This guide describes the requirements and procedures for connecting and configuring the XP family of disk arrays to work with an AlphaServer running the OpenVMS operating system.
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About this guide

This guide describes the requirements and procedures for connecting and configuring the XP family of disk arrays to work with an AlphaServer host running the OpenVMS operating system.

Intended audience

This guide is intended for system administrators who have knowledge of the following topics:

• Data processing concepts
• Direct access storage device subsystems and their basic functions
• Disk arrays and RAID technology
• Operating system commands and utilities

Disk arrays

Unless otherwise noted, the term disk array refers to these disk arrays:

- HP Surestore Disk Array XP512
- HP Surestore Disk Array XP48
- HP StorageWorks Disk Array XP128
- HP StorageWorks Disk Array XP1024
- HP StorageWorks XP12000 Disk Array

Related documentation

HP provides these related documents:

- HP StorageWorks Disk Array XP128: Owner’s Guide
- HP StorageWorks Disk Array XP1024: Owner’s Guide
- HP StorageWorks Command View XP for XP Disk Arrays: User Guide
- HP StorageWorks XP12000 Disk Array: Owner’s Guide
- Guidelines for OpenVMS Cluster Configurations (Chapter 7)
Refer to the manufacturer’s documentation for information about operating system commands and third-party products.

**Conventions**

This guide uses these text conventions.

**Figure 1** Blue text represents a cross-reference. In the online version of this guide, the reference is linked to the target.

www.hp.com Underlined, blue text represents a website on the Internet. For the online version of this guide, the reference is linked to the target.

**literal** Bold text represents literal values that you type exactly as shown, as well as key and field names, menu items, buttons, file names, application names, and dialog box titles.

**variable** Italic type indicates that you must supply a value. Italic type is also used for manual titles.

**input/output** Monospace font denotes user input and system responses, such as output and messages.

**Example** Denotes an example of input or output. The display shown in this guide may not match your configuration exactly.

[] Indicates an optional parameter.

{} Indicates that you must specify at least one of the listed options.

| Separates alternatives in a list of options.
**HP technical support**

In North America, call technical support at 1-800-652-6672, available 24 hours a day, 7 days a week.

Outside North America, call technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the HP website under support:


Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

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

**HP storage website**

Visit the support website for the most current information about HP StorageWorks XP products.


Consult your HP account representative for information about product availability, configuration, and connectivity.
### HP authorized reseller

For the name of your nearest HP authorized reseller, call:

<table>
<thead>
<tr>
<th>Country</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>1-800-345-1518</td>
</tr>
<tr>
<td>Canada</td>
<td>1-800-263-5868</td>
</tr>
</tbody>
</table>

Or visit: [www.hp.com](http://www.hp.com)
Revision history

September 2000    First release
March 2001       Added appendixes D, E, and glossary
February 2003    Updates
November 2003    Updates
July 2004        Updates for version 7.3
November 2004    Updated for XP12000
Warranty statement

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You and your HP service representative each play a role in installation. Your HP service representative is responsible for installing the disk array and formatting the disk devices. You are responsible for configuring the host server for the new devices with assistance from your HP service representative.
Features and requirements

The disk array and host have the following features:

- **Storage capacity.** The storage capacity for each model is listed below:
  - **XP48:** Up to 48 drives from 72 GB to 8.7 TB, 24 FC ports
  - **XP128:** From 8 to 128 drives for up to 18 TB, 48 FC ports
  - **XP512:** Up to 512 drives from 72 GB to 93 TB, 48 FC ports
  - **XP1024:** From 8 to 1024 drives for up to 149 TB, 64 FC ports
  - **XP12000:** Up to 1152 drives for up to 165 TB, 128 FC ports

- **Server support.** PCI-based AlphaServers

- **Operating system support.** OpenVMS 7.3 or later

Before installing the disk array, ensure the environment conforms to these requirements:

- Alpha System Firmware version 5.6 or higher for Fibre Channel support.

- Host Bus Adapters (HBAs). Install HBAs and all utilities and drivers. Refer to the adapter documentation for installation details.

- *(Recommended)* HP StorageWorks Command View XP with LUN management feature or Remote Control with LUN Configuration Manager XP option. These are used to configure disk array ports and paths.

- *(Recommended)* HP StorageWorks Secure Manager XP. Allows the host to access only authorized array devices.

- *(Optional)* Other available XP software (some may not be supported by your system):
  - HP StorageWorks Business Copy XP
  - HP StorageWorks Continuous Access XP
  - HP StorageWorks Continuous Access Extension XP
  - HP StorageWorks Auto LUN XP
  - HP StorageWorks Data Exchange XP
HP StorageWorks Resource Manager XP
HP StorageWorks RAID Manager XP
HP StorageWorks Cache LUN XP
HP StorageWorks Auto Path XP
HP StorageWorks Cluster Extension XP
HP StorageWorks Performance Advisor XP

**Fibre Channel interface**

The XP family of disk arrays supports these Fibre Channel elements:

- Connection speed of 1 Gbps and 2 Gbps
- Short-wave non-OFC (open fiber control) optical interface
- Multimode optical cables with SC or LC connectors
- Public or private arbitrated loop (FC-AL) or direct fabric attach
- Fibre Channel switches

Even though the interface is Fibre Channel, this guide uses the term “SCSI disk” because disk array devices are defined to the host as SCSI disks.

**Device emulation types**

The XP family of disk arrays supports these device emulation types:

- **OPEN-\(x\) devices**: OPEN-\(x\) logical units represent disk devices. Except for OPEN-V, these devices are based on fixed sizes. OPEN-V is a user-defined size. Supported emulations include OPEN-3, OPEN-8, OPEN-9, OPEN-E, OPEN-L, and OPEN-V devices.

- **LUSE devices (OPEN-\(x^n\))**: Logical Unit Size Expansion (LUSE) devices combine 2 to 36 OPEN-\(x\) devices to create expanded LDEVs larger than standard OPEN-\(x\) disk devices. For example, an OPEN-\(x\) LUSE volume created from ten OPEN-\(x\) volumes is designated as OPEN-\(x^{*10}\).

- **CVS devices (OPEN-\(x\) CVS)**: Volume Size Configuration (VSC) defines custom volumes (CVS) that are smaller than normal fixed-sized logical disk devices (volumes). (OPEN-V is a
CVS-based custom disk size that you determine. OPEN-L does not support CVS.)

- **LUSE (expanded) CVS devices (OPEN-x*n CVS):** LUSE CVS combines CVS devices to create an expanded device. This is done by first creating CVS custom-sized devices and then using LUSE to combine from 2 to 36 CVS devices. For example, if three OPEN-9 CVS volumes are combined to create an expanded device, this device is designated as OPEN-9*3-CVS.

### RAID Manager command devices

HP’s RAID Manager optional software product manages Business Copy (BC) or Continuous Access (CA) operations from a host server. To use RAID Manager with BC or CA, use Command View or LUN Configuration Manager to designate at least one disk array LDEV as a Raid Manager command device. Refer to the Command View or LUN Configuration Manager user guide for information about how to designate a command device.

On the OS side, you should create a LUN 0 device of 35 megabytes (the smallest allowed). This will allow you to use host-based RAID management tools available from HP and will also allow HP support to do some additional diagnostics.

Note that storage assigned to the LUN 0 device is not accessible from OpenVMS.

### Failover

The XP family of disk arrays supports many standard software products, including OpenVMS Multipath Software, that provide host, application, or I/O path failover and logical volume (storage) management.
SNMP configuration

The XP family of disk arrays supports standard Simple Network Management Protocol (SNMP) to remotely manage the disk array from the host. The SNMP agent on the remote console PC or Command View can provide status and Remote Service Information Message (R-SIM) reporting to the SNMP manager on the host for up to eight disk arrays. Refer to the operating system documentation to configure the SNMP manager on the host.
Installation procedures

Perform these actions to set up the disk array:

1. Install and configure the disk array (page 19)
   - Setting the System Option Modes
   - Configuring the Fibre Channel ports

2. Install and configure the host (page 24)
   - Loading the OS and software
   - Installing and configuring the HBAs
   - Clustering and fabric zoning

3. Configure FC switches (page 27)
   - Defining the paths

4. Connect the disk array (page 29)
   - Verifying disk array device recognition

5. Configure disk array devices (page 30)
   - Initializing and label the devices
   - Mounting the devices
   - Verifying file system operation
Install and configure the disk array

The HP service representative performs these tasks:

- Assembling hardware and installing software
- Loading the microcode updates
- Installing the channel adapters (CHAs) and cabling
- Installing and formatting devices

After these tasks are finished, you will use Command View or LUN Configuration Manager to complete the remaining tasks listed below. If you do not have Command View or LUN Configuration Manager, your HP service representative can perform these tasks for you.

The following restrictions apply when configuring any XP disk array with an OpenVMS host:

- When an XP port is assigned to OpenVMS, that port may not be shared with any other operating system.
- Multiple OpenVMS hosts may share the same XP port.
- Sharing of CHA microprocessors is not recommended.
Setting the System Option Modes

The HP service representative sets the System Option Mode(s) based on the operating system and software configuration of the host.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Level</th>
<th>Description and Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>161</td>
<td>Mandatory</td>
<td>Allows high-speed microprocessor FW update.</td>
</tr>
<tr>
<td>228</td>
<td>Mandatory</td>
<td>Provides unique UUIDs to the boot device, which allows the SRM console WWIDMGRquickset to discover multiple boot paths.</td>
</tr>
<tr>
<td>278</td>
<td>Mandatory</td>
<td>RCSN notification that allows new XP128 ports to be used/identified when adding to an existing configuration.</td>
</tr>
</tbody>
</table>
Configuring the Fibre Channel ports

Configure the Fibre Channel ports on the disk array using Command View (shown) or the Fibre Parameter window in LUN Configuration Manager. Select the settings for each port based on your storage area network topology. Use switch zoning if you connect different types of hosts to the array through the same switch.

![Image showing Fibre Channel configuration](image)

Fibre address

In fabric environments, the port addresses are assigned automatically.
Fabric and connection parameter settings

Set each array port to FABRIC ON or OFF with connections of POINT-TO-POINT or FC-AL as shown in the following table and figures. For detailed topology information, refer to the HP StorageWorks SAN Design Reference Guide on the hp.com website.

<table>
<thead>
<tr>
<th>Fabric Parameter</th>
<th>Connection Parameter</th>
<th>Provides</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>FC-AL</td>
<td>Not supported by OpenVMS</td>
</tr>
<tr>
<td>ON</td>
<td>Point-to-Point</td>
<td>N-port (fabric port, direct connect)</td>
</tr>
<tr>
<td>OFF</td>
<td>FC-AL</td>
<td>Not supported by OpenVMS</td>
</tr>
<tr>
<td>OFF</td>
<td>Point-to-Point</td>
<td>Not supported</td>
</tr>
</tbody>
</table>
Setting the Host Mode for the disk array ports

The disk array ports have Host Modes that you must set depending on the host you use. After the disk array is installed, use Command View (shown) or LUN Configuration Manager to set the Host Mode for each port.

The required Host Mode setting for OpenVMS is 05.
Install and configure the host

This section explains how to install and configure the host and host bus adapters (HBAs) that connect the host to the disk array.

Loading the OS and software

Follow the manufacturer’s instructions to load the operating system and software onto the host. Load all OS patches and configuration utilities supported by HP and the HBA manufacturer.

Installing and configuring the HBAs

Install and configure the host bus adapters using the HBA manufacturer’s instructions.

Verify FC HBA installation and set fabric mode by using wwidmgr:

1. P00 >>> set mode diagnostic
2. P00 >>> wwidmgr -show adapter
   The list of adapters is displayed.
3. P00 >>> wwidmgr -set adapter -item xxxx -topology fabric
   This sets the HBA for the required fabric mode.
4. P00 >>> wwidmgr -show adapter
   The list of adapters is displayed, showing fabric topology.
5. P00 >>> initialize
**Clustering and fabric zoning**

Clustering is the organization of multiple servers into groups. Within a cluster, each server is a node. Multiple clusters compose a multi-cluster environment. The following example shows a multi-cluster environment with three clusters, each containing two nodes. The nodes share access to the disk array.

Clustering software is an integral part of OpenVMS, however, it requires a license. Refer to the HP manual “Guidelines for OpenVMS Cluster Configurations” for complete instructions.

Within the Storage Area Network (SAN), the clusters may be homogeneous (all the same operating system) or they may be heterogeneous (mixed operating systems). How you configure LUN security and fabric zoning depends on the operating system mix and the SAN configuration.
**Fabric zoning and LUN security for multiple operating systems**

You can connect multiple clusters of various operating systems to the same switch and fabric using appropriate zoning and LUN security as follows:

- Host zones must contain only homogeneous operating systems.
- Storage port zones may overlap if more than one operating system needs to share an array port.
- Heterogeneous operating systems may share an XP array port if you use Secure Manager and set the appropriate host group and mode. All others must connect to a dedicated XP array port.
- Use Secure Manager for LUN isolation when multiple hosts connect through a shared array port. Secure Manager provides LUN security by allowing you to restrict which LUNs each host can access.

<table>
<thead>
<tr>
<th>Environment</th>
<th>OS Mix</th>
<th>Fabric Zoning</th>
<th>LUN Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standalone SAN (non-clustered)</td>
<td>homogeneous (a single OS type present in the SAN)</td>
<td>Not required</td>
<td>Must be used when multiple hosts connect through a shared port</td>
</tr>
<tr>
<td></td>
<td>heterogeneous (more than one OS type present in the SAN)</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>Clustered SAN</td>
<td>homogeneous (a single OS type present in the SAN)</td>
<td>Not required</td>
<td>Must be used when multiple cluster nodes connect through a shared port</td>
</tr>
<tr>
<td></td>
<td>heterogeneous (more than one OS type present in the SAN)</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>Multi-Cluster SAN</td>
<td>homogeneous (a single OS type present in the SAN)</td>
<td>Not required</td>
<td>Must be used when multiple cluster nodes connect through a shared port</td>
</tr>
<tr>
<td></td>
<td>heterogeneous (more than one OS type present in the SAN)</td>
<td>Required</td>
<td></td>
</tr>
</tbody>
</table>
Configure FC switches

OpenVMS supports Fibre Channel only in a switch topology. Refer to the switch documentation to set up the switch. The disk array may support a large number of LUs. OpenVMS supports 32,768 LUs per port.

Defining the paths

Use Command View (shown) or LUN Configuration Manager to create paths (LUNs) between hosts and volumes in the disk array. This process is also called “LUN mapping.” LUN mapping includes:

- Configuring ports
- Setting LUN security
- Creating host groups
- Assigning host bus adapter WWNs to host groups
- Mapping volumes to host groups (by assigning LUNs)

See the Command View or LUN Configuration Manager guide for more information. Note the LUNS and their ports, WWNs, nicknames, and LDEVs for later use in verifying host and device configuration.

Path configuration for OpenVMS requires the following steps:

1. If you will be using RAID Manager, define a single “command device” LUN per XP array and present it to the OpenVMS hosts across all connected paths.

2. For all LUNs, determine the device number as follows (once OpenVMS sees the XP disks):

   OpenVMS device name ($1$dgaxxx), where xxx = (CU*256) + LDEV (Convert the LDEV number from hex to decimal)

   **Example:** For an XP LUN with a CU of 2 and an LDEV of 59:
   
   LDEV = 59 hex = 89 decimal
   
   OpenVMS device identifier = 2*256+89 = 601
   
   The example LUN is presented to OpenVMS as $1$dga601.
The figure below shows an example of the Command View LUN Management display that you use to perform LUN mapping.
Connect the disk array

Connect the disk array to the host as follows:

1. The HP service representative verifies operational status of the disk array channel adapters, LDEVs, and paths.
2. The HP representative connects the Fibre Channel cables between the host and Fibre Channel switches.
3. Create Fibre Channel zones connecting the host systems to the XP ports.
4. Use the SYSMAN program to configure each OpenVMS system on the SAN.
   For a single system:
   $run sys$system:sysman
   sysman> io autoconfigure
   For all the systems in an OpenVMS cluster:
   $run sys$system:sysman
   sysman> set environment/cluster
   sysman> io autoconfigure
5. Verify the ready status of the XP LUNs.

Verifying disk array device recognition

Verify that the host recognizes the disk array devices:

1. Log into the SYSTEM account, and enter the show device dg command:
   $ show device dg
2. Check the list of peripherals on the host to verify the host recognizes all disk array devices. If any devices are missing, check disk array path configuration, check host HBA configuration, and check cables.
3. Record the disk numbers and other device information. You will need the disk numbers when you format, partition, and mount the disks.
Configure disk array devices

Configure the disk array devices in the same way you would configure any new disk on the host server. Creating scripts to configure all devices at once may save you considerable time.

Initializing and label the devices

Use the initialize command to format each disk array volume and write an identifying label on it:

Example $ init $1$dga100 testscsi

Mounting the devices

Use the mount command to mount and identify each disk array volume:

Example $ mount $1$dga100 testscsi

Verifying file system operation

1. Use the show device d command to list the devices:

Example $ show device dg

2. Create a test user directory:

Example $ create/directory $1$dga100:[user]
This command creates a user directory name USER at the top level of the newly added volume $1$DGA100.

3. Verify that this directory exists:

Example $ set default $1$dga100:[user]
$ show default
$1$dga100:[user]
If the user directory does not exist, OpenVMS returns an error.
4. Create a test user file:

Example

$ create test.txt
this is a line of text for the test file test.txt
[Control-Z]
The create command creates a file with data entered from the terminal. Control-Z terminates the data input.

5. Verify whether the file is created:

Example

$ directory
Directory $1$DGA100:[USER]
TEST.TXT;1
Total of 1 file.

6. Verify the content of the data file:

Example

$ type test.txt
this is a line of text for the test file test.txt

7. Delete the data file:

Example

$ delete test.txt;
$ directory
%DIRECT-W-NOPFILES, no files found
$ type test.txt
%TYPE-W-SEARCHFAIL, error searching for $1$DGA100:[USER]TEST.TXT;
-RMS-E-FNF, file not found

The delete command removes the test.txt file. The directory command verifies that the test.txt file is removed, and the type command verifies that the test.txt file is no longer in the system.
8. Delete the test user directory by entering this command:

   Example
   $ delete $1$dga100:[000000]user.dir;

   $ show default
   $1$DGA100:[USER]
   %DCL-I-INVDEF, $1$DGA100:[USER] does not exist

   The delete command removes the USER directory from the disk
   volume. The show default command verifies that the user directory is
   removed.

9. Restore the default directory by entering this command:
   set default sys$login:
This section includes resolutions for various error conditions you may encounter.

If you are unable to resolve an error condition, ask your HP support representative for assistance. See "Calling the HP support center" (page 36).
Error conditions

Depending on your system configuration, you may be able to view error messages as follows:

- View SIMs in Command View (Device Health tab).
- View R-SIMs in Remote Control XP, including reference codes and severity levels of recent R-SIMs.
- View SIMs that generate SNMP traps on the host.

<table>
<thead>
<tr>
<th>Error Condition</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The logical devices are not recognized by the host.</td>
<td>Verify that the host mode is set correctly for the XP array. See &quot;Setting the Host Mode for the disk array ports&quot; (page 23).</td>
</tr>
<tr>
<td></td>
<td>Verify that the CU is between 0&lt;&gt;31, AND LDEV is between 0&lt;&gt;255.</td>
</tr>
<tr>
<td></td>
<td>Verify that the READY indicator lights on the disk array are ON.</td>
</tr>
<tr>
<td></td>
<td>Verify that the topology is set correctly for the HBA and that the Fibre Channel cables are properly connected. Check the status information LEDs for the HBA, the status LEDs, and other information Fibre Channel switch and the XP array.</td>
</tr>
<tr>
<td></td>
<td>Check zoning on the switch.</td>
</tr>
<tr>
<td>Physical volumes cannot be created.</td>
<td>Verify that the disk array logical devices are correctly formatted. See &quot;Configure disk array devices&quot; (page 30).</td>
</tr>
<tr>
<td>Logical volumes cannot be created.</td>
<td>Verify that the volume capacity for OPEN-x volumes is not greater than the maximum capacity allowed. See the Device Emulations Appendix.</td>
</tr>
<tr>
<td></td>
<td>Verify that the capacity of the volume group is not less than the total capacity of the partitioned logical volume.</td>
</tr>
</tbody>
</table>
## Troubleshooting

<table>
<thead>
<tr>
<th>Error Condition</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The disk array responds “Not Ready” or the disk array has displayed “Not Ready” and timed out.</td>
<td>Contact HP.</td>
</tr>
<tr>
<td>The host does not boot up.</td>
<td>Check the HBA and make sure it was installed properly according to the HBA manufacturer’s instructions. Check the HBA topology. It should be set to <strong>fabric</strong>.</td>
</tr>
<tr>
<td>The HBA is not configured by the host on bootup.</td>
<td>Verify that the HBA is supported by the version of the host operating system and the required minimum ECO kits are installed. ECO kits for HP products are available online from <a href="http://www.itrc.hp.com">http://www.itrc.hp.com</a>.</td>
</tr>
<tr>
<td>Storage is not seen on the adapter by the console program before boot, or on the host after boot.</td>
<td>Check the HBA and make sure it was installed properly. Verify that the topology is set correctly for the HBA and that the Fibre Channel cables are properly connected. Check the status information LEDs for the HBA, the status LEDs, and other information Fibre Channel switch and the XP array. Check the zoning on the switch. Verify that the disk array Host Mode is set correctly. The Host Mode setting for OpenVMS is <strong>05</strong>.</td>
</tr>
</tbody>
</table>
Calling the HP support center

If you are unable to resolve an error condition, contact the HP support center for assistance.

Contact Information

In North America, call technical support at 1-800-652-6672, available 24 hours a day, 7 days a week.

Outside North America, call technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the HP website under support:

http://h18006.www1.hp.com/storage/arraysystems.html

Before you call

Be sure to have the following information available:

• Technical support registration number (if applicable)
• Product serial numbers
• Product model names and numbers
• Applicable error messages
• Operating system type and revision level
• Detailed, specific questions
This appendix provides information about supported emulations and device type specifications. Some parameters may not be relevant to your array. Consult your HP representative for information about supported configurations for your system.
## Supported emulations

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<tr>
<th>XP Model</th>
<th>OPEN Emulation Type</th>
<th>OPEN Emulation Supported</th>
<th>LUSE</th>
<th>CVS</th>
<th>LUSE &amp; CVS</th>
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<tr>
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<th>Blocks (512 bytes)</th>
<th>Sector Size (bytes)</th>
<th># of Cylinders</th>
<th>Heads</th>
<th>Sectors per Track</th>
<th>Capacity MB* (Note 3)</th>
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<tr>
<td>OPEN-3</td>
<td>SCSI disk</td>
<td>4806720</td>
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<td>OPEN-V</td>
<td>SCSI disk</td>
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**LUSE**

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**CVS**

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<td>Note 6</td>
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<tr>
<td>OPEN-8 CVS</td>
<td>SCSI disk</td>
<td>Note 4</td>
<td>512</td>
<td>Note 5</td>
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<td>OPEN-9 CVS</td>
<td>SCSI disk</td>
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<td>SCSI disk</td>
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**CVS LUSE**

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<td>512</td>
<td>Note 5</td>
<td>15</td>
<td>128</td>
<td>Note 6</td>
</tr>
</tbody>
</table>

*Capacity = (512 x number of blocks) ÷ 1024^2*
**Note 1:** The availability of a disk type depends on the disk array.

**Note 2:** The devices are defined to the host as SCSI disk devices, even though the interface is Fibre Channel.

**Note 3:** The device capacity can sometimes be changed by the BIOS or host adapter board. This may make actual capacity different from that listed in the table.

**Note 4:** The number of blocks for a CVS volume is calculated as follows:

\[ \text{# of blocks} = (\text{# of cylinders}) \times (\text{# of heads}) \times (\text{# of sectors per track}) \]

**Example 1:** For an OPEN-3 CVS volume with capacity = 37 MB:

\[ \text{# of blocks} = (53 \text{ cylinders} – \text{see Note 5}) \times (15 \text{ heads}) \times (96 \text{ sectors per track}) = 76320 \]

**Example 2:** For an OPEN-V CVS volume with capacity = 49 MB:

\[ \text{# of blocks} = (53 \text{ cylinders} – \text{see Note 5}) \times (15 \text{ heads}) \times (128 \text{ sectors per track}) = 101760 \]

**Note 5:** The number of cylinders for a CVS volume is calculated as follows (↑ means that the value should be rounded up to the next integer):

**OPEN-3/8/9/E:** The number of cylinders for a CVS volume =

\[ \text{# of cylinders} = \uparrow \text{(capacity (MB) specified by user)} \times 1024/720 \uparrow \]

**Example:** For an OPEN-3 CVS volume with capacity = 37 MB:

\[ \text{# of cylinders} = \uparrow 37 \times 1024/720 \uparrow = \uparrow 52.62 \uparrow \text{(rounded up to next integer)} = 53 \text{ cylinders} \]

**OPEN-V:** The number of cylinders for a CVS volume =

\[ \text{# of cylinders} = \uparrow \text{(capacity (MB) specified by user)} \times 16/15 \uparrow \]

**Example:** For an OPEN-V CVS volume with capacity = 49 MB:

\[ \text{# of cylinders} = \uparrow 49 \times 16/15 \uparrow = \uparrow 52.26 \uparrow \text{(rounded up to next integer)} = 53 \text{ cylinders} \]

**OPEN-3/8/9/E:** The number of cylinders for a CVS LUSE volume =

\[ \text{# of cylinders} = \uparrow \text{(capacity (MB) specified by user)} \times 1024/720 \uparrow \times n \]
**Example:** For a CVS LUSE volume with capacity = 37 MB and n = 4

# of cylinders = \( \frac{37 \times 1024}{720} \times 4 = \frac{52.62}{n} \times 4 = 53 \times 4 = 212 \)

**OPEN-V:** The number of cylinders for a CVS LUSE volume =

# of cylinders = \( \frac{(capacity \ (MB) \ specified \ by \ user)}{16/15} \times n \)

**Example:** For an OPEN-V CVS LUSE volume with capacity = 49 MB and n = 4

# of cylinders = \( \frac{49 \times 16}{15} \times 4 = \frac{52.26}{n} \times 4 = 53 \times 4 = 212 \)

**Note 6:** The capacity of an OPEN-3/8/9/E CVS volume is specified in MB, not number of cylinders. The capacity of an OPEN-V CVS volume can be specified in MB or number of cylinders. You set the volume size using the LUN Configuration Manager or Command View software.
**AL**
Arbitrated loop.

**AL-PA**
Arbitrated loop physical address.

**BC**
HP StorageWorks Business Copy XP. BC lets you maintain up to nine local copies of logical volumes on the disk array.

**CA**
HP StorageWorks Continuous Access XP. CA lets you create and maintain duplicate copies of local logical volumes on a remote disk array.

**Command View**
HP StorageWorks Command View XP, a software product for managing XP arrays. Command View runs on a Windows-based management workstation.

**command device**
An LDEV that transfers RAID Manager commands to BC or CA logical volumes.

**CVS**
CVS devices (OPEN-x CVS) are custom volumes that are smaller than normal fixed-sized logical disk devices (volumes).

**DKC (disk controller unit)**
The array cabinet that houses the channel adapters and service processor (SVP).

**DKU (disk cabinet unit)**
The array cabinets that house the disk array physical disks.

**emulation modes**
Emulation modes can be assigned to LDEVs to make them operate like standard OPEN system disk drives. The emulation mode of an LDEV determines its capacity. Refer to the appendices for device capacities.

**FC**
Fibre Channel.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>FC-AL</td>
<td>Fibre Channel arbitrated loop.</td>
</tr>
<tr>
<td>FCP</td>
<td>Fibre Channel Protocol.</td>
</tr>
<tr>
<td>HBA</td>
<td>Host bus adapter.</td>
</tr>
<tr>
<td>HP</td>
<td>Hewlett-Packard Company.</td>
</tr>
<tr>
<td>LDEV</td>
<td>Logical device. An LDEV is created when a RAID group is divided into sections using a selected host emulation mode (for example, OPEN-9 or OPEN-M). The number of resulting LDEVs depends on the emulation mode. “LDEV” and “volume” are synonyms.</td>
</tr>
<tr>
<td>LUN</td>
<td>Logical unit number. A LUN results from mapping a SCSI logical unit number, port ID, and LDEV ID to a RAID group. The size of the LUN is determined by the emulation mode of the LDEV and the number of LDEVs associated with the LUN. For example, a LUN associated with two OPEN-3 LDEVs has a size of 4,693 MB.</td>
</tr>
<tr>
<td>LUSE</td>
<td>Logical Unit Size Expansion, a feature which logically combines LDEVs so they appear as a larger LDEV. This allows a LUN to be associated with 2 to 36 LDEVs. LUSE allows applications to access data requiring large amounts of disk space.</td>
</tr>
<tr>
<td>OFC</td>
<td>Open Fibre Control.</td>
</tr>
<tr>
<td>OPEN-(x)</td>
<td>A general term describing any one of the supported OPEN emulation modes (for example, OPEN-L).</td>
</tr>
<tr>
<td>OS</td>
<td>Operating system.</td>
</tr>
<tr>
<td>path</td>
<td>“Path” and “LUN” are synonymous. Paths are created by associating a port, a target, and a LUN ID with one or more LDEVs.</td>
</tr>
<tr>
<td>port</td>
<td>A connector on a channel adapter card in the disk array. A port passes data between the disk array and external devices, such as a host server. Ports are named using a port group and port letter, for example, CL1-A.</td>
</tr>
<tr>
<td>RAID</td>
<td>Redundant array of independent disks.</td>
</tr>
<tr>
<td><strong>remote console PC</strong></td>
<td>The PC running HP StorageWorks Remote Control XP.</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td><strong>Remote Control (RC)</strong></td>
<td>HP StorageWorks Remote Control XP. A software product used for managing XP arrays.</td>
</tr>
<tr>
<td><strong>R-SIM</strong></td>
<td>Remote service information message.</td>
</tr>
<tr>
<td><strong>SCSI</strong></td>
<td>Small computer system interface.</td>
</tr>
<tr>
<td><strong>SIM</strong></td>
<td>Service information message.</td>
</tr>
<tr>
<td><strong>SNMP</strong></td>
<td>Simple Network Management Protocol.</td>
</tr>
<tr>
<td><strong>SVP</strong></td>
<td>Service processor. A notebook computer built into the disk array. The SVP provides a direct interface to the disk array and is used only by the HP service representative.</td>
</tr>
<tr>
<td><strong>TID</strong></td>
<td>Target ID.</td>
</tr>
<tr>
<td><strong>VSC</strong></td>
<td>Volume Size Configuration is a feature that defines custom volumes (CVS volumes) that are smaller than normal fixed-sized logical disk devices (volumes).</td>
</tr>
<tr>
<td><strong>WWN</strong></td>
<td>World Wide Name. A unique identifier assigned to a Fibre Channel device.</td>
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