosure” on page 50.
See “Setting the attributes of the paths to a storage array” on page 79.

---

**About DMP attributes**

The following sections discuss DMP attributes that you can define for an enclosure, array name, or array type.

**DMP I/O policy**

Determines how DMP schedules I/O on the paths.

See “About DMP I/O policies” on page 29.

**The partitionsize attribute**

Determines the size of the partition used when DMP uses the balanced I/O policy.

See “About DMP I/O policies” on page 29.

**The use_all_paths attribute**

Schedule I/O on paths of a A/A-A or ALUA array.

See “About the use_all_paths attribute” on page 33.

**DMP recovery options**

Determine how DMP handles I/O errors.

See “About DMP recovery options” on page 31.

**DMP path redundancy levels**

Determine the minimum number of paths required.

See “About the minimum redundancy level of DMP paths” on page 32.
The `dmp_lun_retry_timeout` attribute specifies a retry period for handling transient errors that are not handled by the HBA and the SCSI driver. See “DMP tunable parameters” on page 118.

You can set DMP attributes with the command line or the vSphere GUI. See “Setting the attributes of a storage entity” on page 79.

### About DMP I/O policies

The DMP I/O policy indicates how DMP distributes I/O loads across multiple paths to a disk array or enclosure. You can set the I/O policy for an enclosure (for example, HDS01), for all enclosures of a particular type (such as HDS), or for all enclosures of a particular array type (such as A/A for Active/Active, or A/P for Active/Passive).

The following policies may be set:

- **adaptive**
  
  This policy attempts to maximize overall I/O throughput to or from the disks by dynamically scheduling I/O on the paths. It is suggested for use where I/O loads can vary over time. For example, I/O to or from a database may exhibit both long transfers (table scans) and short transfers (random look ups). The policy is also useful for a SAN environment where different paths may have different number of hops. No further configuration is possible as this policy is automatically managed by DMP.

- **adaptiveminq**
  
  Similar to the `adaptive` policy, except that I/O is scheduled according to the length of the I/O queue on each path. The path with the shortest queue is assigned the highest priority.
balanced
[partitionsize=size]

This policy is designed to optimize the use of caching in disk drives and RAID controllers. The size of the cache typically ranges from 120KB to 500KB or more, depending on the characteristics of the particular hardware. During normal operation, the disks (or LUNs) are logically divided into a number of regions (or partitions), and I/O from/to a given region is sent on only one of the active paths. Should that path fail, the workload is automatically redistributed across the remaining paths.

You can use the size argument to the partitionsize attribute to specify the partition size. The partition size in blocks is adjustable in powers of 2 from 2 up to 231. A value that is not a power of 2 is silently rounded down to the nearest acceptable value.

Specifying a partition size of 0 is equivalent to specifying the default partition size.

The default value for the partition size is 512 blocks (256k). Specifying a partition size of 0 is equivalent to the default partition size of 512 blocks (256k).

The default value can be changed by adjusting the value of the dmp_pathswitch_blks_shift tunable parameter.

**Note:** The benefit of this policy is lost if the value is set larger than the cache size.

For example, the suggested partition size for an Hitachi HDS 9960 A/A array is from 32,768 to 131,072 blocks (16MB to 64MB) for an I/O activity pattern that consists mostly of sequential reads or writes.

minimumq

This policy sends I/O on paths that have the minimum number of outstanding I/O requests in the queue for a LUN. No further configuration is possible as DMP automatically determines the path with the shortest queue.

This is the default I/O policy for all arrays.

priority

This policy is useful when the paths in a SAN have unequal performance, and you want to enforce load balancing manually. You can assign priorities to each path based on your knowledge of the configuration and performance characteristics of the available paths, and of other aspects of your system.

See “Setting the attributes of the paths to an enclosure” on page 50.
round-robin  This policy shares I/O equally between the paths in a round-robin sequence. For example, if there are three paths, the first I/O request would use one path, the second would use a different path, the third would be sent down the remaining path, the fourth would go down the first path, and so on. No further configuration is possible as this policy is automatically managed by DMP.

singleactive  This policy routes I/O down the single active path. This policy can be configured for A/P arrays with one active path per controller, where the other paths are used in case of failover. If configured for A/A arrays, there is no load balancing across the paths, and the alternate paths are only used to provide high availability (HA). If the current active path fails, I/O is switched to an alternate active path. No further configuration is possible as the single active path is selected by DMP.

About DMP recovery options

You can configure how DMP responds to failed I/O requests on the paths to a specified enclosure, disk array name, or type of array. By default, DMP is configured to retry a failed I/O request up to five times for a single path. The settings for handling I/O request failures can be applied to the paths to an enclosure, array name, or array type.

The recovery options are specified as two types: retrying I/O after an error, or throttling I/O.

The retry options limit the number of times that DMP retries an I/O request on a path, after an error. You can use the Fixed-Retry method and the retrycount attribute to specify the number of retries to be attempted before DMP reschedules the I/O request on another available path, or fails the request altogether. As an alternative to specifying a fixed number of retries, you can use the Timebound method and the iotimeout attribute to specify the amount of time DMP allows for handling an I/O request. If the I/O request does not succeed within that time, DMP fails the I/O request. The default value of iotimeout is 300 seconds. For some applications such as Oracle, it may be desirable to set iotimeout to a larger value. The iotimeout value for DMP should be greater than the I/O service time of the underlying operating system layers.

**Note:** The fixedretry and timebound settings are mutually exclusive.
Table 2-1 summarizes the possible recovery option settings for retrying I/O after an error.

**Table 2-1** Recovery options for retrying I/O after an error

<table>
<thead>
<tr>
<th>Recovery option</th>
<th>Possible settings</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>recoveryoption=fixedretry</td>
<td>Fixed-Retry (retrycount)</td>
<td>DMP retries a failed I/O request for the specified number of times if I/O fails.</td>
</tr>
<tr>
<td>recoveryoption=timebound</td>
<td>Timebound (iotimeout)</td>
<td>DMP retries a failed I/O request for the specified time in seconds if I/O fails.</td>
</tr>
</tbody>
</table>

See “Configuring the response to I/O failures” on page 58.

The I/O throttling options control whether DMP uses I/O throttling. By default, DMP is configured with I/O throttling turned off for all paths. If enabled, I/O throttling imposes a small overhead on CPU and memory usage because of the activity of the statistics-gathering daemon. If I/O throttling is disabled, the daemon no longer collects statistics, and remains inactive until I/O throttling is re-enabled.

**Note:** The I/O throttling settings are persistent across reboots of the system.

Table 2-2 summarizes the possible recovery option settings for throttling I/O.

**Table 2-2** Recovery options for I/O throttling

<table>
<thead>
<tr>
<th>Recovery option</th>
<th>Possible settings</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>recoveryoption=nothrottle</td>
<td>None</td>
<td>I/O throttling is not used.</td>
</tr>
<tr>
<td>recoveryoption=throttle</td>
<td>Timebound (iotimeout)</td>
<td>DMP throttles the path if an I/O request does not return within the specified time in seconds.</td>
</tr>
</tbody>
</table>

See “Configuring the I/O throttling mechanism” on page 60.

**About the minimum redundancy level of DMP paths**

You can set the minimum redundancy level for a device or an enclosure. The minimum redundancy level is the minimum number of paths that should be active for the device or the enclosure. If the number of paths falls below the minimum
redundancy level for the enclosure, a message is sent to the system console and also logged to the DMP log file. Also, notification is sent to vxnotify clients.

The value set for minimum redundancy level is stored in the dmppolicy.info file, and is persistent. If no minimum redundancy level is set, the default value is 0.

You can list the devices on a specified enclosure with fewer than a given number of enabled paths, using the command line or the GUI.

**About the use_all_paths attribute**

You can specify the `use_all_paths` attribute in conjunction with the adaptive, balanced, minimumq, priority and round-robin I/O policies to specify whether I/O requests are to be scheduled on the secondary paths in addition to the primary paths of an Asymmetric Active/Active (A/A-A) array or an ALUA array. Depending on the characteristics of the array, the consequent improved load balancing can increase the total I/O throughput. However, this feature should only be enabled if recommended by the array vendor. It has no effect for array types other than A/A-A and ALUA.
Administering DMP using the command line

This chapter includes the following topics:

- About the authentication model for the vxdmpadm command in the VMware environment
- Retrieving information about a DMP node
- Displaying consolidated information about the DMP nodes
- Displaying the paths to a disk
- Displaying paths controlled by a DMP node, controller, enclosure, or array port
- Displaying information about controllers
- Displaying information about enclosures
- Displaying information about array ports
- Displaying extended device attributes
- Gathering and displaying I/O statistics
- Setting the attributes of the paths to an enclosure
- Displaying the redundancy level of a device or enclosure
- Specifying the minimum number of active paths
- Displaying the I/O policy
- Specifying the DMP I/O policy with the command line
Disabling I/O for paths, controllers, array ports, or DMP nodes
- Enabling I/O for paths, controllers, array ports, or DMP nodes
- Configuring the response to I/O failures
- Configuring the I/O throttling mechanism
- Displaying recovery option values
- Configuring DMP path restoration policies
- Stopping the DMP path restoration thread
- Displaying the status of the DMP path restoration thread
- Viewing array policy modules

About the authentication model for the vxdmpadm command in the VMware environment

The `vxdmpadm` command is the utility that performs administrative tasks for Veritas Dynamic Multi-Pathing (DMP). In the VMware environment, execute the `vxdmpadm` command from a command-line prompt on a system that has the VxDMP remote CLI installed.

You can authenticate with the remote ESX using direct ESX credentials or vCenter access credentials.

When you specify vCenter access credentials, the vCenter authentication token is cached briefly. The authentication is reused for subsequent commands, so you do not need to specify the credentials for every command instance. Enter the password in clear text as a command argument, or supply the password when prompted.

To use vCenter access credentials, use the following form of the `vxdmpadm` command:

```
vxdmpadm vcenter=vc_center vc_user=vc_user vc_passwd=vc_pass \
[host=h1,h2...] [flag] keyword attribute=value..
```

where:

- `vcenter` represents the vCenter server.
- `vc_user` represents the vCenter user name.
- `vc_passwd` represents the vCenter user password.
\textit{h1, h2, ...} specify hosts on which to perform the operation. Alternatively, you can specify a list of hosts with the \texttt{ESX_HOST_NAMES} environment variable.

When you use vCenter access credentials, you must have appropriate permissions assigned to your role.

See “About roles and privileges for administering DMP” on page 25.

To use direct ESX credentials, specify one or more ESX host names, and the authentication credentials (user name and password) for each host. Use commas to separate each ESX host name, user name, and password.

To use direct ESX credentials, use the following form of the \texttt{vxdmpadm} command:

\begin{verbatim}
    vxdmpadm [host=h1,h2... [user=u1,u2,... [passwd=p1,p2,...]]] [flag] keyword attribute=value..
\end{verbatim}

For readability, some of the examples in the sections about using the \texttt{vxdmpadm} command do not show the credentials.

## Retrieving information about a DMP node

The following command displays the DMP node that controls a particular physical path:

\begin{verbatim}
    # vxdmpadm getdmpnode nodename=pathname
\end{verbatim}

The physical path is specified by argument to the \texttt{nodename} attribute, which must be a valid path.

The command displays output similar to the following example output.

\begin{verbatim}
    # vxdmpadm getdmpnode nodename=vmhba3:C0:T0:L2
    NAME  STATE  ENCLR-TYPE  PATHS  ENBL  DSBL  ENCLR-NAME
    emc_clariion0_100 ENABLED EMC_CLARiiON 2 2 0 emc_clariion0
\end{verbatim}

Use the \texttt{enclosure} attribute with \texttt{getdmpnode} to obtain a list of all DMP nodes for the specified enclosure.

\begin{verbatim}
    # vxdmpadm getdmpnode enclosure=emc_clariion0
    NAME  STATE  ENCLR-TYPE  PATHS  ENBL  DSBL  ENCLR-NAME
    emc_clariion0_98 ENABLED EMC_CLARiiON 2 2 0 emc_clariion0
    emc_clariion0_99 ENABLED EMC_CLARiiON 2 2 0 emc_clariion0
    emc_clariion0_100 ENABLED EMC_CLARiiON 2 2 0 emc_clariion0
\end{verbatim}
Use the `dmpnodename` attribute with `getdmpnode` to display the DMP information for a given DMP node.

```bash
# vxdmpadm getdmpnode dmpnodename=emc_clariion0_100
```

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE</th>
<th>ENCLR-TYPE</th>
<th>PATHS</th>
<th>ENBL</th>
<th>DSBL</th>
<th>ENCLR-NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>emc_clariion0_100</td>
<td>ENABLED</td>
<td>EMC_CLARiiON</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>emc_clariion0</td>
</tr>
</tbody>
</table>

Displaying consolidated information about the DMP nodes

The `vxdmpadm list dmpnode` command displays the detail information of a DMP node. The information includes the enclosure name, LUN serial number, port id information, device attributes, etc.

The following command displays the consolidated information for all of the DMP nodes in the system:

```bash
# vxdmpadm list dmpnode all
```

Use the `enclosure` attribute with `list dmpnode` to obtain a list of all DMP nodes for the specified enclosure.

```bash
# vxdmpadm list dmpnode enclosure=enclosure name
```

For example, the following command displays the consolidated information for all of the DMP nodes in the `enc0` enclosure.

```bash
# vxdmpadm list dmpnode enclosure=enc0
```

Use the `dmpnodename` attribute with `list dmpnode` to display the DMP information for a given DMP node. The DMP node can be specified by name or by specifying a path name. The detailed information for the specified DMP node includes path information for each subpath of the listed `dmpnode`.

The path state differentiates between a path that is disabled due to a failure and a path that has been manually disabled for administrative purposes. A path that has been manually disabled using the `vxdmpadm disable` command is listed as `disabled(m)`.

```bash
# vxdmpadm list dmpnode dmpnodename=dmpnodename
```

For example, the following command displays the consolidated information for the DMP node `emc_clariion0_158`. 
Displaying the paths to a disk

The `vxdmpadm` command is used to display the multi-pathing information for a particular metadevice. The metadevice is a device representation of a physical disk having multiple physical paths through the system’s HBA controllers. In DMP, all the physical disks in the system are represented as metadevices with one or more physical paths.
To view multi-pathing information for a particular metadevice:

- Use the following command to view multi-pathing information:

```bash
# vxdmpadm host=atria-esx user=root passwd=root123 getsubpaths
```

For example, to view multi-pathing information for `vmhba3`, use the following command:

```bash
# vxdmpadm host=atria-esx user=root passwd=root123 getsubpaths
```

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE[A]</th>
<th>PATH-TYPE[M]</th>
<th>DMPNODENAME</th>
<th>ENCLR-NAME</th>
<th>CTLR</th>
<th>ATTRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3:C0:T5:L2</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>emc_clariion0_100</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L2</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>emc_clariion0_100</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T5:L3</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>emc_clariion0_101</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L3</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>emc_clariion0_101</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T5:L4</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>emc_clariion0_102</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L4</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>emc_clariion0_102</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T5:L5</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>emc_clariion0_163</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L5</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>emc_clariion0_163</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
</tbody>
</table>

Displaying paths controlled by a DMP node, controller, enclosure, or array port

The `vxdmpadm getsubpaths` command lists all of the paths known to DMP. The `vxdmpadm getsubpaths` command also provides options to list the subpaths through a particular DMP node, controller, enclosure, or array port. To list the paths through an array port, specify either a combination of enclosure name and array port id, or array port WWN.

To list all subpaths known to DMP:

```bash
# vxdmpadm getsubpaths
```

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE[A]</th>
<th>PATH-TYPE[M]</th>
<th>DMPNODENAME</th>
<th>ENCLR-NAME</th>
<th>CTLR</th>
<th>ATTRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3:C0:T5:L2</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>emc_clariion0_100</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L2</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>emc_clariion0_100</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T5:L3</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>emc_clariion0_101</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L3</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>emc_clariion0_101</td>
<td>emc_clariion0</td>
<td>vmhba3</td>
<td>-</td>
</tr>
</tbody>
</table>

The `vxdmpadm getsubpaths` command combined with the `dmpnodename` attribute displays all the paths to a LUN that are controlled by the specified DMP node name.
Administering DMP using the command line

Displaying paths controlled by a DMP node, controller, enclosure, or array port

```bash
# vxdmpadm getsubpaths dmpnodename=emc_clariion0_100
```

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3:C0:T5:L2</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>vmhba3</td>
<td>EMC_CLARiiON</td>
<td>emc_clariion0</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L2</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>vmhba3</td>
<td>EMC_CLARiiON</td>
<td>emc_clariion0</td>
<td>-</td>
</tr>
</tbody>
</table>

For A/A arrays, all enabled paths that are available for I/O are shown as ENABLED(A).

For A/P arrays in which the I/O policy is set to singleactive, only one path is shown as ENABLED(A). The other paths are enabled but not available for I/O. If the I/O policy is not set to singleactive, DMP can use a group of paths (all primary or all secondary) for I/O, which are shown as ENABLED(A).

Paths that are in the DISABLED state are not available for I/O operations.

A path that was manually disabled by the system administrator displays as DISABLED(M). A path that failed displays as DISABLED.

You can use `getsubpaths` to obtain information about all the paths that are connected to a particular HBA controller:

```bash
# vxdmpadm getsubpaths ctlr=vmhba3
```

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3:C0:T5:L2</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>emc_clariion0_100</td>
<td>EMC_CLARiiON</td>
<td>emc_clariion0</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L2</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>emc_clariion0_100</td>
<td>EMC_CLARiiON</td>
<td>emc_clariion0</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T5:L3</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>emc_clariion0_101</td>
<td>EMC_CLARiiON</td>
<td>emc_clariion0</td>
<td>-</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L3</td>
<td>ENABLED(A)</td>
<td>PRIMARY</td>
<td>emc_clariion0_101</td>
<td>EMC_CLARiiON</td>
<td>emc_clariion0</td>
<td>-</td>
</tr>
</tbody>
</table>

You can also use `getsubpaths` to obtain information about all the paths that are connected to a port on an array. The array port can be specified by the name of the enclosure and the array port ID, or by the worldwide name (WWN) identifier of the array port:

```bash
# vxdmpadm getsubpaths enclosure=enclosure portid=portid
# vxdmpadm getsubpaths pwwn=pwwn
```

For example, to list subpaths through an array port through the enclosure and the array port ID:

```bash
# vxdmpadm getsubpaths enclosure=emc_clariion0 portid=B4
```

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3:C0:T5:L2</td>
<td>ENABLED</td>
<td>SECONDARY</td>
<td>vmhba3</td>
<td>EMC_CLARiiON</td>
<td>emc_clariion0</td>
<td>-</td>
</tr>
</tbody>
</table>
For example, to list subpaths through an array port through the WWN:

```
# vxdmpadm getsubpaths pwwn=50:06:01:64:41:e0:a2:b0
```

You can use `getsubpaths` to obtain information about all the subpaths of an enclosure.

```
# vxdmpadm getsubpaths enclosure=enclosure_name [ctlr=ctlrname]
```

To list all subpaths of an enclosure:

```
# vxdmpadm getsubpaths enclosure=emc_clariion0
```

To list all subpaths of a controller on an enclosure:

```
# vxdmpadm getsubpaths enclosure=Disk ctlr=c1
# vxdmpadm getsubpaths enclosure=Disk ctlr=vmhba3
```

By default, the output of the `vxdmpadm getsubpaths` command is sorted by enclosure name, DMP node name, and within that, path name.

### Displaying information about controllers

The following command lists attributes of all HBA controllers on the system:

```
# vxdmpadm listctlr all
```

<table>
<thead>
<tr>
<th>CTLR-NAME</th>
<th>ENCLR-TYPE</th>
<th>STATE</th>
<th>ENCLR-NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3</td>
<td>Hitachi_USP-VM</td>
<td>ENABLED</td>
<td>hitachi_usp-vm0</td>
</tr>
<tr>
<td>vmhba3</td>
<td>EMC_CLARiiON</td>
<td>ENABLED</td>
<td>emc_clariion0</td>
</tr>
</tbody>
</table>
The other controllers are connected to disks that are in recognized DMP categories. All the controllers are in the ENABLED state which indicates that they are available for I/O operations.

The state DISABLED is used to indicate that controllers are unavailable for I/O operations. The unavailability can be due to a hardware failure or due to I/O operations being disabled on that controller by using the `vxdmpadm disable` command.

The following forms of the command lists controllers belonging to a specified enclosure or enclosure type:

```bash
# vxdmpadm listctlr enclosure=enc0
```

or

```bash
# vxdmpadm listctlr type=EMC_CLARiiON
```

The `vxdmpadm getctlr` command displays HBA vendor details and the Controller ID. For iSCSI devices, the Controller ID is the IQN or IEEE-format based name. For FC devices, the Controller ID is the WWN. The WWN shown as 'Controller ID' maps to the WWN of the HBA port associated with the host controller.

```bash
# vxdmpadm getctlr
```

<table>
<thead>
<tr>
<th>LNAME</th>
<th>PNAME</th>
<th>VENDOR</th>
<th>CTLR-ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3</td>
<td>/proc/bus/pci/05/00.0 QLogic 10:00:00:24:ff:2f:1f:10/21:00:00:24:ff:2f:1f:10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vmhba4</td>
<td>/proc/bus/pci/05/00.0 QLogic 10:00:00:24:ff:2f:1f:11/21:00:00:24:ff:2f:1f:11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Displaying information about enclosures**

To display the attributes of a specified enclosure, including its enclosure type, enclosure serial number, status, array type, and number of LUNs, use the following command:

```bash
# vxdmpadm listenclosure emc_clariion0
```

<table>
<thead>
<tr>
<th>ENCLR_NAME</th>
<th>ENCLR_TYPE</th>
<th>ENCLR_SNO</th>
<th>STATUS</th>
<th>ARRAY_TYPE</th>
<th>LUN_COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>emc_clariion0</td>
<td>EMC_CLARiiON</td>
<td>CK200080300687</td>
<td>CONNECTED</td>
<td>CLR-A/PF</td>
<td>13</td>
</tr>
</tbody>
</table>

The following command lists attributes for all enclosures in a system:
# vxdmpadm listenclosure all

<table>
<thead>
<tr>
<th>ENCLR_NAME</th>
<th>ENCLR_TYPE</th>
<th>ENCLR_SNO</th>
<th>STATUS</th>
<th>ARRAY_TYPE</th>
<th>LUN_COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>hitachi_usp-vm00</td>
<td>Hitachi_USP-VM</td>
<td>25847</td>
<td>CONNECTED</td>
<td>A/A</td>
<td>5</td>
</tr>
<tr>
<td>emc_clariion0</td>
<td>EMC_CLARiiON</td>
<td>CK200080300687</td>
<td>CONNECTED</td>
<td>CLR-A/PF</td>
<td>13</td>
</tr>
</tbody>
</table>

Displaying information about array ports

Use the commands in this section to display information about array ports. The information displayed for an array port includes the name of its enclosure, and its ID and worldwide name (WWN) identifier.

To display the attributes of an array port that is accessible via a path, DMP node or HBA controller, use one of the following commands:

# vxdmpadm getportids path=path-name
# vxdmpadm getportids dmpnodename=dmpnode-name
# vxdmpadm getportids ctlr=ctlr-name

The following form of the command displays information about all of the array ports within the specified enclosure:

# vxdmpadm getportids enclosure=enclr-name

The following example shows information about the array port that is accessible via DMP node emc_clariion0_100:

# vxdmpadm getportids dmpnodename=emc_clariion0_100

<table>
<thead>
<tr>
<th>NAME</th>
<th>ENCLR-NAME</th>
<th>ARRAY-PORT-ID</th>
<th>pWWN</th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3:C0:T5:L2</td>
<td>emc_clariion0</td>
<td>A4</td>
<td>50:06:01:64:41:e0:a2:b0</td>
</tr>
<tr>
<td>vmhba3:C0:T6:L2</td>
<td>emc_clariion0</td>
<td>B4</td>
<td>50:06:01:6c:41:e0:a2:b0</td>
</tr>
</tbody>
</table>

Displaying extended device attributes

The vxdmpadm list dmpnode command displays DDL extended attributes. For example, the following command shows attributes of “std”, “fc”, and “RAID_0” for this LUN:

# vxdmpadm list dmpnode dmpnodename=emc_clariion0_100

dmpdev = emc_clariion0_100
state = ENABLED
enclosure = emc_clariion0
cab-sno = CK200080300687
asl = libvxCLARiiON
vid = DGC
pid = RAID 0
array-name = EMC_CLARiiON
array-type = CLR-A/PF
iopolicy = minimumq
avid = 100
lun-sno = 600601601C101F00F6E0BEF440DEDD11
udid = DGC%5FRAID%200%5FCK200080300687%5F600601601C101F00F6E0BEF440DEDD11
dev-attr = lun RAID_0
lun_type = std
scsi3_vpd = 600601601C101F00F6E0BEF440DEDD11
media_type = hdd
num_paths = 2
###path =name state type transport ctlr aportID aportWWN
path vmhba3:C0:T5:L2 ENABLED SECONDARY FC vmhba3 A4 50:06:01:64:41:e0:a2:b0
path vmhba3:C0:T6:L2 ENABLED(A) PRIMARY FC vmhba3 B4 50:06:01:6c:41:e0:a2:b0

For a list of ASLs that supports Extended Attributes, and descriptions of these attributes, refer to the hardware compatibility list (HCL) at the following URL:

http://www.symantec.com/docs/TECH170013

Gathering and displaying I/O statistics

You can use the vxdmpadm iostat command to gather and display I/O statistics for a specified DMP node, enclosure, path or controller.

To enable the gathering of statistics, enter this command:

```
# vxdmpadm iostat start [memory=size]
```

To reset the I/O counters to zero, use this command:

```
# vxdmpadm iostat reset
```

The memory attribute can be used to limit the maximum amount of memory that is used to record I/O statistics for each CPU. The default limit is 32k (32 kilobytes) per CPU.

To display the accumulated statistics at regular intervals, use the following command:
This command displays I/O statistics for all paths (all), or for a specified controller, DMP node, enclosure, path or port ID. The statistics displayed are the CPU usage and amount of memory per CPU used to accumulate statistics, the number of read and write operations, the number of kilobytes read and written, and the average time in milliseconds per kilobyte that is read or written.

The interval and count attributes may be used to specify the interval in seconds between displaying the I/O statistics, and the number of lines to be displayed. The actual interval may be smaller than the value specified if insufficient memory is available to record the statistics.

To disable the gathering of statistics, enter this command:

```
# vxmdmpadm iostat stop
```

Examples of using the vxmdmpadm iostat command

The following is an example session using the vxmdmpadm iostat command. The first command enables the gathering of I/O statistics:

```
# vxmdmpadm iostat start
```

The next command displays the current statistics including the accumulated total numbers of read and write operations, and the kilobytes read and written, on all paths.

```
# vxmdmpadm -uk iostat show all
```

```
cpu usage = 143us per cpu memory = 8192b

<table>
<thead>
<tr>
<th>PATHNAME</th>
<th>READS</th>
<th>WRITES</th>
<th>READS</th>
<th>WRITES</th>
<th>AVG TIME(ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>vmhba3:C0:T0:L0</td>
<td>362</td>
<td>0</td>
<td>1k</td>
<td>0k</td>
<td>0.143356</td>
</tr>
<tr>
<td>vmhba3:C0:T0:L1</td>
<td>377</td>
<td>0</td>
<td>2k</td>
<td>0k</td>
<td>0.138427</td>
</tr>
<tr>
<td>vmhba3:C0:T0:L2</td>
<td>368</td>
<td>0</td>
<td>1k</td>
<td>0k</td>
<td>0.141810</td>
</tr>
<tr>
<td>vmhba3:C0:T0:L3</td>
<td>356</td>
<td>0</td>
<td>1k</td>
<td>0k</td>
<td>5.364421</td>
</tr>
</tbody>
</table>
```

The following command changes the amount of memory that vxmdmpadm can use to accumulate the statistics:

```
# vxmdmpadm iostat start memory=4096
```
The displayed statistics can be filtered by path name, DMP node name, and enclosure name (note that the per-CPU memory has changed following the previous command):

```
# vxdmpadm -uk iostat show pathname=vmhba3:C0:T0:L6
    cpu usage = 152us per cpu memory = 4096b
    OPERATIONS        BYTEs        AVG TIME (ms)
    PATHNAME  READS  WRITES  READS  WRITES  READS  WRITES
vmhba3:C0:T0:L6  375     0    2k    0k     0.173720  0.000000
```

```
# vxdmpadm -uk iostat show dmpnodename=emc_clariion0_160
    cpu usage = 161us per cpu memory = 4096b
    OPERATIONS        BYTEs        AVG TIME (ms)
    PATHNAME  READS  WRITES  READS  WRITES  READS  WRITES
vmhba3:C0:T0:L8   331     0    1k    0k     0.220807  0.000000
vmhba3:C0:T1:L8   323     0    2k    0k     0.227632  0.000000
vmhba3:C0:T2:L8   0      0     0k    0k      0.000000  0.000000
vmhba3:C0:T3:L8   0      0     0k    0k      0.000000  0.000000
```

```
# vxdmpadm -uk iostat show enclosure=emc_clariion0
    cpu usage = 171us per cpu memory = 4096b
    OPERATIONS        BYTEs        AVG TIME (ms)
    PATHNAME  READS  WRITES  READS  WRITES  READS  WRITES
vmhba3:C0:T0:L0   362     0    1k    0k     0.143356  0.000000
vmhba3:C0:T0:L1   379     0    2k    0k     0.138588  0.000000
vmhba3:C0:T0:L2   368     0    1k    0k     0.141810  0.000000
vmhba3:C0:T0:L3   357     0    1k    0k     5.367361  0.000000
```

You can also specify the number of times to display the statistics and the time interval. Here the incremental statistics for a path are displayed twice with a 2-second interval:

```
# vxdmpadm -uk iostat show pathname=vmhba3:C0:T0:L6 interval=2
    cpu usage = 176us per cpu memory = 4096b
    OPERATIONS        BYTEs        AVG TIME (ms)
    PATHNAME  READS  WRITES  READS  WRITES  READS  WRITES
vmhba3:C0:T0:L6   375     0    2k    0k     0.173720  0.000000
vmhba3:C0:T0:L6   375     0    0k    0k     0.000000  0.000000
```

Displaying cumulative I/O statistics

Use the `groupby` clause of the `vxdmpadm iostat` command to display cumulative I/O statistics listings per DMP node, controller, array port id, or host-array.
controller pair and enclosure. If the `groupby` clause is not specified, then the statistics are displayed per path.

By default, the read/write times are displayed in milliseconds up to 2 decimal places. The throughput data is displayed in terms of BLOCKS, and the output is scaled, meaning that the small values are displayed in small units and the larger values are displayed in bigger units, keeping significant digits constant. You can specify the units in which the statistics data is displayed. The `-u` option accepts the following options:

- `h` or `H`: Displays throughput in the highest possible unit.
- `k`: Displays throughput in kilobytes.
- `m`: Displays throughput in megabytes.
- `g`: Displays throughput in gigabytes.
- `bytes` or `b`: Displays throughput in exact number of bytes.
- `us`: Displays average read/write time in microseconds.

To group by DMP node:

```
# vxdmpadm [-u unit] iostat show groupby=dmpnode \[all | dmpnodename=dmpnodename | enclosure=enclr-name]
```

To group by controller:

```
# vxdmpadm [-u unit] iostat show groupby=ctlr [ all | ctlr=ctlr ]
```

For example:

```
# vxdmpadm iostat show groupby=ctlr ctlr=vmhba3

cpu usage = 194us per cpu memory = 8192b

OPERATIONS BLOCKS AVG TIME(ms)

CTLRNAME READS WRITES READS WRITES READS WRITES

vmhba3 5916 0 36k 0k 0.825074 0.000000
```

To group by arrayport:

```
# vxdmpadm [-u unit] iostat show groupby=arrayport [ all \[ pwnn=array_pwnn | enclosure=enclr portid=array-port-id ]
```

For example:

```
# vxdmpadm -uk iostat show groupby=arrayport enclosure=emc_clariion0
```
To group by enclosure:

```bash
# vxmpadm [-u unit] iostat show groupby=enclosure [ all \ | enclosure=enclr ]
```

For example:

```bash
# vxmpadm -uh iostat show groupby=enclosure
```

You can also filter out entities for which all data entries are zero. This option is especially useful in a cluster environment which contains many failover devices. You can display only the statistics for the active paths.

To filter all zero entries from the output of the `iostat show` command:

```bash
# vxmpadm [-u unit] -z iostat show [all|ctlr=ctlr_name | dmpnodename=dmp_device_name | enclosure=encl_name | portid=portid] | pathname=path_name|pwnn=port_WWN][interval=seconds [count=N]]
```

For example:

```bash
# vxmpadm -z iostat show dmpnodename=emc_clariion0_160
```

To display average read/write times in microseconds.

```bash
# vxmpadm -uus iostat show pathname=vmhba3:C0:T0:L6
```
Setting the attributes of the paths to an enclosure

You can use the `vxdmpadm setattr` command to set the attributes of the paths to an enclosure or disk array.

The attributes set for the paths are persistent and are stored in the `/etc/vx/dmppolicy.info` file.

To set the attributes for the paths:

To set the attributes for the paths, use the following command:

```bash
# vxdmpadm setattr path vmhba3:C0:T1:L2 pathtype=pathtype
```

Where `pathtype` is:

See “About the DMP attributes of the paths to an enclosure” on page 27.

Specifies a path as preferred, and optionally assigns a priority number to it. If specified, the priority number must be an integer that is greater than or equal to one. Higher priority numbers indicate that a path is able to carry a greater I/O load.

---

**Note:** Setting a priority for path does not change the I/O policy. The I/O policy must be set independently.

See “Specifying the DMP I/O policy with the command line” on page 52.

```bash
# vxdmpadm setattr enclosure enc0 iopolicy=priority
# vxdmpadm setattr path vmhba3:C0:T1:L2 pathtype=preferred 
    priority=2
```

Displaying the redundancy level of a device or enclosure

Use the `vxdmpadm getdmpnode` command to list the devices with less than the required redundancy level.

To list the devices on a specified enclosure with fewer than a given number of enabled paths, use the following command:

```bash
# vxdmpadm getdmpnode enclosure=encl_name redundancy=value
```

For example, to list the devices with fewer than 3 enabled paths, use the following command:
# vxmpadvm getdmpnode enclosure=EMC_CLARiiON0 redundancy=3

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE</th>
<th>ENCLR-TYPE</th>
<th>PATHS</th>
<th>ENBL</th>
<th>DSBL</th>
<th>ENCLR-NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>emc_clariion0_162</td>
<td>ENABLED</td>
<td>EMC_CLARIION</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>emc_clariion0</td>
</tr>
<tr>
<td>emc_clariion0_182</td>
<td>ENABLED</td>
<td>EMC_CLARIION</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>emc_clariion0</td>
</tr>
<tr>
<td>emc_clariion0_184</td>
<td>ENABLED</td>
<td>EMC_CLARIION</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>emc_clariion0</td>
</tr>
<tr>
<td>emc_clariion0_186</td>
<td>ENABLED</td>
<td>EMC_CLARIION</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>emc_clariion0</td>
</tr>
</tbody>
</table>

To display the minimum redundancy level for a particular device, use the `vxmpadvm getattr` command, as follows:

```
# vxmpadvm getattr enclosure|arrayname|arraytype \ component-name redundancy
```

For example, to show the minimum redundancy level for the enclosure HDS9500-ALUA0:

```
# vxmpadvm getattr enclosure HDS9500-ALUA0 redundancy
```

<table>
<thead>
<tr>
<th>ENCLR_NAME</th>
<th>DEFAULT</th>
<th>CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDS9500-ALUA0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

## Specifying the minimum number of active paths

You can use the `vxmpadvm setattr` command to set the minimum redundancy level.

See “About the minimum redundancy level of DMP paths” on page 32.

To specify the minimum number of active paths

- Use the `vxmpadvm setattr` command with the redundancy attribute as follows:

```
# vxmpadvm setattr enclosure|arrayname|arraytype component-name redundancy=value
```

where `value` is the number of active paths.

For example, to set the minimum redundancy level for the enclosure HDS9500-ALUA0:

```
# vxmpadvm setattr enclosure HDS9500-ALUA0 redundancy=2
```
Displaying the I/O policy

To display the current and default settings of the I/O policy for an enclosure, array or array type, use the `vxdmpadm getattr` command.

The following example displays the default and current setting of `iopolicy` for the emc_clariion0 enclosure:

```
# vxdmpadm getattr enclosure emc_clariion0 iopolicy
```

```
ENCLR_NAME DEFAULT CURRENT
---------------------------------------
emc_clariion0 MinimumQ Balanced
```

The next example displays the setting of `partitionsize` for the enclosure enc0, on which the balanced I/O policy with a partition size of 2MB has been set:

```
# vxdmpadm getattr enclosure enc0 partitionsize
```

```
ENCLR_NAME DEFAULT CURRENT
---------------------------------------
enc0 512 4096
```

Specifying the DMP I/O policy with the command line

You can use the `vxdmpadm setattr` command to change the I/O policy for distributing I/O load across multiple paths to a disk array or enclosure. You can set policies for an enclosure (for example, HDS01), for all enclosures of a particular type (such as HDS), or for all enclosures of a particular array type (such as A/A for Active/Active, or A/P for Active/Passive).

The following example sets the adaptive I/O policy for the enclosure enc1:

```
# vxdmpadm setattr enclosure enc1 \
  iopolicy=adaptive
```

The following example sets the balanced I/O policy with a partition size of 4096 blocks (2MB) on the enclosure enc0:

```
# vxdmpadm setattr enclosure enc0 \
  iopolicy=balanced partitionsize=4096
```

The following example sets the I/O policy to `minimumq`:
The following example sets the I/O policy to `priority` for all SENA arrays:

```
# vxdmpadm setattr arrayname SENA \ 
iopolicy=priority
```

The next example sets the I/O policy to `round-robin` for all Active/Active arrays:

```
# vxdmpadm setattr arraytype A/A \ 
iopolicy=round-robin
```

The following example sets the I/O policy to `singleactive` for JBOD disks:

```
# vxdmpadm setattr arrayname Disk \ 
iopolicy=singleactive
```

Scheduling I/O on the paths of an Asymmetric Active/Active array or an ALUA array

You can specify the `use_all_paths` attribute in conjunction with the `adaptive`, `balanced`, `minimumq`, `priority` and `round-robin` I/O policies to specify whether I/O requests are to be scheduled on the secondary paths in addition to the primary paths of an Asymmetric Active/Active (A/A-A) array or an ALUA array. Depending on the characteristics of the array, the consequent improved load balancing can increase the total I/O throughput. However, this feature should only be enabled if recommended by the array vendor. It has no effect for array types other than A/A-A and ALUA.

For example, the following command sets the `balanced` I/O policy with a partition size of 4096 blocks (2MB) on the enclosure `enc0`, and allows scheduling of I/O requests on the secondary paths:

```
# vxdmpadm setattr enclosure enc0 iopolicy=balanced \ 
  partitionsize=4096 use_all_paths=yes
```

The default setting for this attribute is `use_all_paths=no`.

You can display the current setting for `use_all_paths` for an enclosure, `arrayname` or `arraytype`. To do this, specify the `use_all_paths` option to the `vxdmpadm` `getattr` command.

```
# vxdmpadm getattr enclosure HDS9500-ALUA0 use_all_paths
The `use_all_paths` attribute only applies to A/A-A arrays and ALUA arrays. For other arrays, the above command displays the message:

Attribute is not applicable for this array.

Example of applying load balancing in a SAN

This example describes how to configure load balancing in a SAN environment where there are multiple primary paths to an Active/Passive device through several SAN switches.

To apply load balancing in a SAN

1. Display the paths of the device. This sample output from the `vxdmpadm getsubpaths` command shows that the device has two primary paths:

```
# vxdmpadm getsubpaths dmpnodename=emc_clariion0_160
vmhba3:C0:T0:L8 ENABLED(A) PRIMARY      vmhba3  EMC_CLARiiON emc_clariion0 -
vmhba3:C0:T1:L8 ENABLED(A) PRIMARY      vmhba3  EMC_CLARiiON emc_clariion0 -
vmhba3:C0:T2:L8 ENABLED SECONDARY       vmhba3  EMC_CLARiiON emc_clariion0 -
vmhba3:C0:T3:L8 ENABLED SECONDARY       vmhba3  EMC_CLARiiON emc_clariion0 -
```

2. Enable the gathering of DMP statistics:

```
# vxdmpadm iostat start
```

3. Initiate I/O load on the device. To do this, map the device using physical Raw Device Mapping to a Virtual Machine, and then start the I/O load on the virtual disk corresponding to the device.
Run the `vxdmpadm iostat` command to display the DMP statistics for the device. In this example, all I/O is being directed to one path, vmhba3:C0:T0:L8:

```
# vxdmpadm iostat show dmpnodename=emc_clariion0_160 \
  interval=5 count=2

 cpu usage = 230us per cpu memory = 8192b

<table>
<thead>
<tr>
<th>OPERATIONS</th>
<th>KBYTES</th>
<th>AVG TIME(ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATHNAME</td>
<td>READS</td>
<td>WRITES</td>
</tr>
<tr>
<td>vmhba3:C0:T0:L8</td>
<td>333</td>
<td>0</td>
</tr>
<tr>
<td>vmhba3:C0:T1:L8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>vmhba3:C0:T2:L8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>vmhba3:C0:T3:L8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
```

5 Display the I/O policy for the enclosure that contains the device:

```
# vxdmpadm getattr enclosure emc_clariion0 iopolicy

ENCLR_NAME  DEFAULT  CURRENT
emc_clariion0 MinimumQ  Single-Active

In this example, the policy for the enclosure is set to singleactive, which explains why all the I/O is taking place on one path.

6 To balance the I/O load across the multiple primary paths, set the policy to round-robin as shown here:

```
# vxdmpadm setattr enclosure emc_clariion0 iopolicy=round-robin
# vxdmpadm getattr enclosure emc_clariion0 iopolicy

ENCLR_NAME  DEFAULT  CURRENT
emc_clariion0 MinimumQ  Round-Robin
```

7 Reset the DMP statistics:

```
# vxdmpadm iostat reset
```
8  With the workload still running, you can now see the effect of changing the I/O policy to balance the load across the primary paths.

```
# vxdmpadm iostat show dmpnodename=emc_clariion0_160 \
interval=5 count=2
```

```
cpu usage = 230us per cpu memory = 8192b
OPERATIONS KBYTES AVG TIME (ms)
PATHNAME READS WRITES READS WRITES READS WRITES
vmhba3:C0:T0:L8 333 0 1k 0k 0.220270 0.000000
vmhba3:C0:T1:L8 323 0 2k 0k 0.227632 0.000000
vmhba3:C0:T2:L8 0 0 0k 0k 0.000000 0.000000
vmhba3:C0:T3:L8 0 0 0k 0k 0.000000 0.000000
```

9  If required, return the enclosure to the single active I/O policy by entering the following command:

```
# vxdmpadm setattr enclosure emc_clariion0 iopolicy=singleactive
```

Disabling I/O for paths, controllers, array ports, or DMP nodes

Disabling I/O through a path, HBA controller, array port, or DMP node prevents DMP from issuing I/O requests through the specified path, or the paths that are connected to the specified controller, array port, or DMP node. The command blocks until all pending I/O requests issued through the paths are completed.

DMP does not support the operation to disable I/O for the controllers that use Third-Party Drivers (TPD) for multi-pathing.

To disable I/O for one or more paths, use the following command:

```
# vxdmpadm [-c|-f] disable path=path_name1,path_name2,path_nameN
```

To disable I/O for the paths connected to one or more HBA controllers, use the following command:

```
# vxdmpadm [-c|-f] disable ctlr=ctlr_name1,ctlr_name2,ctlr_nameN
```

To disable I/O for the paths connected to an array port, use one of the following commands:
# vxmpadm [-c|-f] disable enclosure=enclr_name portid=array_port_ID
# vxmpadm [-c|-f] disable pwwn=array_port_WWN

where the array port is specified either by the enclosure name and the array port ID, or by the array port’s worldwide name (WWN) identifier.

The following examples show how to disable I/O on an array port:

# vxmpadm disable enclosure=HDS9500V0 portid=1A
# vxmpadm disable pwwn=20:00:00:E0:8B:06:5F:19

To disable I/O for a particular path, specify both the controller and the portID, which represent the two ends of the fabric:

# vxmpadm [-c|-f] disable ctrlr=ctrlr_name enclosure=enclr_name \ portid=array_port_ID

to disable I/O for a particular DMP node, specify the DMP node name.

# vxmpadm [-c|-f] disable dmpnodename=dmpnode

You can use the -c option to check if there is only a single active path to the disk. If so, the disable command fails with an error message unless you use the -f option to forcibly disable the path.

The disable operation fails if it is issued to a controller that is connected to the root disk through a single path, and there are no root disk mirrors configured on alternate paths. If such mirrors exist, the command succeeds.

Enabling I/O for paths, controllers, array ports, or DMP nodes

Enabling a controller allows a previously disabled path, HBA controller, array port, or DMP node to accept I/O again. This operation succeeds only if the path, controller, array port, or DMP node is accessible to the host, and I/O can be performed on it. When connecting Active/Passive disk arrays, the enable operation results in failback of I/O to the primary path. The enable operation can also be used to allow I/O to the controllers on a system board that was previously detached.

Note: This operation is supported for controllers that are used to access disk arrays on which cluster-shareable disk groups are configured.

DMP does not support the operation to enable I/O for the controllers that use Third-Party Drivers (TPD) for multi-pathing.
To enable I/O for one or more paths, use the following command:

```
# vxdmpadm enable path=path_name1[,path_name2,path_nameN]
```

To enable I/O for the paths connected to one or more HBA controllers, use the following command:

```
# vxdmpadm enable ctrlr=ctrlr_name1[,ctrlr_name2,ctrlr_nameN]
```

To enable I/O for the paths connected to an array port, use one of the following commands:

```
# vxdmpadm enable enclosure=enclr_name portid=array_port_ID
# vxdmpadm enable pwwn=array_port_WWN
```

where the array port is specified either by the enclosure name and the array port ID, or by the array port’s worldwide name (WWN) identifier.

The following are examples of using the command to enable I/O on an array port:

```
# vxdmpadm enable enclosure=HDS9500V0 portid=1A
# vxdmpadm enable pwwn=20:00:00:E0:8B:06:5F:19
```

To enable I/O for a particular path, specify both the controller and the portID, which represent the two ends of the fabric:

```
# vxdmpadm enable ctrlr=ctrlr_name enclosure=enclr_name portid=array_port_ID
```

To enable I/O for a particular DMP node, specify the DMP node name.

```
# vxdmpadm enable dmpnodename=dmpnode
```

### Configuring the response to I/O failures

You can configure how DMP responds to failed I/O requests on the paths to a specified enclosure, disk array name, or type of array. By default, DMP is configured to retry a failed I/O request up to five times for a single path.

To display the current settings for handling I/O request failures that are applied to the paths to an enclosure, array name or array type, use the `vxdmpadm getattr` command.

See “Displaying recovery option values” on page 61.

To set a limit for the number of times that DMP attempts to retry sending an I/O request on a path, use the following command:
The value of the argument to retrycount specifies the number of retries to be attempted before DMP reschedules the I/O request on another available path, or fails the request altogether.

As an alternative to specifying a fixed number of retries, you can specify the amount of time DMP allows for handling an I/O request. If the I/O request does not succeed within that time, DMP fails the I/O request. To specify an iotimeout value, use the following command:

```
# vxdmpadm setattr 
  {enclosure enc-name|arrayname name|arraytype type} 
  recoveryoption=timebound iotimeout=seconds
```

The default value of iotimeout is 300 seconds. For some applications such as Oracle, it may be desirable to set iotimeout to a larger value. The iotimeout value for DMP should be greater than the I/O service time of the underlying operating system layers.

**Note:** The fixedretry and timebound settings are mutually exclusive.

The following example configures time-bound recovery for the enclosure enc0, and sets the value of iotimeout to 360 seconds:

```
# vxdmpadm setattr enclosure enc0 recoveryoption=timebound \
  iotimeout=360
```

The next example sets a fixed-retry limit of 10 for the paths to all Active/Active arrays:

```
# vxdmpadm setattr arraytype A/A recoveryoption=fixedretry \
  retrycount=10
```

Specifying recoveryoption=default resets DMP to the default settings corresponding to recoveryoption=fixedretry retrycount=5, for example:

```
# vxdmpadm setattr arraytype A/A recoveryoption=default
```

The above command also has the effect of configuring I/O throttling with the default settings.

See “Configuring the I/O throttling mechanism” on page 60.
Configuring the I/O throttling mechanism

By default, DMP is configured with I/O throttling turned off for all paths. To display the current settings for I/O throttling that are applied to the paths to an enclosure, array name or array type, use the `vxdmpadm getattr` command.

See “Displaying recovery option values” on page 61.

If enabled, I/O throttling imposes a small overhead on CPU and memory usage because of the activity of the statistics-gathering daemon. If I/O throttling is disabled, the daemon no longer collects statistics, and remains inactive until I/O throttling is re-enabled.

To turn off I/O throttling, use the following form of the `vxdmpadm setattr` command:

```
# vxdmpadm setattr 
   {enclosure enc-name|arrayname name|arraytype type} 
   recoveryoption=nothrottle
```

The following example shows how to disable I/O throttling for the paths to the enclosure `enc0`:

```
# vxdmpadm setattr enclosure enc0 recoveryoption=nothrottle
```

The `vxdmpadm setattr` command can be used to enable I/O throttling on the paths to a specified enclosure, disk array name, or type of array:

```
# vxdmpadm setattr 
   {enclosure enc-name|arrayname name|arraytype type} 
   recoveryoption=throttle [iotimeout=seconds]
```

If the `iotimeout` attribute is specified, its argument specifies the time in seconds that DMP waits for an outstanding I/O request to succeed before invoking I/O throttling on the path. The default value of `iotimeout` is 10 seconds. Setting `iotimeout` to a larger value potentially causes more I/O requests to become queued up in the SCSI driver before I/O throttling is invoked.

The following example sets the value of `iotimeout` to 60 seconds for the enclosure `enc0`:

```
# vxdmpadm setattr enclosure enc0 recoveryoption=throttle 
   iotimeout=60
```
Specify `recoveryoption=default` to reset I/O throttling to the default settings, as follows:

```
# vxdmpadm setattr arraytype A/A recoveryoption=default
```

The above command configures the default behavior, corresponding to `recoveryoption=nothrottle`. The above command also configures the default behavior for the response to I/O failures.

See “Configuring the response to I/O failures” on page 58.

**Note:** The I/O throttling settings are persistent across reboots of the system.

### Displaying recovery option values

To display the current settings for handling I/O request failures that are applied to the paths to an enclosure, array name or array type, use the following command:

```
# vxdmpadm getattr 
  {enclosure enc-name|arrayname name|arraytype type} \
  recoveryoption
```

The following example shows the `vxdmpadm getattr` command being used to display the `recoveryoption` option values that are set on an enclosure.

```
# vxdmpadm getattr enclosure HDS9500-ALUA0 recoveryoption
ENCLR-NAME  RECOVERY-OPTION  DEFAULT[VAL]  CURRENT[VAL]
===============================================================
HDS9500-ALUA0  Throttle  Nothrottle[0]  Timebound[60]
```

This shows the default and current policy options and their values.

See “About DMP recovery options” on page 31.

### Configuring DMP path restoration policies

DMP maintains a kernel thread that re-examines the condition of paths at a specified interval. The type of analysis that is performed on the paths depends on the checking policy that is configured.

**Note:** The DMP path restoration thread does not change the disabled state of the path through a controller that you have disabled using `vxdmpadm disable`. 
When configuring DMP path restoration policies, you must stop the path restoration thread, and then restart it with new attributes.

See “Stopping the DMP path restoration thread” on page 63.

Use the `vxdmpadm settune dmp_restore_policy` command to configure one of the following restore policies. The policy will remain in effect until the restore thread is stopped or the values are changed using `vxdmpadm settune` command.

- **check_all**
  The path restoration thread analyzes all paths in the system and revives the paths that are back online, as well as disabling the paths that are inaccessible.
  The command to configure this policy is:
  ```
  # vxdmpadm settune dmp_restore_policy=check_all
  ```

- **check_alternate**
  The path restoration thread checks that at least one alternate path is healthy. It generates a notification if this condition is not met. This policy avoids inquiry commands on all healthy paths, and is less costly than `check_all` in cases where a large number of paths are available. This policy is the same as `check_all` if there are only two paths per DMP node. The command to configure this policy is:
  ```
  # vxdmpadm settune dmp_restore_policy=check_alternate
  ```

- **check_disabled**
  This is the default path restoration policy. The path restoration thread checks the condition of paths that were previously disabled due to hardware failures, and revives them if they are back online. The command to configure this policy is:
  ```
  # vxdmpadm settune dmp_restore_policy=check_disabled
  ```

- **check_periodic**
  The path restoration thread performs `check_all` once in a given number of cycles, and `check_disabled` in the remainder of the cycles. This policy may lead to periodic slowing down (due to `check_all`) if a large number of paths are available. The command to configure this policy is:
  ```
  # vxdmpadm settune dmp_restore_policy=check_periodic
  ```
  The default number of cycles between running the `check_all` policy is 10.
The `dmp_restore_interval` tunable parameter specifies how often the path restoration thread examines the paths. For example, the following command sets the polling interval to 400 seconds:

```
# vxdmpadm settune dmp_restore_interval=400
```

The settings are immediately applied and are persistent across reboots. Use the `vxdmpadm gettune` to view the current settings.

See “DMP tunable parameters” on page 118.

If the `vxdmpadm start restore` command is given without specifying a policy or interval, the path restoration thread is started with the persistent policy and interval settings previously set by the administrator with the `vxdmpadm settune` command. If the administrator has not set a policy or interval, the system defaults are used. The system default restore policy is `check_disabled`. The system default interval is 300 seconds.

**Warning:** Decreasing the interval below the system default can adversely affect system performance.

### Stopping the DMP path restoration thread

Use the following command to stop the DMP path restoration thread:

```
# vxdmpadm stop restore
```

**Warning:** Automatic path failback stops if the path restoration thread is stopped.

### Displaying the status of the DMP path restoration thread

Use the `vxdmpadm gettune` command to display the tunable parameter values that show the status of the DMP path restoration thread. These tunables include:

- `dmp_restore_state` the status of the automatic path restoration kernel thread.
- `dmp_restore_interval` the polling interval for the DMP path restoration thread.
- `dmp_restore_policy` the policy that DMP uses to check the condition of paths.
To display the status of the DMP path restoration thread

- Use the following commands:

  ```
  # vxdmpadm gettune dmp_restore_state
  # vxdmpadm gettune dmp_restore_interval
  # vxdmpadm gettune dmp_restore_policy
  ```

Viewing array policy modules

An array policy module (APM) is a dynamically loadable kernel module (plug-in for DMP) for use in conjunction with an array. An APM defines array-specific procedures and commands to:

- Select an I/O path when multiple paths to a disk within the array are available.
- Select the path failover mechanism.
- Select the alternate path in the case of a path failure.
- Put a path change into effect.
- Respond to SCSI reservation or release requests.

DMP supplies default procedures for these functions when an array is registered. An APM may modify some or all of the existing procedures that are provided by DMP or by another version of the APM.

You can use the following command to display all the APMs that are configured for a system:

```
# vxdmpadm listapm all
```

The output from this command includes the file name of each module, the supported array type, the APM name, the APM version, and whether the module is currently loaded and in use. To see detailed information for an individual module, specify the module name as the argument to the command:

```
# vxdmpadm listapm module_name
```

See the `vxdmpadm(1M)` manual page.
Getting started with the Veritas Dynamic Multi-Pathing solution in vSphere Client

Symantec’s Veritas Dynamic Multi-Pathing for VMware provides a vCenter Plugin. This plugin enables you to manage DMP in the vSphere environment, using VMware vSphere Client as the graphical user interface (GUI). The GUI appears as the Veritas Dynamic Multi-Pathing solution’s home view, and also as the VxDMP tab for the host and datacenter components of the inventory.
The Veritas Dynamic Multi-Pathing for VMware home view enables you to:

- Manage the licenses for the hosts.
- Obtain the DMP offline bundle for ESX/ESXi.
- Obtain the administration command line interface (CLI) for remote machines.

See “Working with the Veritas Dynamic Multi-Pathing for VMware home view” on page 67.

The host view in the VxDMP tab enables you to:

- View the storage and connectivity configuration for a selected host.
- Configure the attributes for the storage entities.
- Manage the distribution of I/O load for a selected host.

See “Working with the host view in the VxDMP tab” on page 73.

The datacenter view in the VxDMP tab enables you to:
■ View the list of storage arrays in the datacenter.
■ View the list of hosts issuing I/O requests to a storage array for a selected datacenter.
■ View the distribution of I/O load across various ports of a storage.
■ View the I/O statistics and details of virtual machines for a LUN.
■ Manage the array ports.
■ View the hosts common to the selected LUNs.

See “Working with datacenter view in the VxDMP tab” on page 83.

---

**Working with the Veritas Dynamic Multi-Pathing for VMware home view**

The following topics provide information for working with the Veritas Dynamic Multi-Pathing for VMware home view.

See “About the Veritas Dynamic Multi-Pathing for VMware home view” on page 67.

See “Accessing the Veritas Dynamic Multi-Pathing for VMware home view” on page 68.

Use the Veritas Dynamic Multi-Pathing for VMware home view to perform the following tasks:

To manage the licenses for the hosts.

See “Viewing the DMP and license compliance for hosts” on page 72.

See “Viewing the license details” on page 72.

See “Applying new license to a single host or multiple hosts” on page 72.

To download the DMP offline bundle for ESX/ESXi.

See “Downloading the DMP offline bundle for ESX/ESXi” on page 68.

To download the administration CLI package for remote hosts.

See “Downloading the administration CLI package for a remote host” on page 70.

---

**About the Veritas Dynamic Multi-Pathing for VMware home view**

Veritas Dynamic Multi-Pathing for VMware home view displays the Getting Started tab and the License Management tab. You can view a diagrammatic representation of the VxDMP configuration on the Getting Started tab.
Accessing the Veritas Dynamic Multi-Pathing for VMware home view

You can access the Veritas Dynamic Multi-Pathing for VMware home view from the vCenter Home in vSphere Client.

To access Veritas Dynamic Multi-Pathing for VMware home

1. Log in to vSphere Client.
2. From vCenter Home > Solutions and Applications, click Veritas Dynamic Multi-Pathing. The Veritas Dynamic Multi-Pathing for VMware home view with Getting Started tab appears.

You can also access the License Management tab from the home view.

Downloading the DMP offline bundle for ESX/ESXi

You can use the vSphere Client GUI to download the DMP offline bundle for ESX/ESXi.
Note: To be able to download the offline bundle from the home view, make sure that for the logged in user, the IE Enhanced Security setting is set to "Off".

To download the installer from vSphere Client

1 Log in to vSphere Client.

2 From vCenter Home > Solutions and Applications, click Veritas Dynamic Multi-Pathing. The Veritas Dynamic Multi-Pathing for VMware home view with Getting Started tab appears.

3 From Downloads, click the link to download the ESX/ESXi bundle for an ESX/ESXi server. The File Download window appears.

4 Click Save to save the .zip file in your system.
Note: See *Veritas Dynamic Multi-Pathing Installation Guide* for the procedure to install the DMP offline bundle for ESX/ESXi.

**Downloading the administration CLI package for a remote host**

You can administer DMP from remote physical or virtual machines, by installing the administration CLIs on the remote machine. VxMP CLIs are available for both Windows and Linux operating systems.

You can use the vSphere Client GUI to download the administration CLI package for a remote host.
To download the administration CLI package for a remote host

1. Log in to vSphere Client.

2. From vCenter Home > Solutions and Applications, click Veritas Dynamic Multi-Pathing. The Veritas Dynamic Multi-Pathing for VMware home view with Getting Started tab appears.

3. From Downloads, click the link to download the CLI package.

Note: See Veritas Dynamic Multi-Pathing Installation Guide for the procedure to install the CLI package.
Viewing the DMP and license compliance for hosts

The Veritas Dynamic Multi-Pathing solution enables you to view the percentage of your host inventory that uses DMP. You can also check the percentage for which the license is applied already.

To view the DMP and license compliance for hosts

1. From vCenter Home > Solutions and Applications, click Veritas Dynamic Multi-Pathing. The Veritas Dynamic Multi-Pathing for VMware home view with Getting Started tab appears.

2. Click the License Management tab.

3. In the DMP Managed Hosts Licensing Statistics section, view the following information:
   - Percentage of hosts not under VxDMP
   - Percentage of hosts using VxDMP without license
   - Percentage of hosts using VxDMP with license

Viewing the license details

The VxDMP solution enables you to view the license details for one or more hosts.

To view the license details

1. From vCenter Home > Solutions and Applications, click Veritas Dynamic Multi-Pathing. The Veritas Dynamic Multi-Pathing for VMware home view with Getting Started tab appears.

2. Click the License Management tab. The table displays the list of hosts with their licensing details.

Applying new license to a single host or multiple hosts

You can apply the DMP license to a host, from vSphere Client's Veritas Dynamic Multi-Pathing for VMware home view.

To apply license to a single host or multiple hosts

1. From vCenter Home > Solutions and Applications, click Veritas Dynamic Multi-Pathing. The Veritas Dynamic Multi-Pathing for VMware home view with Getting Started tab appears.

2. Click the License Management tab.
3 From the list of hosts, select one or more hosts.

**Note:** To select multiple hosts, hold the **Ctrl** key, and click the host names.

4 To apply the license key, click **Apply**.

5 The **Add New License** window appears. Enter the license key.

6 Select the check box to accept the license agreement.

7 Click **Apply**.

**Note:** An error message appears, if any of the license keys are not applied. Select the hosts and apply the correct license keys.

---

**Working with the host view in the VxDMP tab**

The following topics provide information for working with the VxDMP host view.

- See “About the host view in the VxDMP tab” on page 73.
- See “Accessing the host view in the VxDMP tab” on page 77.

Use the VxDMP host view to perform the following tasks:

- See “Setting the attributes of a storage entity” on page 79.
- See “Setting the attributes of the paths to a storage array” on page 79.
- See “Enabling or disabling paths” on page 79.
- See “Working with the I/O Statistics pane” on page 82.

---

**About the host view in the VxDMP tab**

The VxDMP tab enables you to configure and administer DMP for a host in the VMware vSphere environment.

The VxDMP tab lets you administer the following entities:

- Storage arrays
- HBAs
- LUNs
- Array ports
- Paths
The work area displays an attributes table for the selected entity, and the collapsible I/O statistics pane.

The following figure illustrates the work area:

**Figure 4-3** VxDMP host view

Table 4-1 describes the elements of the VxDMP tab in detail:
### Elements of the VxDMP host view

<table>
<thead>
<tr>
<th>Label shown in figure</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VxDMP Configuration pane</td>
<td>Displays the host, the storage arrays, and the LUNs in a hierarchical manner. For example, if you select a host, you can view the attributes and I/O statistics of the configured storage arrays across the host. You can drill down to a storage array and view the aggregate statistics and attributes of configured LUNs in that storage array. You can further drill down to an individual LUN and view the statistics and attributes of the paths to that LUN. This is a collapsible pane. You can choose to show or hide it using the Expand/Collapse icons. See “Navigating through the storage configuration hierarchy using the breadcrumbs trail” on page 78.</td>
</tr>
</tbody>
</table>
| 2                     | Summary bar | Displays information about the entity you select from the VxDMP Configuration tree. For example, if you select a host, the summary bar displays the number of connected, disconnected, and degraded storage arrays and HBAs. For a selected storage array, this displays the number of connected LUNs and array ports. For a selected LUN, this displays the number of connected paths. You can also view other information such as the I/O policy, media type, size, and so on, at a glance. A horizontal scroll bar appears if the text exceeds the available space. The summary bar also enables you to view the multi-pathing state of the selected entity, using the following color coding:  
  - Green icon: For the selected entity, all paths are properly connected or enabled.  
  - Yellow icon: The selected entity is in a degraded state, as one or more paths are disconnected or disabled.  
  - Red icon: For the selected entity, all paths are disconnected. |
Table 4-1  Elements of the VxMP host view (continued)

<table>
<thead>
<tr>
<th>Label shown in figure</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Attributes table</td>
<td>Displays the details of the attributes for the selected entity:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ For storage, the attributes displayed are: storage array name, state, HBAs connected, total LUNs, vendor, product ID, serial number, and type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ For HBA, the attributes displayed are: HBA name, state, storage arrays connected, HBA ID, vendor and transport details for the storage array.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ For LUN, the attributes displayed are: LUN name, state, enabled paths, disabled paths, media, RAID type, snapshot, size, serial number, and attributes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ For array port, the attributes displayed are: port name, state, port ID, and HBAs connected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ For path, the attributes displayed are: path name, state, type, attribute, HBA, and array port.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See “Customizing the attributes table” on page 78.</td>
</tr>
</tbody>
</table>

| 4                    | I/O Statistics pane | Displays details of I/O load distribution across the storage in terms of number of read or write operations, blocks, and average time.              |
|                      |                    | You can view the information in a tabular view or a graphical view. To switch between the views, use the corresponding icon.                      |
|                      |                    | The tabular view enables you to view the number of read or write operations, blocks, and average time at a glance. You can also compare the numeric details for multiple storage arrays. The Export icon enables you to export the I/O statistics as a .csv file. |
|                      |                    | The graphical view displays separate bar charts for number of read or write operations, blocks, and average time. This enables you to visually compare the I/O loads for multiple storage arrays. |
|                      |                    | This is a collapsible pane. You can choose to show or hide it using the Expand/Collapse icons.                                              |
Table 4-1 Elements of the VxDMP host view (continued)

<table>
<thead>
<tr>
<th>Label shown in figure</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>DMP events log icon</td>
<td>Opens the <strong>DMP Events Log</strong> window. This window enables you to remotely view the events and issues on a host, using the vSphere Client.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>From the <strong>VxDMP Configuration</strong> pane, select a host to view events at all levels. Select an HBA to view the HBA and DMP device specific events. Select a LUN to view only the DMP device and path level events.</td>
</tr>
<tr>
<td>6</td>
<td>Settings icon</td>
<td>Opens a window where you can configure the settings for the selected host or storage array. The Setting icon is not available at the LUN level.</td>
</tr>
<tr>
<td>7</td>
<td>Refresh icon</td>
<td>Lets you refresh all the entities, to display their latest status.</td>
</tr>
<tr>
<td>8</td>
<td>Logs icon</td>
<td>Enables you to view the GUI debug logs.</td>
</tr>
<tr>
<td>9</td>
<td>Help icon</td>
<td>Enables you to view the online Help topics for VxDMP. You can also access the online Help from <strong>Help &gt; VxDMP Help</strong>.</td>
</tr>
</tbody>
</table>

See “**Accessing the host view in the VxDMP tab**” on page 77.

**Accessing the host view in the VxDMP tab**

You can access the VxDMP tab's host view from vCenter Home in vSphere Client.

**To access the host view in the VxDMP tab**

1. Log in to vSphere Client.
2. From **vCenter Home > Inventory**, click **Hosts and Clusters**. The **Getting Started** tab appears in the Hosts and Clusters view.
3. From the inventory tree, select a host. The VxDMP tab appears.
4. Click the **VxDMP** tab. The VxDMP host view for the selected host appears.

**Note:** If the VxDMP components are not installed or running for the selected host, an error message appears.
Navigating through the storage configuration hierarchy using the breadcrumbs trail

The breadcrumbs trail displays the VxDMP Configuration hierarchy, Host > Storage array > LUN, for the selected entity in the hierarchy.

The trail helps you easily navigate up the storage hierarchy you have expanded, also letting you skip an intermediate level. For example, from the LUN level, you can navigate directly to the host level, without going back to the storage array level. The breadcrumbs trail is especially useful, when you hide the collapsible VxDMP Configuration pane, or if the inventory tree is very long.

You cannot navigate down a breadcrumbs trail, once you are back at the host level. You must navigate using the VxDMP Configuration tree.

Figure 4-4  VxDMP breadcrumbs trail

To navigate using the breadcrumbs trail

◆ In the breadcrumbs trail, click the storage level you want to navigate to. The details for the selected device at that level appear in the work area.

Customizing the attributes table

From the host view, you can customize the attributes table for the selected storage entity.

To sort the table rows

◆ Click the arrow icon next to the heading of a column.

For example, if you want to sort the storage attributes table according to the state, click the State column.

To rearrange the columns

◆ Click the heading of a column, and drag and drop it to the left or right, as desired.
Setting the attributes of a storage entity

From the host view, you can set the attributes for a host or a storage array.

To set the attributes of a storage entity

1. In the VxDMP host view, from the VxDMP Configuration tree, select a storage entity.
2. Click the Settings icon. The Settings window appears.

   Note: For a storage array that is listed in the attributes table for a host, you can also use the right-click menu Change attributes, to access the Settings window.

3. Set the desired setting values.
4. Click OK.

Setting the attributes of the paths to a storage array

From the host view, you can set the attributes of the paths to a storage array.

To set the attribute value of the path

1. Right-click the path name.
2. Click the required attribute value. Possible values are Set Active, Set Standby, Set Preferred, and Set Non-Preferred. A confirmation message appears.
3. Click OK.

Enabling or disabling paths

From the host view, you can enable or disable the paths for the storage entities. Refer to the following information to enable or disable paths:

- To a storage array
- From HBA to array port
- To a LUN
- From array port to HBA
To enable or disable the paths connected to a storage array

1. In the attributes table, select the storage array, and right-click. The context menu appears.
2. Click Enable or Disable. A confirmation message appears.
3. Click OK.

*Note:* You can enable or disable one or more paths to a storage array at a time.

To enable or disable the paths from an HBA to an array port

1. In the attributes table, select the HBA, and right-click. The context menu appears.
2. Click Enable or Disable.
3. Select the check box to select an array port you want to enable or disable. You can select one or more array ports at a time.
4. Click OK.

To enable or disable the paths to a LUN

1. In the attributes table, select a LUN, and right-click. The context menu appears.
2. Click Enable or Disable. A confirmation message appears.
3. Click OK.

To enable or disable the paths connected from array port to HBA

1. In the attributes table, select the array port, and right-click. The context menu appears.
2. Click Enable or Disable.
3. Select the check box to select an HBA you want to enable or disable. You can select one or more HBAs at a time.
4. Click OK.

To enable or disable a path

1. In the attributes table, select the path, and right-click. The context menu appears.
2. Click Enable or Disable. A confirmation message appears.
3. Click OK.
Note: You can enable or disable one or more paths at a time.

See “Disabling an array port, HBA, or path by force” on page 81.

Disabling an array port, HBA, or path by force

From the host view, you can disable the HBAs connected to an array port. Refer to the following information to disable the last path by force.

To force disable the HBAs connected to the array port

1. In the attributes table, select the port, and right-click. The context menu appears.
2. Click Disable.
3. Select the HBAs to be disabled.
4. Check the HBA Name check box.
5. Check the Force disable the last path check box. Selecting this check box forcibly disables the last path.
6. Click OK.

To force disable a path

1. In the attributes table, select the path, and right-click. The context menu appears.
2. Click Disable.
3. Check the Force Disable the last path check box. A confirmation message appears.
4. Click OK.

Filtering the LUNs configured for a storage array

From the host view, you can customize the attributes table for a storage array. The filter menu enables you to dynamically filter the LUNs that are displayed in the attributes table.

To filter the LUNs displayed in the attributes table of a storage array

1. In the VxDMP host view, navigate to the required storage array. The LUNs tab appears.
2. To select the filtering criteria, click the arrow button next to the search box.
3. In the filter menu box, select the check boxes for the criteria by which you want to filter the LUNs.
Click **OK**. The selected filter criteria are listed next to the search box.

In the search box, type one or more letters for the LUN names to search. The attributes table displays the filtered list of LUNs. The table is empty if none of the LUNs meet the filter and search criteria.

### Working with the I/O Statistics pane

You can use the I/O statistics pane to gather and display I/O statistics for a specified storage array, HBA, LUN, array port, or path.

See “**Resetting the I/O Statistics collection**” on page 82.

See “**Setting the time interval for automatic refresh of I/O statistics**” on page 82.

See “**Working with the host view in the VxDMP tab**” on page 73.

### Enabling or disabling the collection of I/O statistics

From the host view, you can enable or disable the collection of I/O statistics.

**To enable or disable the collection of I/O statistics**

1. In the VxDMP host view, expand the I/O statistics pane.
2. To start collecting the I/O statistics, click the **Enable** link.
   - To stop collecting the I/O statistics, click the **Disable** link.
   - A confirmation message appears.
3. Click **OK**. The I/O statistics collection starts or stops as selected.

### Resetting the I/O Statistics collection

From the host view, you can reset the collected I/O statistics to zero, and start collecting the I/O details afresh.

**To reset the I/O Statistics collection**

1. In the VxDMP host view, expand the I/O statistics pane.
2. Click the **Reset** link. A confirmation message appears.
3. Click **OK**. This resets the statistics that is collected for all the DMP entities.

### Setting the time interval for automatic refresh of I/O statistics

From the host view, you can set the time interval after which the displayed I/O statistics is automatically refreshed.
To set the time interval for automatic refresh of I/O statistics

1. In the VxDMP host view, expand the I/O statistics pane.
2. In the Auto Refresh box, select the required time interval in seconds. The I/O statistics is refreshed after the selected time interval.

Note: The Auto Refresh interval is set to the value none by default.

Working with datacenter view in the VxDMP tab

The VxDMP datacenter view displays the Host tab and the Storage tab. The following topics provide information for working with the datacenter view.

See “About the Host tab in the VxDMP datacenter view” on page 84.

See “About the Storage tab in the VxDMP datacenter view” on page 86.

See “Accessing the datacenter view in the VxDMP tab” on page 83.

Use the Host tab to perform the following tasks for a selected host:

See “Saving a DMP tuning template” on page 85.

See “Applying a DMP tuning template” on page 86.

Use the Storage tab to perform the following tasks for a selected storage array:

From the Load Distribution tab,

See “Viewing the I/O load distribution across hosts for a storage array” on page 90.

See “Viewing the I/O statistics for a LUN” on page 91.

See “Resetting the I/O statistics for all hosts” on page 91.

See “Managing the array ports” on page 92.

From the LUNs tab,

See “Viewing the hosts common to the selected LUNs” on page 92.

Accessing the datacenter view in the VxDMP tab

You can access the VxDMP tab's datacenter view from the vCenter Home in vSphere Client.
To access the datacenter view in the VxDMP tab

1. Log in to vSphere Client.

2. From vCenter Home > Inventory, click Hosts and Clusters. The Getting Started tab appears in the Hosts and Clusters view.

3. From the Inventory tree, select a datacenter. The VxDMP tab appears.

4. Click the VxDMP tab. The VxDMP datacenter view for the selected datacenter appears. The Host tab is selected.

Click the Storage tab to select it.

About the Host tab in the VxDMP datacenter view

The datacenter Host tab displays details about the hosts, and enables you to save or apply the tuning template or the naming template to a single host or multiple hosts.

The following figure illustrates the work area:

Figure 4-5 VxDMP datacenter view: Host tab

Table 4-2 describes the elements of the datacenter view in detail.
Table 4-2  Elements of the datacenter Host tab

<table>
<thead>
<tr>
<th>Label shown in figure</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Summary bar</td>
<td>Displays the name of the datacenter, the number of hosts on which the license is installed or not installed, and the number of storage arrays. A horizontal scroll bar appears if the text exceeds the available space.</td>
</tr>
<tr>
<td>2</td>
<td>Refresh icon</td>
<td>Lets you refresh all the storage arrays to display their latest information.</td>
</tr>
<tr>
<td>3</td>
<td>Logs icon</td>
<td>Enables you to view the GUI debug logs.</td>
</tr>
<tr>
<td>4</td>
<td>Help icon</td>
<td>Enables you to view the online Help topics for VxDMP. You can also access the online Help from Help &gt; VxDMP Help.</td>
</tr>
<tr>
<td>5</td>
<td>Host tab</td>
<td>Displays information about the hosts, and enables you to save and apply the tuning templates.</td>
</tr>
<tr>
<td>6</td>
<td>Attributes table</td>
<td>Displays the following information for each host in the datacenter:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Host name.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ DMP version installed on the host.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Tuning template name.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ License Status, active or inactive.</td>
</tr>
</tbody>
</table>

See “Accessing the datacenter view in the VxDMP tab” on page 83.

**Saving a DMP tuning template**

From the datacenter view **Host** tab, you can save a DMP tuning template of a host, and apply it to other hosts.

**To save a DMP tuning template**

1. In VxDMP datacenter > **Host**, in the attributes table, click a host name. The row is selected.
2. Right-click the selected row. The context menu appears.
3. Click **Save Template**. The **Save Template** window appears.
4. Click **Save**. The **Select location for download by host name** window appears.
5. Navigate to the desired folder, and click **Save**. The template is saved.
Applying a DMP tuning template

From the datacenter view Host tab, you can apply the selected DMP tuning template to one or more hosts.

To apply a DMP tuning template

1. In VxDMP datacenter > Host, in the attributes table, click one or more host names. The row(s) is/are selected.
2. Right-click the selected row(s). The context menu appears.
3. Click Apply Template. The Select file to upload by hostname window appears.
4. Navigate to the desired location and select the tuning template you want to apply.
5. Click Open. The Apply Template window appears. By default, the check box(es) for the selected host(s) appears selected.

**Note:** You can deselect a check box if you do not want to apply the template to a host in the Selected host(s) list.

6. Click Apply. The template is applied to the selected host(s). The Tuning Template column displays the name of the applied template for the selected host(s) row(s).

**Note:** In case of an error to apply the template to a host, the Tuning Template column on the Host tab displays an error icon for the host. Hovering the mouse over the error icon displays the ToolTip, showing the reason for the failure to apply the template.

See “About the Host tab in the VxMP datacenter view” on page 84.

About the Storage tab in the VxMP datacenter view

The datacenter Storage tab displays the list of storage arrays controlled by DMP, the load distribution (I/O Statistics) details for the selected storage array, and the load distribution of blocks for each port. The Storage tab also enables you to manage the array ports.

The following figure illustrates the work area:
Table 4-3 describes the elements of the datacenter view in detail.

**Table 4-3  Elements of the datacenter Storage tab**

<table>
<thead>
<tr>
<th>Label shown in figure</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Summary bar</td>
<td>Displays the name of the datacenter, the number of hosts on which the license is installed or not installed, and the number of storage arrays. A horizontal scroll bar appears if the text exceeds the available space.</td>
</tr>
<tr>
<td>2</td>
<td>Refresh icon</td>
<td>Lets you refresh all the storage arrays to display their latest information.</td>
</tr>
<tr>
<td>3</td>
<td>Logs icon</td>
<td>Enables you to view the GUI debug logs.</td>
</tr>
<tr>
<td>4</td>
<td>Help icon</td>
<td>Enables you to view the online Help topics for VxDMP. You can also access the online Help from Help &gt; VxDMP Help.</td>
</tr>
<tr>
<td>5</td>
<td>Storage tab</td>
<td>Displays information about the storage arrays, and load distribution.</td>
</tr>
</tbody>
</table>
## Table 4-3  Elements of the datacenter Storage tab (continued)

<table>
<thead>
<tr>
<th>Label shown in figure</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Attributes table</td>
<td>Displays the following information for each storage array:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Storage name.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Number of DMP-managed hosts that are connected to a storage array. Roll the mouse over the Information icon to see the name of the storage array on the hosts connected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If a storage array has different names on different hosts, then the storage array name is: vendor_product ID_Serial number. The name thus formed is the unique ID of the storage array.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Name of the vendor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Product ID.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Serial number of the storage array.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The table does not display any hosts the vCenter Server is not able to connect to.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>You can resize the table to show more or less rows, by dragging up, or down, the bottom edge of the table.</td>
</tr>
<tr>
<td>7</td>
<td>I/O statistics grouped by array ports pane</td>
<td>Displays a pie chart showing the number of blocks that are transferred across all the ports of the selected storage array, for which I/O is in progress.</td>
</tr>
</tbody>
</table>
## Table 4-3  Elements of the datacenter Storage tab (continued)

<table>
<thead>
<tr>
<th>Label shown in figure</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
</table>
| 8                     | Load Distribution tab | Displays the details about the load distribution across the storage in terms of number of read or write operations, blocks, and average time per operation, in milliseconds.  

If the I/O statistics collection for one or more hosts has been disabled, the I/O statistics pane does not display the host/s in the view. You can find the names of such hosts by hovering the mouse over the I/O statistics stopped on host(s) link.  

You can view the information in a tabular view or a graphical view. To switch between the views, use the corresponding button.  

The tabular view enables you to view the number of read or write operations, blocks, and average time, per host at a glance. You can also compare the numeric details for multiple hosts. The table can be filtered using the storage processor and the port level. The Export icon enables you to export the I/O statistics as a .csv file.  

The graphical view displays separate bar charts for the number of read or write operations, blocks, and average time, per host. This enables you to visually compare the I/O loads for multiple hosts. Each bar also enables you to launch a window to display the load distribution by LUNs for the host. Additionally, the window displays the LUN mapping for the LUNs from the host issuing I/O to the selected array storage processor port.  

The hosts are sorted in the descending order with respect to the load distribution. The top 10 hosts are displayed in the graphical view and all hosts are displayed in the tabular view. |
| 9                     | LUNs tab | Displays an attributes table, summarizing the following information for each LUN: LUN name, media, type, tier, size, connected hosts, and so on. The Export icon enables you to export the I/O statistics as a .csv file.  

You can select one or more LUNs. Using the right-click menu, you can view the list of hosts connected to the selected LUNs, along with the type of connectivity (number of paths, ports of the array connected, and the virtual machines of the hosts that are running on these LUNs). |

See “Accessing the datacenter view in the VxDMP tab” on page 83.
See “About the Host tab in the VxMP datacenter view” on page 84.

**Viewing the I/O load distribution across hosts for a storage array**

From the datacenter view **Storage** tab, you can view the I/O load that is distributed across hosts for:

- A selected storage array
- A selected storage processor
- A selected array port

**To view the I/O statistics for a storage array connected to a number of hosts**

1. In VxMP datacenter > **Storage**, in the attributes table, click the storage array name.

   The row is selected, and the I/O statistics pane displays the I/O load distribution per host, for the storage array.

**To view the I/O statistics for a selected storage processor connected to a number of hosts**

1. In VxMP datacenter > **Storage**, in the attributes table, click the storage array name.

   The row is selected, and the I/O statistics pane displays the I/O load distribution per host, for the storage array.

2. In the **Storage Processor** box, select the required storage processor.

   The I/O statistics pane displays the I/O load distribution per host, for the storage processor.

**To view the I/O statistics for a selected array port connected to a number of hosts**

1. In VxMP datacenter > **Storage**, in the attributes table, click the storage array name.

   The row is selected, and the I/O statistics pane displays the I/O load distribution per host, for the storage array.

2. In the **Storage Processor** box, select the storage processor of the array port.

3. In the **Array Ports** box, select the array port.

   The I/O statistics pane displays the I/O load distribution per host, for the array port.
Viewing the I/O statistics for a LUN

From the datacenter view Storage tab, you can view the I/O statistics and the mapping of virtual machines on a LUN.

To view the I/O statistics and the details of virtual machines on a LUN

1. In VxDMP datacenter > Storage, in the attributes table, click the required storage array. The I/O statistics for the selected storage array appears in the I/O statistics pane.

2. In the I/O statistics pane, select the graphical view. The load distribution is displayed in a bar graph. Each bar represents the Read or Write load for a host.

3. To select a host, click a bar for the host. A window displaying the load distribution by LUNs for the host appears.

   The window also displays the mapping of virtual machines and disks for the LUNs.

   To view the information in a bar chart, click the Graphical view icon. Click the respective links to view the separate bar charts for the number of read or write operations, blocks, and average time.

   To view the information in a table, click the Tabular view icon.

   Note: In the I/O statistics pane, if you filter the load distribution for storage processors or array ports, then only the LUNs from those storage processors are displayed for the selected host.

4. Click Close to close the window.

Resetting the I/O statistics for all hosts

From the datacenter view Storage tab, you can reset the I/O statistics.

To reset the I/O statistics for all hosts connected to a storage array

1. In VxDMP datacenter > Storage, in the attributes table, click the required storage array. The I/O statistics for the selected storage array appears in the I/O statistics pane.

2. Click the Reset I/O Statistics link. A confirmation message appears.

3. Click OK. This resets the I/O statistics for all the DMP entities of all hosts that are connected to the storage array.
Managing the array ports

From the datacenter view Storage tab, you can access the Manage Array Ports window. This window helps you to enable or disable the array ports connected to one or more hosts.

To manage an array port

1. In VxDMP datacenter > Storage, in the attributes table, click the storage array name. The row is selected.
2. Right-click. The context menu appears.
3. Click Manage Array Ports. The Manage Array Ports window appears.
4. To select an array port, click the column heading of the array port column. The column is selected, indicating that the array port is selected for all the hosts. The Enable Port and the Disable Port buttons are activated.
5. To deselect a host, press the Ctrl key, and click the array port cell for the host. You can deselect the array port for one or more hosts at a time.
6. To enable the array port, click the Enable Port button.
   To disable an array port, click the Disable Port button

   **Note:** To manage more than one array port, select each array port column, and follow the same procedure. You can select only one column at a time.

7. Click Close, to close the window.

Viewing the hosts common to the selected LUNs

From the datacenter view Storage tab, you can select LUNs and view information about the hosts common to the selected LUNs.

To view the hosts common to the selected LUNs

1. In VxDMP datacenter > Storage, in the attributes table, click the storage array name. The row is selected.
2. Click the LUNs tab. The LUNs table displays information about the LUNs in the selected storage.
3. To select a LUN, click its name.
   To select more than one LUN, press the Ctrl key, and click the LUN names. The rows are selected.
4. Right-click. The context menu appears.
5 Click **Show Hosts Connected**. The **Show Hosts Connected** window appears.

6 Select a host from the list of **Host(s) common to all selected LUN(s)**. The information about LUNs and virtual machines connected to the selected host appears in the tables.

7 Click **Close**, to close the window.
Administering DMP using vSphere Client

Working with datacenter view in the VxDMP tab
Administering device discovery

This chapter includes the following topics:

- About device discovery management
- About the authentication model for the vxddladm command in the VMware environment
- How DMP claims devices
- Disk categories
- Discovering and configuring newly added disk devices
- Adding support for a new disk array
- Listing all supported disk arrays
- Displaying details about a supported array library
- Displaying the disk-naming scheme

About device discovery management

Veritas Dynamic Multi-Pathing (DMP) is used to administer multiported disk arrays.

DMP uses the Device Discovery Layer (DDL) to handle device discovery and configuration of disk arrays. DDL discovers disks and their attributes that are required for DMP operations. Use the vxddladm utility to administer the DDL.
About the authentication model for the vxddladm command in the VMware environment

The vxddladm command is the utility that performs disk discovery tasks for Veritas Dynamic Multi-Pathing (DMP). In the VMware environment, execute the vxddladm command from a command-line prompt on a system that has the VxDMP remote CLI installed.

You can authenticate with the remote ESX using direct ESX credentials or vCenter access credentials.

When you specify vCenter access credentials, the vCenter authentication token is cached briefly. The authentication is reused for subsequent commands, so you do not need to specify the credentials for every command instance. Enter the password in clear text as a command argument, or supply the password when prompted.

To use vCenter access credentials, use the following form of the vxddladm command:

vxddladm vcenter=vccenter vc_user=vc_user vc_passwd=vc_pass  
[host=h1,h2,...] [flag] keyword  
   attribute=value..

where:

vcenter represents the vCenter server.
vc_user represents the vCenter user name.
vc_passwd represents the vCenter user password.

h1, h2, ... specify hosts on which to perform the operation. Alternatively, you can specify a list of hosts with the ESX_HOST_NAMES environment variable.

When you use vCenter access credentials, you must have appropriate permissions assigned to your role.

See “About roles and privileges for administering DMP” on page 25.

To use direct ESX credentials, specify one or more ESX host names, and the authentication credentials (user name and password) for each host. Use commas to separate each ESX host name, user name, and password.

To use direct ESX credentials, use the following form of the vxddladm command:

vxddladm [host=h1,h2,... [user=u1,u2,... [passwd=p1,p2,...]]]  
[flag] keyword  
   attribute=value..
For readability, some of the examples in the sections about using the vxdladm command do not show the credentials.

How DMP claims devices

For fully optimized support of any array and for support of more complicated array types, DMP requires the use of array-specific array support libraries (ASLs), possibly coupled with array policy modules (APMs). ASLs and APMs effectively are array-specific plugins that allow close tie-in of DMP with any specific array model.

See the Hardware Compatibility List for the complete list of supported arrays.

http://www.symantec.com/docs/TECH170013

During device discovery, the DDL checks the installed ASL for each device to find which ASL claims the device.

Disk categories

Disk arrays that have been certified for use with Veritas Dynamic Multi-Pathing are supported by an array support library (ASL), and are categorized by the vendor ID string that is returned by the disks (for example, “HITACHI”).

Discovering and configuring newly added disk devices

When you physically connect new disks to a host or when you zone new fibre channel devices to a host, use the ESX esxcfg-rescan command to make the ESX see the newly added devices and to update the DMP internal database to reflect the new state of the system.

DMP uses array support libraries (ASLs) to provide array-specific support for multi-pathing. An array support library (ASL) is a dynamically loadable module. The ASL implements hardware-specific logic to discover device attributes during device discovery. DMP provides the device discovery layer (DDL) to determine which ASLs should be associated to each disk array.

Adding support for a new array

To add support for a new array, add a claim rule for the array according to the following procedure.
To add support for a new array

1. Look up the library to claim the new array. Note the VID (vendor id) value for
   the required library. For ESX 4.1, you also need to note the PID value.
   See “DMP libraries for array support” on page 100.

2. Add the claim rules with the VID and PID values.
   For ESX 4.1:
   Add the claim rule with the exact VID and PID values.
   
   ```
   /usr/sbin/esxcli corestorage claimrule add --rule ruleID
   --type vendor --vendor=VID --model=PID -P VxDMP
   ```
   For ESX 5.x:
   Add the claim rule with the exact VID, and an asterisk (*) for all PIDs.
   
   ```
   /usr/sbin/esxcli storage core claimrule add \
   --claimrule-class=MP --rule=ruleID --plugin VxDMP \
   --type vendor --vendor VID --model *
   ```

3. Load the claim rules that you added in step 2.
   For ESX 4.1:
   
   ```
   /usr/sbin/esxcli corestorage claimrule load
   ```
   For ESX 5.x:
   
   ```
   /usr/sbin/esxcli storage core claimrule load
   ```

4. Reboot the system.

5. After the system reboots, verify that the library is loaded as a vmkernel
   module.
   
   ```
   # vmkload_mod -l | grep libname
   ```
   DMP now claims the new array.

Removing support for an array

To remove support for an array, remove the claim rule for the array according to
the following procedure.
To remove support for an array

1. Look up the library that claims the array to be removed. Note the VID (vendor id) value for the library that you plan to remove. For ESX 4.1, you also need to note the PID value.

   See “DMP libraries for array support” on page 100.

2. Find the claim rule to be deleted from the claim rule list.

   For ESX 4.1:

   ```
   /usr/sbin/esxcli corestorage claimrule list | grep "vendor=vid \n   model=PID"
   ```

   For ESX 5.x:

   ```
   /usr/sbin/esxcli storage core claimrule list | grep "vendor VID"
   ```

3. Fetch the ruleID `ruleID` of the claim rules extracted from step 2.

4. Delete the claim rules with ruleID `ruleID`. Note that if the claim rule is used by other libraries, deleting the claim rule also causes the other libraries to be removed from DMP.

   For ESX 4.1:

   ```
   /usr/sbin/esxcli corestorage claimrule delete --rule ruleID
   ```

   For ESX 5.x:

   ```
   /usr/sbin/esxcli storage core claimrule remove --rule ruleID
   ```

5. Load the claim rules.

   For ESX 4.1:

   ```
   /usr/sbin/esxcli corestorage claimrule load
   ```

   For ESX 5.x:

   ```
   /usr/sbin/esxcli storage core claimrule load
   ```

6. Reboot the system.

7. After the system reboots, verify that the library to claim the array is not loaded as a vmkernel module.

   ```
   # vmkload_mod -l | grep libname
   ```

DMP no longer claims the devices.
DMP libraries for array support

Table 5-1 lists the libraries that DMP uses for array support for arrays with the specified Vendor ID (VID) and PID. The ATYPE column shows the array type.

For the latest list of supported hardware and storage arrays, see the following URL:

https://sort.symantec.com

<table>
<thead>
<tr>
<th>S.No</th>
<th>VID</th>
<th>PID</th>
<th>ATYPE</th>
<th>Library</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>3PARdata</td>
<td>VV</td>
<td>A/A</td>
<td>ddl3par</td>
</tr>
<tr>
<td>2.</td>
<td>DGC</td>
<td>*</td>
<td>CLR-A/P, CLR-A/PF, CLR-ALUA</td>
<td>ddlCLARiiON</td>
</tr>
<tr>
<td>3.</td>
<td>FUJITSU</td>
<td>E6000</td>
<td>A/A</td>
<td>ddlFJTSYe6k</td>
</tr>
<tr>
<td>4.</td>
<td>FUJITSU</td>
<td>*</td>
<td>A/A</td>
<td>ddlFJTSYe8k</td>
</tr>
<tr>
<td>5.</td>
<td>EMC</td>
<td>Invista</td>
<td>Inv-A/A, VPLEX-A/A</td>
<td>ddlInvista</td>
</tr>
<tr>
<td>6.</td>
<td>COMPELNT</td>
<td>Compellent Vol</td>
<td>A/A</td>
<td>ddlcompellent</td>
</tr>
<tr>
<td>7.</td>
<td>COPANSYS</td>
<td>8814, 8818</td>
<td>A/A-A</td>
<td>ddlcopan</td>
</tr>
<tr>
<td>8.</td>
<td>DDN</td>
<td>S2A 9550, S2A 9900, S2A 9700</td>
<td>A/A</td>
<td>ddddns2a</td>
</tr>
<tr>
<td>9.</td>
<td>DDN</td>
<td>S2A 6620, SFA 10000</td>
<td>ALUA</td>
<td>ddddns2a_sfa</td>
</tr>
<tr>
<td>11.</td>
<td>ECCS</td>
<td>*</td>
<td>A/A</td>
<td>ddleccs</td>
</tr>
<tr>
<td>12.</td>
<td>EMC</td>
<td>SYMMETRIX</td>
<td>A/A</td>
<td>ddlemc</td>
</tr>
<tr>
<td>13.</td>
<td>EQLOGIC</td>
<td>100E-00</td>
<td>A/A</td>
<td>ddleqlogic</td>
</tr>
<tr>
<td>S.No</td>
<td>VID</td>
<td>PID</td>
<td>ATYPE</td>
<td>Library</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>----------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>14.</td>
<td>HP</td>
<td>A5277A</td>
<td>A/A, A/P</td>
<td>ddfc60</td>
</tr>
<tr>
<td>15.</td>
<td>FUJITSU</td>
<td>E3000, E400A</td>
<td>A/PG</td>
<td>ddfje3k4ka</td>
</tr>
<tr>
<td>16.</td>
<td>FUJITSU</td>
<td>E2000, ETERNUS_DX1</td>
<td>A/A</td>
<td>ddfjtseye2k</td>
</tr>
<tr>
<td>17.</td>
<td>FSC</td>
<td>FibreCAT_SX1</td>
<td>A/A</td>
<td>ddfsc</td>
</tr>
<tr>
<td>18.</td>
<td>FUJITSU</td>
<td>GR710, GR720, GR730, GR740, GR820, GR840</td>
<td>A/A, A/P</td>
<td>ddfujitsu</td>
</tr>
<tr>
<td>19.</td>
<td>HITACHI</td>
<td>DF600, DF600-V, DF600F, DF600F-V</td>
<td>A/A-A, A/PG, A/P, A/A</td>
<td>ddlhdsaluA</td>
</tr>
<tr>
<td>20.</td>
<td>HITACHI</td>
<td>*</td>
<td>A/A, A/P</td>
<td>ddlhdsusp</td>
</tr>
<tr>
<td>21.</td>
<td>DotHill</td>
<td>SANnet II FC, SANnet II SCSI, SANnet II SATA, SANnet II U320</td>
<td>A/A</td>
<td>ddlhillsannet2</td>
</tr>
<tr>
<td>22.</td>
<td>HP, COMPAQ</td>
<td>HSV101, HSV111, HSV111, HSV200, HSV210, HSV300, HSV400, HSV450, HSV340, HSV360</td>
<td>ALUA</td>
<td>ddlhpaluA</td>
</tr>
<tr>
<td>23.</td>
<td>HP</td>
<td>HSVX740</td>
<td>ALUA</td>
<td>ddlhpsvsp</td>
</tr>
<tr>
<td>24.</td>
<td>IBM</td>
<td>2107, 2107900</td>
<td>A/A</td>
<td>ddlibmds8k</td>
</tr>
<tr>
<td>25.</td>
<td>IBM</td>
<td>2145</td>
<td>IBMIVCS-ALUA</td>
<td>ddlibmmvc</td>
</tr>
<tr>
<td>26.</td>
<td>IBM, SUN, STK, SGI, DELL</td>
<td>*</td>
<td>A/P, A/PF-LSI</td>
<td>ddsisiall</td>
</tr>
<tr>
<td>27.</td>
<td>HP</td>
<td>MSA2012fc, MSA2212fc, MSA2012i</td>
<td>A/A</td>
<td>ddlmsa2k</td>
</tr>
</tbody>
</table>
### Table 5-1  
DMP libraries for array support *(continued)*

<table>
<thead>
<tr>
<th>S.No</th>
<th>VID</th>
<th>PID</th>
<th>ATYPE</th>
<th>Library</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.</td>
<td>NETAPP</td>
<td>*</td>
<td>ALUA, A/A</td>
<td>ddlnetapp</td>
</tr>
<tr>
<td>30.</td>
<td>NEXSAN</td>
<td>SATABoy2, SATABeast2, NXS-B01-000</td>
<td>ALUA</td>
<td>ddlnexsan</td>
</tr>
<tr>
<td>31.</td>
<td>NEC</td>
<td>iStorage 1000, iStorage 2000, iStorage 4000, DISK ARRAY</td>
<td>A/A, ALUA</td>
<td>ddlnipnyis</td>
</tr>
<tr>
<td>32.</td>
<td>Pillar</td>
<td>Axiom 300, Axiom 500, Axiom 600</td>
<td>ALUA</td>
<td>ddlpillaraxiom</td>
</tr>
<tr>
<td>33.</td>
<td>Promise</td>
<td>VTrak E610f, VTrak E310f, VTrak E610s, VTrak E310s</td>
<td>A/A</td>
<td>ddlpromise</td>
</tr>
<tr>
<td>34.</td>
<td>TMS</td>
<td>RamSan 400, RamSan</td>
<td>A/A</td>
<td>ddrlramsan</td>
</tr>
<tr>
<td>35.</td>
<td>IBM</td>
<td>2105</td>
<td>A/A</td>
<td>ddlsahark</td>
</tr>
<tr>
<td>36.</td>
<td>StorComp</td>
<td>OmniForce</td>
<td>A/A</td>
<td>ddlsstorcomp</td>
</tr>
<tr>
<td>S.No</td>
<td>VID</td>
<td>PID</td>
<td>ATYPE</td>
<td>Library</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>37.</td>
<td>SUN</td>
<td>Sun Storage 7410, Sun Storage 7310, Sun Storage 7210, Sun Storage 7110, ZFS Storage 7120, ZFS Storage 7320, ZFS Storage 7420, ZFS Storage 7720</td>
<td>SUN7x10-ALUA</td>
<td>ddsun7x10</td>
</tr>
<tr>
<td>38.</td>
<td>SUN</td>
<td>StorEdge 3310, StorEdge 3320, StorEdge 3510, StorEdge 3511</td>
<td>A/A</td>
<td>ddsunse3k</td>
</tr>
<tr>
<td>39.</td>
<td>SUN</td>
<td>T4</td>
<td>A/P, A/PF-T3PLUS</td>
<td>ddsunset4</td>
</tr>
<tr>
<td>40.</td>
<td>TOSHIBA</td>
<td>AF_AF3500, AF_AF1500, AF2_AF7000, AF2_AF2000, AF3_AF7500, AF3_AF2500</td>
<td>A/A</td>
<td>ddltsbaf</td>
</tr>
<tr>
<td>41.</td>
<td>HP</td>
<td>A6188A, A6189A</td>
<td>A/A</td>
<td>ddlva</td>
</tr>
<tr>
<td>42.</td>
<td>WINSYS, EVERTZ</td>
<td>SX2318R, SC10R12</td>
<td>ALUA</td>
<td>ddlwinsys</td>
</tr>
<tr>
<td>43.</td>
<td>XIOTECH</td>
<td>ISE1400</td>
<td>A/A</td>
<td>ddlxiotechE5k</td>
</tr>
<tr>
<td>44.</td>
<td>XIV, IBM</td>
<td>NEXTRA, 2810XIV</td>
<td>A/A, ALUA</td>
<td>ddlxiv</td>
</tr>
<tr>
<td>45.</td>
<td>HP</td>
<td>*</td>
<td>A/A</td>
<td>ddlxp1281024</td>
</tr>
<tr>
<td>46.</td>
<td>HP</td>
<td>*</td>
<td>A/A</td>
<td>ddlxp12k</td>
</tr>
<tr>
<td>47.</td>
<td>HP</td>
<td>*</td>
<td>A/A</td>
<td>ddlxp256</td>
</tr>
</tbody>
</table>
Adding support for a new disk array

You can add support for a new type of disk array. The support comes in the form of Array Support Libraries (ASLs) that are developed by Symantec. Symantec provides support for new disk arrays through updates to the VRTSaslapm bundle. To determine if an updated VRTSaslapm bundle is available for download, refer to the hardware compatibility list tech note. The hardware compatibility list provides a link to the latest bundle for download and instructions for installing the VRTSaslapm bundle.

To access the hardware compatibility list, go to the following URL:

http://www.symantec.com/docs/TECH170013

Each VRTSaslapm bundle is specific for the Dynamic Multi-Pathing version. Be sure to install the VRTSaslapm bundle that supports the installed version of Dynamic Multi-Pathing.

If you need to remove the latest VRTSaslapm bundle, you can revert to the previously installed version. For the detailed procedure, refer to the Veritas Storage Foundation and High Availability Solutions Troubleshooting Guide.

Listing all supported disk arrays

Use this procedure to obtain values for the vid and pid attributes that are used with other forms of the vxddladm command.

To list all supported disk arrays

◆ Type the following command:

```bash
# vxddladm listsupport all
```

Displaying details about a supported array library

DMP enables you to display details about the Array Support Libraries (ASL).
To display details about a supported array library

- Type the following command:

```
# vxddladm listsupport libname=library_name
```

This command displays the vendor ID (VID), product IDs (PIDs) for the arrays, array types (for example, A/A or A/P), and array names. The following is sample output.

```
# vxddladm listsupport libname=libvxemc

<table>
<thead>
<tr>
<th>ATTR_NAME</th>
<th>ATTR_VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIBNAME</td>
<td>libvxemc</td>
</tr>
<tr>
<td>VID</td>
<td>EMC</td>
</tr>
<tr>
<td>PID</td>
<td>SYMMETRIX</td>
</tr>
<tr>
<td>ARRAY_TYPE</td>
<td>A/A</td>
</tr>
<tr>
<td>ARRAY_NAME</td>
<td>EMC</td>
</tr>
</tbody>
</table>
```

Displaying the disk-naming scheme

DMP disk naming can be operating-system based naming or enclosure-based naming.

For ESX, DMP disk naming supports only enclosure-based naming.

The following command displays whether the DMP disk naming scheme is currently set. It also displays the attributes for the disk naming scheme, such as whether persistence is enabled.

To display the current disk-naming scheme and its mode of operations, use the following command:

```
# vxddladm get namingscheme

<table>
<thead>
<tr>
<th>NAMING_SCHEME</th>
<th>PERSISTENCE</th>
<th>LOWERCASE</th>
<th>USE_AVID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
```

See “Disk device naming in DMP” on page 18.
Administering device discovery

Displaying the disk-naming scheme
Performance monitoring and tuning

This chapter includes the following topics:

- About tuning Veritas Dynamic Multi-Pathing (DMP) with templates
- DMP tuning templates
- Example DMP tuning template
- Tuning a DMP host with a configuration attribute template
- Managing the DMP configuration files
- Resetting the DMP tunable parameters and attributes to the default values
- DMP tunable parameters and attributes that are supported for templates
- DMP tunable parameters

**About tuning Veritas Dynamic Multi-Pathing (DMP) with templates**

Veritas Dynamic Multi-Pathing has multiple tunable parameters and attributes that you can configure for optimal performance. DMP provides a template method to update several tunable parameters and attributes with a single operation. The template represents a full or partial DMP configuration, showing the values of the parameters and attributes of the host.

To view and work with the tunable parameters, you can dump the configuration values of the DMP tunable parameters to a file. Edit the parameters and attributes,
if required. Then, load the template file to a host to update all of the values in a single operation.

You can load the configuration file to the same host, or to another similar host. The template method is useful for the following scenarios:

- Configure multiple similar hosts with the optimal performance tuning values. Configure one host for optimal performance. After you have configured the host, dump the tunable parameters and attributes to a template file. You can then load the template file to another host with similar requirements. Symantec recommends that the hosts that use the same configuration template have the same operating system and similar I/O requirements.

- Define multiple specialized templates to handle different I/O load requirements. When the load changes on a host, you can load a different template for the best performance. This strategy is appropriate for predictable, temporary changes in the I/O load. As the system administrator, after you define the system's I/O load behavior, you can customize tuning templates for particular loads. You can then automate the tuning, since there is a single load command that you can use in scripts or cron jobs.

At any time, you can reset the configuration, which reverts the values of the tunable parameters and attributes to the DMP default values.

You can manage the DMP configuration file with the `vxdmpadm config` commands. See the `vxdmpadm(1m)` man page.

**DMP tuning templates**

The template mechanism enables you to tune DMP parameters and attributes by dumping the configuration values to a file, or to standard output.

DMP supports tuning the following types of information with template files:

- DMP tunable parameters.
- DMP attributes defined for an enclosure, array name, or array type.
- Veritas naming scheme parameters.

The template file is divided into sections, as follows:

- **DMP Tunables**
  Applied to all enclosures and arrays.

- **Namingscheme**
  Applied to all enclosures and arrays.

- **Arraytype**
  Use to customize array types. Applied to all of the enclosures of the specified array type.
Arrayname

Use if particular arrays need customization; that is, if the tunables vary from those applied for the array type.

Attributes in this section are applied to all of the enclosures of the specified array name.

Enclosurename

Applied to the enclosures of the specified Cab serial number and array name.

Use if particular enclosures need customization; that is, if the tunables vary from those applied for the array type and array name.

Loading is atomic for the section. DMP loads each section only if all of the attributes in the section are valid. When all sections have been processed, DMP reports the list of errors and warns the user. DMP does not support a partial rollback. DMP verifies the tunables and attributes during the load process. However, Symantec recommends that you check the configuration template file before you attempt to load the file. Make any required corrections until the configuration file validates correctly.

The attributes are given priority in the following order when a template is loaded:

Enclosure Section > Array Name Section > Array Type Section

If all enclosures of the same array type need the same settings, then remove the corresponding array name and enclosure name sections from the template. Define the settings only in the array type section. If some of the enclosures or array names need customized settings, retain the attribute sections for the array names or enclosures. You can remove the entries for the enclosures or the array names if they use the same settings that are defined for the array type.

When you dump a configuration file from a host, that host may contain some arrays which are not visible on the other hosts. When you load the template to a target host that does not include the enclosure, array type, or array name, DMP ignores the sections.

You may not want to apply settings to non-shared arrays or some host-specific arrays on the target hosts. Be sure to define an enclosure section for each of those arrays in the template. When you load the template file to the target host, the enclosure section determines the settings. Otherwise, DMP applies the settings from the respective array name or array type sections.
Example DMP tuning template

This section shows an example of a DMP tuning template.

```
# DMP settings are saved into this template file on
# Jul 13, 2012 at 09:38:25
#
#
# Template Format:
#   <section 1>
#     <tab><attribute 1>=<value>
#     <tab><attribute 2>=<value>
#   <section 2>
#     <tab><attribute 1>=<value>
#     <tab><attribute 2>=<value>

DMP Tunables

# The first open performed by an ASL on the device
# is cached to enhances the performance of device
# discovery by minimizing the overhead caused by
# subsequent opens by ASLs if set to on.
# dmp_cache_open=on

# The number of kernel threads that are available
# for servicing error handling, path restoration
# and other DMP administrative tasks is equal to
# the value of 'dmp_daemon_count'.
# dmp_daemon_count=10

# Set the time interval in seconds for which DMP
# needs to delay the error processing in case the
# device is found to be busy.
# dmp_delayq_interval=15

# Start the kernel thread that implement DMP path
# restoration activity if set to on.
# dmp_restore_state=enabled

# HBA interface if supported is used to obtain
# SCSI error information for faster recovery if
# set to on.
# dmp_fast_recovery=on

# Set the time period in seconds for which a path
# must stay healthy. If path's state changes back
# to disabled within this time period then DMP
# marks the path as intermittently failing and
# does not re-enable the path for I/O until
# 'dmp_path_age' seconds elapse.
# dmp_health_time=60
```
# Set the level of detail to which DMP console messages are displayed.
dmp_log_level=1
# Set low impact path probing feature to on/off.
dmp_low_impact_probe=on
# Set retry period for handling transient errors.
# If set to a nonzero value, I/Os to a disk with all failed paths will be retried until the
# specified interval or until I/O succeeds on one of the paths, whichever happens first.
dmp_lun_retry_timeout=60
# Set time for which intermittently failing path needs to be monitored before DMP marks the path
# as healthy and, again attempts to schedule I/O requests on it.
dmp_path_age=300
# Set the default number of contiguous I/O blocks (as integer exponent of a power of 2 e.g., 11
# represents 2048 blocks) that are sent along DMP path to an array before switching to the next
# available path.
dmp_pathswitch_blks_shift=9
# Controls the activity of the path restoration kernel thread. Idle LUNs are also probed when
# set to on.
dmpprobe_idle_lun=on
# Set number of paths which will be probed by the
# restore daemon in order to determine idle/failed
# subset within a subpaths failover group(SFG).
dmp_probe_threshold=5
# Set the number of cycles between running the
# check_all policy, when the restore policy is
# check_periodic.
dmp_restore_cycles=10
# Set time interval in seconds for restore daemon
# to analyzes the condition of paths.
dmp_restore_interval=300
# Set DMP path restoration policy.
dmp_restore_policy=check_disabled
# Set maximum number of retries to attempt on
# the path if there is an I/O error.
dmp_retry_count=5
# Set the timeout value for any SCSI command
# that is sent via DMP.
dmp_scsi_timeout=30
# Set the status of the subpaths failover group
# (SFG) feature. The feature is turned off on
# setting to 0.
dmp_sfg_threshold=1
# Set the time interval between gathering
# DMP statistics.
dmp_stat_interval=1
# Enable monitoring of dynamic change in
# LUN ownership.
dmp_monitor_ownership=on
# Controls the use of SINA (Storage Networking
# Industry Association) HBA API for ESD. This
# API allows DDL to improve the performance of
# failover by collecting information about the
# SAN topology and by monitoring fabric events
# when set to on.
dmp_monitor_fabric=on
# Controls the functionality of ESD to monitor
# LUN add/remove OS events.
dmp_monitor_osevent=on
# Set native support feature to on/off.
dmp_native_support=off
# The 'namingscheme' attribute can be set to either EBN or OSN.
# The EBN namingscheme sets the DMP meta node names based on the
# enclosure name whereas OSN namingscheme sets the DMP meta node
# names as same as operating system device names.
#
# The 'persistence' attribute specifies whether the names of disk
# devices that are displayed by DMP remain unchanged after disk
# hardware has been reconfigured and/or the system rebooted.
#
# The 'lowercase' attribute is yes by default. The name of the
# enclosure is converted to lowercase, regardless of the case of
# the name specified by the ASL. To suppress the conversion to
# lowercase, use lowercase=no option.
#
# The 'use_avid' attribute is yes by default. For EBN scheme, the
# Array Volume ID (AVID) is used together with the enclosure name
# for the DMP meta node name.
Namingscheme
namingscheme=ebn
persistence=yes
lowercase=yes
use_avid=yes

# The Arraytype/Arrayname/Enclosure sections contain following
# attributes. These attributes can be set for the all paths to an
# enclosure, for the paths to all enclosures of a particular type
# (for example EVA4K6K) and for the paths to all enclosures of a
# particular array type (for example A/A). The priority are given
# in following order while loading below mentioned attributes:
#
# Enclosure Section > Arrayname Section > Arraytype Section
#
# iopolicy The I/O load is balanced based on the
# policy across multiple paths to a disk
# array or enclosure in a system.
#
# partitionsize This is an optional attribute which is
# specified with adaptive | adaptiveminq
# | balanced iopolicy only. It determines
# the size of the track cache. The size
# is in blocks and should be power of 2.
# If the specified size is not a power of
# 2, it is rounded down to the nearest
# power of 2.
#
# use_all_paths This is also an optional attribute which
# controls whether the secondary paths in
# an Asymmetric Active/Active(A/A-A) or an
# ALUA array are used for scheduling
# I/O requests in addition to the primary
# paths or not.
#
# recoveryoption It determines how DMP handles throttling
# and error recovery.
#
# dmp_lun_retry_timeout Set retry period for handling transient
# errors. If set to a nonzero value, I/Os
# to a disk with all failed paths will be
# retried until the specified interval or
# until I/O succeeds on one of the paths,
# whichever happens first. This is valid
# for Enclosure section only.
Arraytype
arraytype=A/A
iopolicy=minimumq
partitionsize=512
recoveryoption=nothrottle
recoveryoption=timebound iotimeout=300
redundancy=0

Arrayname
arrayname=Hitachi_USP-VM
iopolicy=minimumq
partitionsize=512
recoveryoption=nothrottle
recoveryoption=timebound iotimeout=300
redundancy=0

Arrayname
arrayname=Hitachi_VSP
iopolicy=minimumq
partitionsize=512
recoveryoption=nothrottle
recoveryoption=timebound iotimeout=300
redundancy=0

Arrayname
arrayname=EMC
iopolicy=minimumq
partitionsize=512
recoveryoption=nothrottle
recoveryoption=timebound iotimeout=300
redundancy=0

Enclosure
serial=25847
arrayname=Hitachi_USP-VM
arraytype=A/A
iopolicy=minimumq
partitionsize=512
recoveryoption=nothrottle
recoveryoption=timebound iotimeout=300
redundancy=0
dmp_lun_retry_timeout=60

Enclosure
serial=54332
arrayname=Hitachi_VSP
arraytype=A/A
Tuning a DMP host with a configuration attribute template

You can use a template file to upload a series of changes to the DMP configuration to the same host or to another similar host.

Symantec recommends that you load the DMP template to a host that is similar to the host that was the source of the tunable values.
To configure DMP on a host with a template

1. Dump the contents of the current host configuration to a file.

   ```
   # vxcmpadm config dump file=filename
   ```

2. Edit the file to make any required changes to the tunable parameters in the template.

   The target host may include non-shared arrays or host-specific arrays. To avoid updating these with settings from the array name or array type, define an enclosure section for each of those arrays in the template. When you load the template file to the target host, the enclosure section determines the settings. Otherwise, DMP applies the settings from the respective array name or array type sections.

3. Validate the values of the DMP tunable parameters.

   ```
   # vxcmpadm config check file=filename
   ```

   DMP displays no output if the configuration check is successful. If the file contains errors, DMP displays the errors. Make any required corrections until the configuration file is valid. For example, you may see errors such as the following:

   ```
   VxVM vxcmpadm ERROR V-5-1-0 Template file 'error.file' contains following errors:
   
   Line No: 22  'dmp_daemon_count' can not be set to 0 or less
   Line No: 44  Specified value for 'dmp_health_time' contains non-digits
   Line No: 64  Specified value for 'dmp_path_age' is beyond the limit of its value
   Line No: 76  'dmp_probe_idle_lun' can be set to either on or off
   Line No: 281 Unknown arraytype
   ```

4. Load the file to the target host.

   ```
   # vxcmpadm config load file=filename
   ```

   During the loading process, DMP validates each section of the template. DMP loads all valid sections. DMP does not load any section that contains errors.
Managing the DMP configuration files

You can display the name of the template file most recently loaded to the host. The information includes the date and time when DMP loaded the template file.

To display the name of the template file that the host currently uses

◆  # vxdmpadm config show

<table>
<thead>
<tr>
<th>TEMPLATE_FILE</th>
<th>DATE</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>machinename@/tmp/myconfig</td>
<td>Feb 09, 2011</td>
<td>11:28:59</td>
</tr>
</tbody>
</table>

Resetting the DMP tunable parameters and attributes to the default values

DMP maintains the default values for the DMP tunable parameters and attributes. At any time, you can restore the default values to the host. Any changes that you applied to the host with template files are discarded.

To reset the DMP tunables to the default values

◆  Use the following command:

  # vxdmpadm config reset

DMP tunable parameters and attributes that are supported for templates

DMP supports tuning the following tunable parameters and attributes with a configuration template.

DMP tunable parameters

- iopolicy
- partitionsize
- use_all_paths
- recoveryoption attributes (retrycount or iotimeout)
- redundancy
- dmp_lun_retry_timeout

DMP attributes defined for an enclosure, array name, or array type.

See “DMP tunable parameters” on page 118.
DMP tunable parameters

DMP provides various parameters that you can use to tune your environment. Table 6-1 shows the DMP parameters that can be tuned. You can set a tunable parameter online, without a reboot.

Table 6-1  DMP parameters that are tunable

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dmp_daemon_count</td>
<td>The number of kernel threads that are available for servicing path error handling, path restoration, and other DMP administrative tasks. The default number of threads is 10.</td>
</tr>
<tr>
<td>dmp_delayq_interval</td>
<td>How long DMP should wait before retrying I/O after an array fails over to a standby path. Some disk arrays are not capable of accepting I/O requests immediately after failover. The default value is 15 seconds.</td>
</tr>
<tr>
<td>dmp_health_time</td>
<td>DMP detects intermittently failing paths, and prevents I/O requests from being sent on them. The value of ( dmp_health_time ) represents the time in seconds for which a path must stay healthy. If a path’s state changes back from enabled to disabled within this time period, DMP marks the path as intermittently failing, and does not re-enable the path for I/O until ( dmp_path_age ) seconds elapse. The default value is 60 seconds. A value of 0 prevents DMP from detecting intermittently failing paths.</td>
</tr>
</tbody>
</table>
Table 6-1  DMP parameters that are tunable *(continued)*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| dmp_log_level                 | The level of detail that is displayed for DMP console messages. The following level values are defined:  

  1 — Displays all DMP log messages that existed in releases before 5.0.  

  2 — Displays level 1 messages plus messages that relate to path or disk addition or removal, SCSI errors, IO errors and DMP node migration.  

  3 — Displays level 1 and 2 messages plus messages that relate to path throttling, suspect path, idle path and insane path logic.  

  4 — Displays level 1, 2 and 3 messages plus messages that relate to setting or changing attributes on a path and tunable related changes.  

The default value is 2. |
| dmp_low_impact_probe         | Determines if the path probing by restore daemon is optimized or not. Set it to *on* to enable optimization and *off* to disable. Path probing is optimized only when restore policy is check_disabled or during check_disabled phase of check_periodic policy.  

The default value is *on*. |
Table 6-1  DMP parameters that are tunable (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dmp_lun_retry_timeout</td>
<td>Specifies a retry period for handling transient errors that are not handled by the HBA and the SCSI driver. If the value of the dmp_lun_retry_timeout tunable parameter is 0, the paths are checked for connectivity only once. When all paths to a disk fail, DMP fails the I/Os to the application. The default value of the dmp_lun_retry_timeout tunable parameter is 60. In special cases when DMP needs to handle the transient errors, configure DMP to delay failing the I/Os to the application for a short interval. Set the dmp_lun_retry_timeout tunable parameter to a non-zero value to specify the interval. If all of the paths to the LUN fail and I/Os need to be serviced, then DMP probes the paths every five seconds for the specified interval. If the paths are restored within the interval, DMP detects this and retries the I/Os. DMP does not fail I/Os to a disk with all failed paths until the specified dmp_lun_retry_timeout interval or until the I/O succeeds on one of the paths, whichever happens first.</td>
</tr>
<tr>
<td>dmp_monitor_fabric</td>
<td>Determines whether the Event Source daemon (vxesd) uses the Storage Networking Industry Association (SNIA) HBA API. This API allows DDL to improve the performance of failover by collecting information about the SAN topology and by monitoring fabric events. If this parameter is set to on, DDL uses the SNIA HBA API. Note that the HBA vendor specific HBA-API library should be available to use this feature. If this parameter is set to off, the SNIA HBA API is not used.</td>
</tr>
</tbody>
</table>
## Table 6-1  DMP parameters that are tunable (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dmp_monitor_ownership</td>
<td>Determines whether the ownership monitoring is enabled for ALUA arrays. When this tunable is set to on, DMP polls the devices for LUN ownership changes. The polling interval is specified by the dmp_restore_interval tunable. The default value is on. When the dmp_monitor_ownership tunable is off, DMP does not poll the devices for LUN ownership changes.</td>
</tr>
<tr>
<td>dmp_path_age</td>
<td>The time for which an intermittently failing path needs to be monitored as healthy before DMP again tries to schedule I/O requests on it. The default value is 300 seconds. A value of 0 prevents DMP from detecting intermittently failing paths.</td>
</tr>
<tr>
<td>dmp_pathswitch_blks_shift</td>
<td>The default number of contiguous I/O blocks that are sent along a DMP path to an array before switching to the next available path. The value is expressed as the integer exponent of a power of 2; for example 9 represents 512 blocks. This parameter only affects the behavior of the balanced I/O policy. A value of 0 disables multi-pathing for the policy unless the vxdmpadm command is used to specify a different partition size for an array.</td>
</tr>
<tr>
<td>dmp_probe_idle_lun</td>
<td>If DMP statistics gathering is enabled, set this tunable to on (default) to have the DMP path restoration thread probe idle LUNs. Set this tunable to off to turn off this feature. (Idle LUNs are VM disks on which no I/O requests are scheduled.) The value of this tunable is only interpreted when DMP statistics gathering is enabled. Turning off statistics gathering also disables idle LUN probing. The default value is on.</td>
</tr>
</tbody>
</table>
Table 6-1  DMP parameters that are tunable (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dmp_probe_threshold</td>
<td>If the dmp_low_impact_probe is turned on, dmp_probe_threshold determines the number of paths to probe before deciding on changing the state of other paths in the same subpath failover group. The default value is 5.</td>
</tr>
<tr>
<td>dmp_restore_cycles</td>
<td>If the DMP restore policy is check_periodic, the number of cycles after which the check_all policy is called. The default value is 10. See “Configuring DMP path restoration policies” on page 61.</td>
</tr>
<tr>
<td>dmp_restore_interval</td>
<td>The interval attribute specifies how often the path restoration thread examines the paths. Specify the time in seconds. The default value is 300. The value of this tunable can also be set using the vxdmpadm start restore command. See “Configuring DMP path restoration policies” on page 61.</td>
</tr>
<tr>
<td>dmp_restore_policy</td>
<td>The DMP restore policy, which can be set to one of the following values: check_all check_alternate check_disabled check_periodic The default value is check_disabled The value of this tunable can also be set using the vxdmpadm start restore command. See “Configuring DMP path restoration policies” on page 61.</td>
</tr>
</tbody>
</table>
### Table 6-1  
DMP parameters that are tunable (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dmp_restore_state</td>
<td>If this parameter is set to <em>enabled</em>, it enables the path restoration thread to be started.</td>
</tr>
<tr>
<td></td>
<td>See “Configuring DMP path restoration policies” on page 61.</td>
</tr>
<tr>
<td></td>
<td>If this parameter is set to <em>disabled</em>, it stops and disables the path restoration thread.</td>
</tr>
<tr>
<td></td>
<td>If this parameter is set to <em>stopped</em>, it stops the path restoration thread until the next device discovery cycle.</td>
</tr>
<tr>
<td></td>
<td>The default is <em>enabled</em>.</td>
</tr>
<tr>
<td></td>
<td>See “Stopping the DMP path restoration thread” on page 63.</td>
</tr>
<tr>
<td>dmp_retry_count</td>
<td>When I/O fails on a path with a path busy error, DMP marks the path as busy and avoids using it for the next 15 seconds. If a path reports a path busy error for dmp_retry_count number of times consecutively, DMP marks the path as failed. The default value of dmp_retry_count is 5.</td>
</tr>
<tr>
<td>dmp_scsi_timeout</td>
<td>Determines the timeout value to be set for any SCSI command that is sent via DMP. If the HBA does not receive a response for a SCSI command that it has sent to the device within the timeout period, the SCSI command is returned with a failure error code.</td>
</tr>
<tr>
<td>dmp_sfg_threshold</td>
<td>Determines the minimum number of paths that should be failed in a failover group before DMP starts suspecting other paths in the same failover group. The value of 0 disables the failover logic based on subpath failover groups. The default value is 1.</td>
</tr>
<tr>
<td>dmp_stat_interval</td>
<td>The time interval between gathering DMP statistics. The default and minimum value are 1 second.</td>
</tr>
</tbody>
</table>
DMP troubleshooting

This appendix includes the following topics:

- Troubleshooting tips
- Collecting logs for Symantec Support
- Symantec VxDMP plugin unregistration error
- Symantec VxDMP plugin appears "Disabled" or the VxDMP tabs are not visible at the datacenter or host level
- VMware vCenter Server becomes permanently unavailable
- Downgrading the array support
- Troubleshooting tips if the system panicks or hangs
- Troubleshooting tips for Command Line exception errors
- Device disappears after VxDMP installation on ESX/ESXi 4.1

Troubleshooting tips

Use the information in this section to diagnose the installation or operation problems that you might encounter.

Troubleshooting issues require looking at the log files created by the various components.

The following files may be required to determine the source of a problem:

- For installation issues: Refer to the Symantec VxDMP Console installation log file.
  %AllUsersProfile%\Veritas\VPI\log\date_timestamp\n
- For ESX server issues: Refer to the ESX log files from the following locations.
Logs for provider: /var/log/messages
Logs for MPP for ESX 4.1 host: /var/log/vmkernel
Logs for MPP for ESX 5.x host: /scratch/log/vmkernel

- For DMP Console-related issues: Refer to the DMPConsole file.
  %AllUsersProfile%\Symantec\DMP\Logs\DMPConsole.log

- For VxDMP Plugin-related issues: Refer to the VIPluginRegistration file.
  %AllUsersProfile%\Symantec\DMP\Logs\VIPluginRegistration.log

- For VxDMP tab issues at the host or datacenter level: In the VxDMP tab, click the View Log icon.

Here, %AllUsersProfile% is the Windows variable that typically expands to:

C:\Documents and Settings\All Users

On Windows 2008 and 2008 R2, it typically expands to:

C:\ProgramData

Collecting logs for Symantec Support

In case of any issues, use the vxexplorer support tool on the ESX server. The vxexplorer tool collects the information required for Symantec Support to troubleshoot the issue.

The tool collects the logs and displays the name of the log file. Provide the log file to Symantec Support.

To use the vxexplorer tool
- Use the following command:

  # vxexplorer

Symantec VxDMP plugin unregistration error

Symantec VxDMP plugin unregistration may fail during the DMP Console uninstallation.

Resolution: Use the registerPlugin.bat utility to unregister the plugin. Run this utility on the host where DMP Console is installed, using the same user account that was used for DMP Console installation.

You can run the utility from:

DMP Console install directory\DMP\bin>registerPlugin.bat
You can run the utility as follows:

```bash
registerPlugin DMPConsole_IP vCenterServer_IP vCenterServerSDK_Port vCenterServer_Username vCenterServer_Password
register|unregister|verify
[AppServerConfigFileName]
```

Make sure that the vCenter Server user, `vCenterServer_Username` in the above usage statement, has the extension registration privileges on vCenter Server, to run the registerPlugin.bat utility.

**Symantec VxDMP plugin appears "Disabled" or the VxDMP tabs are not visible at the datacenter or host level**

Symantec VxDMP plugin appears disabled in vCenter Server Plug-in Manager if vCenter Server fails to access the DMP Console server IP. Since the plugin is disabled, the VxDMP tab is not available at the host and the datacenter level.

Alternately, the VxDMP tab in vSphere Client may display an HTTP 404 Not Found error.

Resolution: Verify the following conditions and then refresh the tab in vSphere Client.

- Verify that the DMP Console host is running and is accessible over the network.
- Verify that the 'VxDMP Console server ' service is running on the DMP Console server.
- Verify that the VMware Web Service is running on the vCenter Server.
- Verify that ports, 14241 and 14242, are not blocked by a firewall on DMP Console server.
- Log out of vSphere Client and log in again. Then, verify that the Symantec VxDMP plugin is installed and enabled.

If the plugin is still in the disabled state, use the registerPlugin.bat to unregister the plugin, and then register it again. While registering the plugin again, specify a DMP Console server IP address that is accessible over the network from vCenter Server.

For information to run the registerPlugin.bat utility:

See “**Symantec VxDMP plugin unregistration error**” on page 126.
For prerequisite settings before you verify the installation, see *Veritas Dynamic Multi-Pathing Installation Guide*.

**VMware vCenter Server becomes permanently unavailable**

The VMware vCenter Server may be unavailable either due to a server crash or because you want to set up a new server altogether.

Resolution: Perform the following steps to set up the new server.

**To set up a new server**

1. Create a new vCenter Server. Refer to the VMware documentation for instructions. Symantec VxDMP supports the VMware vCenter versions 4.1 and 5.0.
2. Move all the VMware ESX hosts to the new vCenter Server you created. Refer to the VMware documentation for instructions.
3. Register the VxDMP plugin for vCenter Server.
4. Exit vSphere Client, launch it again, and then log in to the new vCenter Server where you moved all the ESX hosts, to view the VxDMP tabs.

**Downgrading the array support**

The array support is available in a single bundle, `VRTSaslapm`, that includes Array Support Libraries (ASLs) and Array Policy Modules (APMs). Each major release of Dynamic Multi-Pathing includes the supported `VRTSaslapm` bundle, which is installed as part of the product installation. Between major releases, Symantec may provide additional array support through updates to the `VRTSaslapm` bundle.

If you have issues with an updated `VRTSaslapm` bundle, Symantec may recommend that you downgrade to a previous version of the ASL/APM bundle. You can only revert to a bundle that is supported for the installed release of Dynamic Multi-Pathing. To perform the downgrade while the system is online, do not remove the installed bundle. Instead, you can install the previous version of the bundle over the new bundle. This method prevents multiple instances of the `VRTSaslapm` bundle from being installed.

Use the following method to downgrade the `VRTSaslapm` bundle.
Troubleshooting tips if the system panicks or hangs

See the Known issues and Software limitations sections in this document.
Obtain and send the following files to Symantec:
- vmkernel core file in the /root directory of ESX4.1
- /var/log/vmkernel* and /var/log/messages log files

Troubleshooting tips for Command Line exception errors

See the Known issues and Software limitations sections in this document.
Obtain and send the following files to Symantec:
- CLI output
- /var/log/messages log file

Device disappears after VxDMP installation on ESX/ESXi 4.1

Check if the vendor and the model of the storage device is supported by VxDMP. If the device is not supported, delete the MPP claim rule associated with VxDMP from the esxcli corestorage claimrule list.

If the device is supported, check if the Model property used by VMware matches exactly with the value in the VxDMP claim rule. VMware ESX environment does not support claim rules that include wild card characters or partial matches. The claim rule must have the exact value without any extra characters for VMware to present the device to VxDMP. Remove the existing claim rule and add a claim rule with the exact match of the Model property.
Device disappears after VxMP installation on ESX/ESXi 4.1
<table>
<thead>
<tr>
<th>Glossary Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active/Active disk arrays</strong></td>
<td>This type of multi-pathed disk array allows you to access a disk in the disk array through all the paths to the disk simultaneously, without any performance degradation.</td>
</tr>
<tr>
<td><strong>Active/Passive disk arrays</strong></td>
<td>This type of multipathed disk array allows one path to a disk to be designated as primary and used to access the disk at any time. Using a path other than the designated active path results in severe performance degradation in some disk arrays.</td>
</tr>
<tr>
<td><strong>device name</strong></td>
<td>The device name or address used to refer to a physical disk connected to the host. In a SAN environment, it is more convenient to use enclosure-based naming, which forms the device name by concatenating the name of the enclosure (such as enc0) with the disk’s number within the enclosure, separated by an underscore (for example, enc0_2). The term disk access name can also be used to refer to a device name.</td>
</tr>
<tr>
<td><strong>disabled path</strong></td>
<td>A path to a disk that is not available for I/O. A path can be disabled due to real hardware failures or if the user has used the <code>vxdmpadm disable</code> command on that controller.</td>
</tr>
<tr>
<td><strong>disk</strong></td>
<td>A collection of read/write data blocks that are indexed and can be accessed fairly quickly. Each disk has a universally unique identifier.</td>
</tr>
<tr>
<td><strong>disk access name</strong></td>
<td>An alternative term for a device name.</td>
</tr>
<tr>
<td><strong>disk array</strong></td>
<td>A collection of disks logically arranged into an object. Arrays tend to provide benefits such as redundancy or improved performance.</td>
</tr>
<tr>
<td><strong>disk array serial number</strong></td>
<td>This is the serial number of the disk array. It is usually printed on the disk array cabinet or can be obtained by issuing a vendor-specific SCSI command to the disks on the disk array. This number is used by the DMP subsystem to uniquely identify a disk array.</td>
</tr>
<tr>
<td><strong>disk controller</strong></td>
<td>In the multipathing subsystem of VxVM, the controller (host bus adapter or HBA) or disk array connected to the host, which the operating system represents as the parent node of a disk.</td>
</tr>
<tr>
<td><strong>disk enclosure</strong></td>
<td>An intelligent disk array that usually has a backplane with a built-in Fibre Channel loop, and which permits hot-swapping of disks.</td>
</tr>
<tr>
<td><strong>disk ID</strong></td>
<td>A universally unique identifier that is given to each disk and can be used to identify the disk, even if it is moved.</td>
</tr>
<tr>
<td><strong>disk name</strong></td>
<td>A logical or administrative name chosen for a disk that is under the control of VxVM, such as disk03. The term disk media name is also used to refer to a disk name.</td>
</tr>
<tr>
<td><strong>enabled path</strong></td>
<td>A path to a disk that is available for I/O.</td>
</tr>
<tr>
<td><strong>enclosure</strong></td>
<td>See disk enclosure.</td>
</tr>
<tr>
<td><strong>enclosure-based naming</strong></td>
<td>See device name.</td>
</tr>
<tr>
<td><strong>fabric mode disk</strong></td>
<td>A disk device that is accessible on a Storage Area Network (SAN) via a Fibre Channel switch.</td>
</tr>
<tr>
<td><strong>Fibre Channel</strong></td>
<td>A collective name for the fiber optic technology that is commonly used to set up a Storage Area Network (SAN).</td>
</tr>
<tr>
<td><strong>file system</strong></td>
<td>A collection of files organized together into a structure. The UNIX file system is a hierarchical structure consisting of directories and files.</td>
</tr>
<tr>
<td><strong>multipathing</strong></td>
<td>Where there are multiple physical access paths to a disk connected to a system, the disk is called multipathed. Any software residing on the host, (for example, the DMP driver) that hides this fact from the user is said to provide multipathing functionality.</td>
</tr>
<tr>
<td><strong>path</strong></td>
<td>When a disk is connected to a host, the path to the disk consists of the HBA (Host Bus Adapter) on the host, the SCSI or fibre cable connector and the controller on the disk or disk array. These components constitute a path to a disk. A failure on any of these results in DMP trying to shift all I/O for that disk onto the remaining (alternate) paths.</td>
</tr>
<tr>
<td><strong>primary path</strong></td>
<td>In Active/Passive disk arrays, a disk can be bound to one particular controller on the disk array or owned by a controller. The disk can then be accessed using the path through this particular controller.</td>
</tr>
<tr>
<td><strong>RAID (redundant array of independent disks)</strong></td>
<td>A disk array set up with part of the combined storage capacity used for storing duplicate information about the data stored in that array. This makes it possible to regenerate the data if a disk failure occurs.</td>
</tr>
<tr>
<td><strong>secondary path</strong></td>
<td>In Active/Passive disk arrays, the paths to a disk other than the primary path are called secondary paths. A disk is supposed to be accessed only through the primary path until it fails, after which ownership of the disk is transferred to one of the secondary paths.</td>
</tr>
<tr>
<td><strong>SAN (storage area network)</strong></td>
<td>A networking paradigm that provides easily reconfigurable connectivity between any subset of computers, disk storage and interconnecting hardware such as switches, hubs and bridges.</td>
</tr>
</tbody>
</table>
A
A/A disk arrays 12
A/A-A disk arrays 13
A/P disk arrays 13
A/P-C disk arrays 13–14
A/P-F disk arrays 13
A/P-G disk arrays 14
access port 13
active path attribute 27
active paths
devices 50–51
Active/Active disk arrays 12
Active/Passive disk arrays 13
adaptive load-balancing 29
adaptiveminq policy 29
Add New License 72
APM
configuring 64
Apply Template 86
array policy module (APM)
configuring 64
Array Ports
gathering I/O statistics 90
array ports
disabling for DMP 56
displaying information about 44
enabling for DMP 57
managing 92
array support library (ASL) 97
arrays
DMP support 97
ASL
array support library 97
Asymmetric Active/Active disk arrays 13
attributes
active 27, 79
nopreferred 27
preferred priority 28
setting for paths 27, 50–51
standby 28, 79
attributes table
datacenter Host 84
datacenter Storage 86
filtering the LUN view 81
host view 73
sorting 78
Auto Refresh 82
autotrespass mode 13
B
balanced path policy 30
breadcrumbs trail 78
C
categories
disks 97
Change attributes
host view 79
check_all policy 62
check_alternate policy 62
check_disabled policy 62
check_periodic policy 62
CLI package
about 11
downloading from GUI 70
configuring attributes
host view
path 79
storage array 79
Configuring DMP
using templates 107
configuring new disks 97
Controller ID
displaying 43
collectors
disabling for DMP 56
disabling in DMP 26
displaying information about 42
enabling for DMP 57
D

datacenter view
  accessing 83
Host tab 84
Load Distribution
  Array Ports 90
  Storage Array 90
  Storage Processor 90
Reset I/O Statistics link 91
Storage tab 86

DDL 17
device discovery
  introduced 17
Device Discovery Layer (DDL) 17
devices
  JBOD 97
  path redundancy 50-51
Disable 82
  Disable Port 92
disk arrays
  A/A 12
  A/A-A 13
  A/P 13
  A/P-F 13
  A/P-G 14
  Active/Active 12
  Active/Passive 13
  Asymmetric Active/Active 13
  JBOD devices 97
  listing supported 104
  multipathed 17
  supported with DMP 104
disk discovery 97
disks
  array support library 97
  categories 97
  configuring newly added 97
  discovery of by DMP 97
  displaying naming scheme 105
  enclosures 19
  naming schemes 18
displaying
  DMP nodes 38
  HBA information 43
  redundancy levels 50
  supported disk arrays 104
DMP
  check_all restore policy 62
  check_alternate restore policy 62

DMP (continued)
  check_disabled restore policy 62
  check_periodic restore policy 62
  configuring DMP path restoration policies 61
  configuring I/O throttling 32, 60
  configuring response to I/O errors 31, 58, 61
  disabling array ports 56
  disabling controllers 56
  disabling paths 56
  disk discovery 97
  displaying DMP database information 27
  displaying DMP node for a path 37
  displaying DMP node for an enclosure 37-38
  displaying DMP nodes 38
  displaying information about array ports 44
  displaying information about controllers 42
  displaying information about enclosures 43
  displaying information about paths 59
  displaying paths for a controller 41
  displaying paths for an array port 41
  displaying recoveryoption values 61
  displaying status of DMP path restoration thread 63
  dynamic multi-pathing 12
  enabling array ports 57
  enabling controllers 57
  enabling paths 57
  enclosure-based naming 14
  gathering I/O statistics 45
  load balancing 17
  logging levels 119
  path aging 118
  path failover mechanism 16
  path-switch tunable 121
  restore policy 62
  scheduling I/O on secondary paths 33, 53
  setting the DMP restore polling interval 62
  stopping the DMP restore daemon 63
  tuning with templates 107
  viewing hosts using license 72

DMP bundle
  about 11
  downloading from GUI 68

DMP Console
  about 11

DMP for VMware
  about home view 67
accessing home view 68
home view 65
DMP nodes
displaying consolidated information 38
DMP support
JBOD devices 97
dmp_daemon_count tunable 118
dmp_delayq_interval tunable 118
dmp_health_time tunable 118
dmp_log_level tunable 119
dmp_low_impact_probe 119
dmp_monitor_ownership tunable 121
dmp_path_age tunable 121
dmp_pathswitch_blks_shift tunable 121
dmp_probe_idle_lun tunable 121
dmp_probe_threshold tunable 122
dmp_restore_cycles tunable 122
dmp_restore_interval tunable 122
dmp_restore_state tunable 123
dmp_scsi_timeout tunable 123
dmp_sfg_threshold tunable 123
dmp_stat_interval tunable 123

e
Enable 82
Enable Port 92
enclosure-based naming 19, 21
   DMP 14
enclosures 19
displaying information about 43
   path redundancy 50–51
   setting attributes of paths 27, 50–51
esxcfg-rescan command 97
eui based naming scheme 19
explicit failover mode 13

f
failover mode 13
Force
disabling the last path 81

G
Getting Started
tab 67

H
HBA
disabling by force 81
HBA information
displaying 43

I
I/O
gathering statistics for
   disabling or enabling 82
   resetting from datacenter view 91
   resetting from host view 82
   setting automatic refresh time 82
   gathering statistics for DMP 45
   scheduling on secondary paths 33, 53
   throttling 16
I/O policy
displaying 52
example 54
specifying 29, 52
I/O Statistics
   Array Ports 90
   Storage Array 90
   Storage Processor 90
I/O throttling 32, 60
I/O throttling options
  configuring 32
idle LUNs 121
implicit failover mode 13

J
JBOD
  DMP support 97

L
License Management
  applying license 72
  tab 67
  viewing host license details 72
  viewing license compliance 72
listing
  DMP nodes 38
  supported disk arrays 104
load balancing 12
  displaying policy for 52
  specifying policy for 29, 52
Load Distribution
  tab 86
logical units 13
LUN 13
  Viewing I/O statistics for 91
LUN group failover 14
LUNs
  idle 121
  tab 86, 92

M
Manage Array Ports 92
managing array ports 92
minimum queue load balancing policy 30
minimum redundancy levels
  displaying for a device 50
  specifying for a device 51
mrl
  keyword 51
multi-pathing
  displaying information about 39

N
naa based naming scheme 19
naming scheme
  displaying for disks 105
naming schemes
  for disks 18
non-autotrespass mode 13
nopreferred path attribute 27

P
pane
  host I/O statistics 73
  VxDMP Configuration 73
partition size
  displaying the value of 52
  specifying 30
path aging 118
path failover in DMP 16
paths
  disabling by force 81
  disabling for DMP 56, 79
  enabling for DMP 57, 79
  setting attributes of 27, 50-51, 79
performance
  load balancing in DMP 17
polling interval for DMP restore 62
preferred priority path attribute 28, 79
primary path 13
priority load balancing 30

R
recovery option values
  configuring 61
redundancy levels
  displaying for a device 50
  specifying for a device 51
redundant-loop access 20
Reset 82
Reset I/O Statistics 91
restore policy
  check_all 62
  check_alternate 62
  check_disabled 62
  check_periodic 62
retry option values
  configuring 61
round-robin
  load balancing 31

S
scanning disks 97
secondary path 13
Set Active
host view 79
Set Non-Preferred
host view 79
Set Preferred
host view 79
Set Standby
host view 79
setting
path redundancy levels 51
Settings
host view 79
Show Hosts Connected 92
single active path policy 31
specifying
redundancy levels 51
standby path attribute 28, 79
statistics gathering 16
Storage Array
gathering I/O statistics 90
storage array
setting attributes 79
Storage Processor
gathering I/O statistics 90
storage processor 13
Storage tab
datacenter view 86

T

tab
datacenter Host 84
datacenter Storage 86
  Load Distribution 86
  LUNs 86
Getting Started 67–68
License Management 67–68
Load Distribution 90
VxDMP 65
throttling 16
tunables (continued)
dmp_probe_threshold 122
dmp_restore_cycles 122
dmp_restore_interval 122
dmp_restore_state 123
dmp_scsi_timeout 123
dmp_sfg_threshold 123
dmp_stat_interval 123
Tuning DMP
  using templates 107

U
use_all_paths attribute 33, 53

V
Veritas Dynamic Multi-Pathing
  solution 65
vxddladm
displaying the disk-naming scheme 105
listing supported disk arrays 104
VxDMP
tab 65
VxDMP Configuration
diagramic representation 67
  pane 73
VxDMP tab
datacenter Host tab 84
datacenter Storage tab 86
  host view 73
vxdmpadm
configuring I/O throttling 32, 60
configuring response to I/O errors 31, 58, 61
disabling controllers in DMP 26
disabling I/O in DMP 56
displaying APM information 64
displaying DMP database information 27
displaying DMP node for a path 37
displaying DMP node for an enclosure 37–38
displaying I/O error recovery settings 61
displaying I/O policy 52
displaying I/O throttling settings 61
displaying information about controllers 42
displaying information about enclosures 43
displaying multi-pathing information 40
displaying partition size 52
displaying paths controlled by DMP node 40
displaying status of DMP restoration thread 63
enabling I/O in DMP 58
vxdmpadm  *(continued)*
  gathering I/O statistics  45
  listing information about array ports  44
  setting I/O policy  30, 53
  setting path attributes  50
  setting restore polling interval  62
  specifying DMP path restoration policy  62
  stopping DMP restore daemon  63
vxdmpadm list
  displaying DMP nodes  38

W
worldwide name identifiers  18
WWN identifiers  18